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PREFACE

Dear readers and delegates at International Congress on International Congress on Sustainable Development in The Human Environment - Current and Future Challenges (ICSDEV2022), it is a pleasure for us to present you with this Book of Proceedings, consisting of selected scientific contributions accepted for publication at the ICSDEV2022) We are honored to host all local and foreign participants in Alanya, Turkey. A total of 10 different countries (Hungray, Poland, Syria, India, Lithvania, Croatia, Romania, Moldova, Serbia and South Korea) participated in the congress. And 76% of the papers at the congress were presented by foreign researchers.

This book of abstracts summarizes a wide range of interesting topics presented during the *International Congress On Sustainable Development In The Human Environment - Current & Future Challenges*, which was held in 2022 in Alanya, Turkey.

The main aim of the congress was to discuss the researchers' studies, new technologies and new ideas related to chalanges of sustainable development with recpect of human factors. Especcialy after the pandemic, human being needs should be of interest and consern to scientists an professionals.
The contributions cover higly diverse aspects of engineering and health sciences to be implemented to achieve sustainable development goals.

The idea of sustainable development is based on the natural environment. It provides production resources, but also provides friendly living conditions for human beings and animals. Therefore, building the greatest possible synergy between humans and the surrounding world is a particularly important principle of sustainable development. It is also very important to stop the wasteful economy and implement solutions aimed at repairing the damage already done.

The Congress topics included:
- Environment and Health
- Public Health Issues
- Medical Sciences
- Food Problems
- Agricultural Sciences
- Biosystem Engineering
- Agricultural Economics
- Sustainable development of rural areas and agriculture, Circular economy, Resource efficiency, Bioeconomy
- Animals Science
- Other sustainable challenges and solutions for health human environment

This book is organized in 2 parts. I the first part are full manuscripts presented at the Congress and the second part includes abstract of submitted works.

With kind regards

The Organizing Committee of ICSDEV2022

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FULL MANUSCRIPTS

Maize production in Sombora Region - Northwestern Serbia in the period from 2012 – 2021

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Abstract

The most cultivated crop in the areas of northwestern Serbia is corn. In the Sombor region, corn is grown on about 60.000 ha each year, and in Serbia it is grown on more than 1.000.000 ha, which makes Serbia a significant producer of this cereal. The Agricultural Extension Service Sombor has been monitoring the correlation between agrotechnical measures and corn yield for several decades. The following agrotechnical measures are monitored: time of basic tillage, impact of pre-crops, use of mineral fertilizers, time of sowing and selection of hybrids. Each of these measures are in the hands of agricultural producers and through these measures, producers affect the level of maiz yield. The basic tillage in dry condition preserves the necessary moisture and is one of the most important moments in production given climate change. Proper use of mineral fertilizers, the choice of the appropriate pre-crop and sowing time also has a very significant impact on yield. Also, the choice of corn hybrids according to FAO groups and production orientation (mercantile or silage corn, sweet corn, popcorn) has a great influence.

Keywords: maize, tillage, sowing time, fertilizer, pre-crop

Introduction

Maize (Zea mays) is the most important field crop in Serbia. The large spread of corn and the tendency to further increase the area under this crop results from its economic importance, and the economic importance of this crop is determined by the use value of corn. It is used for three main purposes: in human nutrition, in livestock nutrition and as a raw material for the production of a very large number of industrial products. Due to its versatile use, corn is of great importance for export. This versatile use of corn allows it to be mostly consumed on the farms where it was produced, either directly as human food in less developed countries, or, which is more often the case, as feed for domestic animals in developed countries.

Materials and Methods

PSS Sombor has been monitoring agricultural production in the Sombor Region for several decades. The region of Sombor has 144820 ha of area under field and vegetable crops. Areas under maize for the observed period of 10 years ranged from 55.000 to 65.000 ha. In the last few years, the area is above 60.000 ha, which is about 41,43% of the total area. PSS Sombor, in cooperation with agricultural companies and producers, collects data on production technology. For this research, a statistical sample of 69.683 ha was observed on which maize was sown, and it refers to the period from 2012 to 2021 (a total of 10 years). The agrotechnical measures are monitored is: time of basic tillage, impact of pre-crops, use of mineral fertilizers, sowing time and choice of hybrids. The data collection method is an insight into the field book of companies and producers who have participated in the monitoring and analysis of maize production over 10 years. Every year after collecting data in the field, the data were processed by dedicated statistical software. The data are included in a detailed analysis of production each year. Production analysis is presented to producers each year. Based on the results of the production analysis, producers are given recommendations for improving maize production. By observing the results obtained from the field, the influence of individual agrotechnical measures, their quality and timely performance, give us most realistically seen how to reach on the height and stability of yield.

Results and Discussion

1. Time of basic tillage - Plowing is an obligatory agro-technical measure for maiz production. Plowing must be done in the fall, which precedes the production of maize in the next vegetation season. The future yield of maize is directly dependent on the time of basic tillage. The period for basic tillage, which is in the field was found is from September to June next year. For the analysis, this period is divided into four period: I period (01.Sep. - 30. Sep.), II period (01. Okt. - 31. Okt.) , III period (01.Nov – 31.12.Dec) and IV period (sprinng tillage). It is desirable that the basic tillage is done in the first three periods. These three periods are in autumn and the beginning of winter. During that period, the soil soaks by the rain and freezes when temperature is under zero, and a crumbly soil structure is formed by spring. The soil prepared in this way provides the possibility of quality sowing, uniform germination, undisturbed growth of maiz plants and high and stable yield. The fourth period includes early and late spring basic tillage. The land on which the basic tillage is applied in this period does not have good properties and a crumbly structure. The water-air regime of the soil is bad. The final yield was lower over 10 years on the areas plowed in

the fourth period compared to the first three periods. Figure 1. shows the declining trend of yield in the direction from I to IV period. The highest yield was achieved when the basic processing was done during the first period (01.Sep. - 30. Sep.).

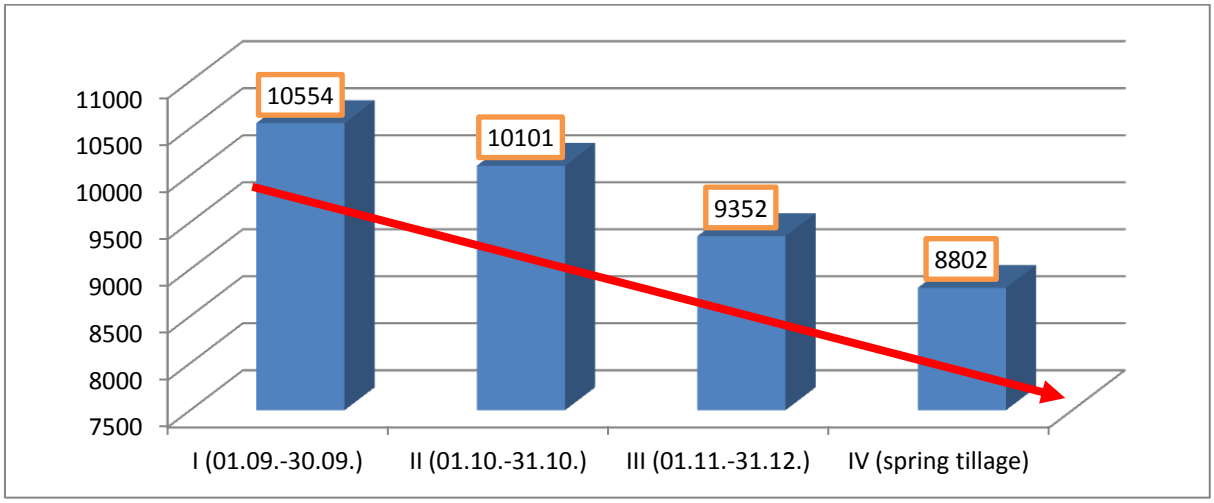


Figure 1. Time of basic tillage

2. **Impact of pre-crops** is large and significantly affects on future yields. Therefore, it is necessary to choose the best pre-crops. However, producers cannot choose too much because in the sowing structure, corn and small grains occupy the largest percentage of areas. However, the most important thing is not to sow maiz in repeated sowing. However, from the data it can be concluded that the share of repeated sowing is high - as much as 18.7%. Soybeans, small grains and sugar beets are the most common pre-crops.

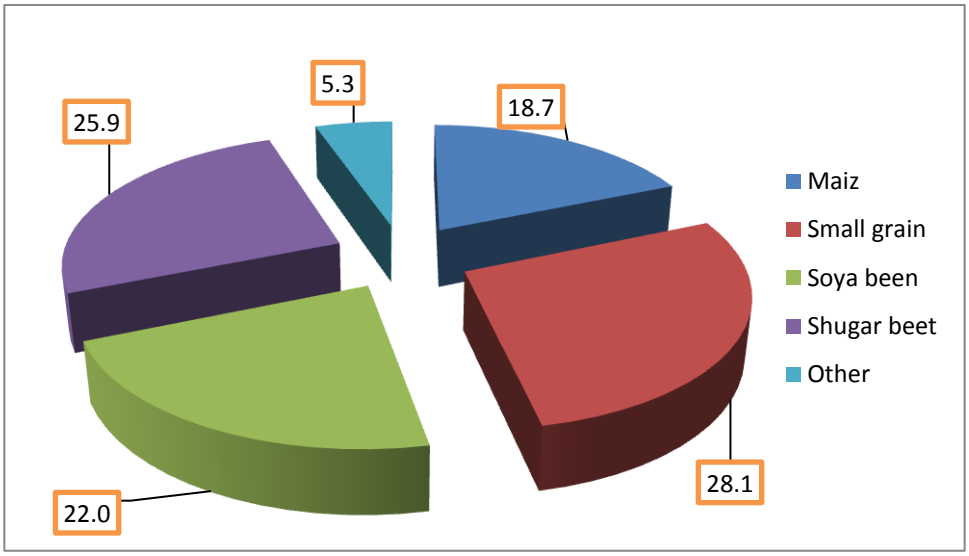


Figure 2. Percentage share of pre - crops

The best yields were achieved when the soybean was pre-cropped. An average yield of 10.423 kg/ha was achieved. It is interesting that a very good result was achieved in the

repeated sowing of corn. With a yield of 9.399 kg/ha, repeated sowing is in second place. Small grains (9.386 kg/ha) and sugar beet (9.200 kg/ha) follow. The "other" category achieved a yield of 9.643 kg/ha, but it is too heterogeneous a category, occupying only 5.3% of the total area.

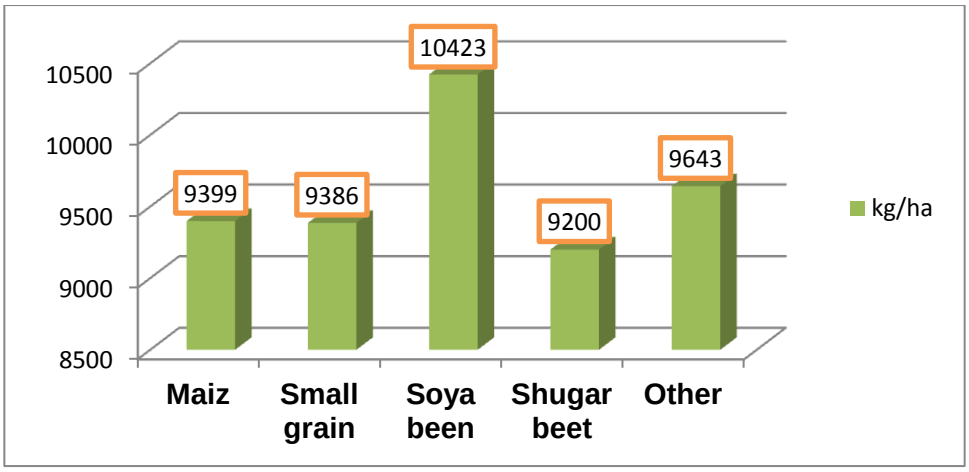
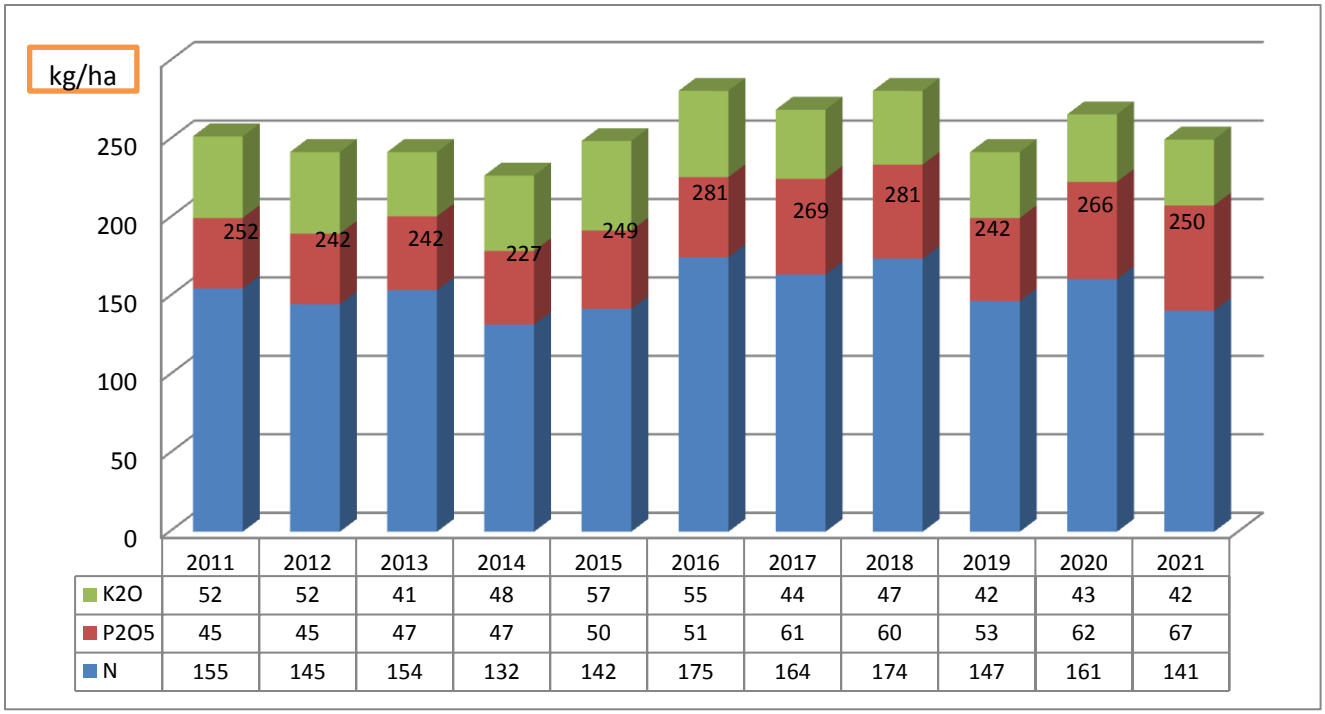


Figure 3. Maize yield in kg / ha by pre-crops

3. **The use of mineral fertilizers** is necessary for the successful production of maize. Maize achieves a large grain yield, but also forms a large biomass. In this sense, it is necessary to balance the optimal mineral nutrition.. The use of fertilizers depends on economic circumstances, the price of fertilizers, pre-crops, the use of organic fertilizers, etc. The analysis observed the use of fertilizers through basic fertilization in autumn (NPK) and the use of fertilizers before sowing. Quantities are expressed in kg / ha of active substance: nitrogen (N), phosphorus (P2O5) and potassium (K2O). The entire amount of phosphorus and potassium and part of the nitrogen was used in the fall with basic tillage. Only nitrogen was used before sowing. Nitrogen amounts are shown collectively regardless of the time of use. In Chart 4, it can be seen that the use of fertilizers during the previous decade is very equal.



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
K2O	52	52	41	48	57	55	44	47	42	43	42
P2O5	45	45	47	47	50	51	61	60	53	62	67
N	155	145	154	132	142	175	164	174	147	161	141

Figure 4. Use of mineral fertilizers expressed in kg of active substance

4. **Sowing time** – is not as wide a time span as base processing time. This research looks at the sowing time from Aprol 01th to June 1. This time of 70 days is divided into 4 periods, namely: I period (April 1 - April 15), II period (April 16 - April 20), III period (April 21 - April 30) and IV period (May 1 - June 30). Figure 5 shows that the best yield (10,123 kg/ha) was achieved when corn was sown in period III (April 16 - April 20). However, the largest percentage of areas was sown in the first period (April 1 - April 15), 49.2% with a yield of 9608 kg/ha, which is the second most successful.

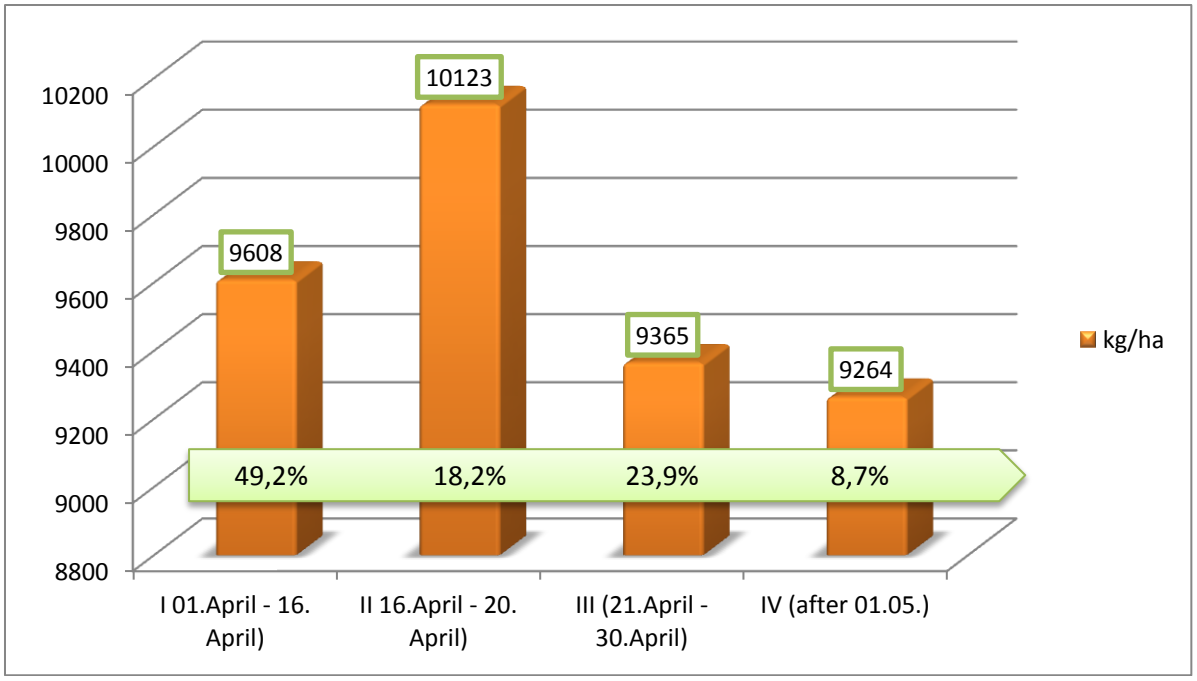


Figure 5. Sowing time

5. **Choice of hybrids** – The choice of corn hybrid depends on the size of the farm. Small farms can sow hybrids from one FAO group. Larger farms with larger areas choose hinrids from more FAO groups to have successive spawning and harvesting.

In the conditions of the Sombor region, equally good yields are achieved by FAO 400 - FAO 700, with the emphasis that FAO 600 achieves the highest yield. FAO 300 came into wider use only a few years ago and achieves a somewhat lower yield.

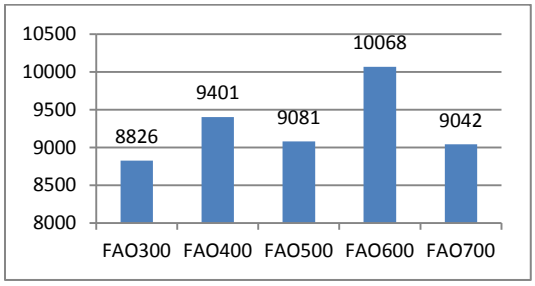


Figure 6. Yields of hybrids (kg/ha)

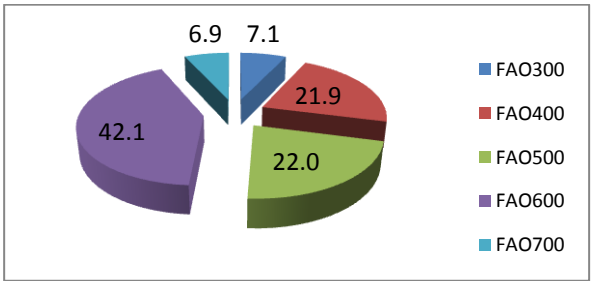


Figure 7. Hybrid share (ha)

Conclusion

Out of a large number of agrotechnical measures, this research has for analysis five agrotechnical measures on which producers have a decisive influence. Based on a multi-year analysis, the best periods of basic cultivation, sowing dates, pre-sowing, fertilization

amounts and the choice of hybrids were determined. Any deviation from this leads to a decrease in corn yield.

This research determined that the best period for basic tillage is from September 1 to October 30, and an average yield of 10,554 kg/ha was achieved.

The best pre-crops are soybeans, as well as small grains and repeated sowing of corn, and sugar beets. After soybeans, an average yield of about 10423 kg/ha was achieved.

The use of mineral fertilizers should be based on the agrochemical analysis of the soil. Too little amount of fertilizer leads to a decrease in yield. With the increase in the use of mineral fertilizers, the yield increased year by year. However, excessive use of fertilizers is not good either, because it is not profitable or leads to harmful effects on the soil and plants.

Sowing is best done in the period from April 16 to 20. The areas sown in that period yielded an average of 10,123 kg/ha, which is the highest yield compared to other sowing periods.

Proper selection of hybrids, along with other agrotechnical measures, contributes to stable and high yields. The sowing of hybrids of the FAO 600 group is dominant with 42.1% of the total sowing. At the same time, hybrids of the FAO 600 group achieved the highest average yield of 10,068 kg/ha.

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Compliance History, The requirement for Effective Enforcement of Food Official Controls.
Empirical Approach to the Case of The Republic of Moldova

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Abstract

Recent years have seen a considerable increase in global and national concerns about food safety. Both FBOs and authorities with official control responsibilities prioritize giving consumers safe food products. This study uses the Reclamation Index for the history of non-conformities I to interpret official control statistics (RI).By calculating the Reclamation Index for the history of non-conformities I(RI), this study focuses on the interpretation of official control statistics and how it affects the organization and implementation of official controls in the area of food safety. The relationship between the number of controls and the rate of non-compliance has been established for some FBOs. The control authority must increase the number of controls when Index I (RI) has positive values in the range of numerical series closed from +0.099%, n..... to +30. The calculated values for I(RI) were interpreted, and a range of numerical series from -30%, n1,.....+30% were plotted on the Figure. The results of the research are helpful both to public institutions and the overall domestic economy.

Keywords: official control, Compliance history, Moldova, non-compliance rate

Introduction

The National Agency for Food Safety (ANSA) is a governmental authority that reports directly to the Government of the Republic of Moldova and is responsible for official food safety control. The authority's sole authority is to ensure that food business operators provide safe food to consumers. Over the last decade, legislative changes in food safety have largely concentrated responsibility for official control on the ANSA in order to bring quality requirements in line with the EU acquis. These official control responsibilities assigned to ANSA are primarily motivated by the inability of operators to immediately implement new quality standards and individual control models such as the HCCP model. In 2002, the EU Commission stated that food business operators are best placed to design a safe food supply

system and, as such, should bear primary legal responsibility for food safety. This principle existed in some Member States and parts of food law; in others, it either did not exist explicitly or the responsibility was assumed by the Member State's competent authorities through their control activities (EC No 178/2002, 2002).

Government authorities transferred responsibility to the state control authority for a period of adaptation and transition of food operators to the new requirements, which is typical of developing countries, particularly post-Soviet countries whose regulations were based on the GOST. Thus, ANSA performs official state control in the areas of food safety and quality, veterinary and animal health, wine/alcoholic beverage production and marketing, and consumer protection in the food segment. The authority conducts official controls in accordance with the Multiannual Control Plan 2018-2022. Official food safety controls are planned after an analysis of the risk criteria for each economic operator. Regardless of the specifics of each control area, the risk criteria that must be used are: 1) the scope of the economic activity, 2) the controlled subject, a risk criterion that relates to the subject and reflects the size or specificity of the economic activity, and 3) the history of compliance or non-compliance previously detected and with the control body's requirements. The estimated level of risk for each unit under control determines the frequency and intensity of control actions required (Government Decision, HG no.1280/2018, 2018). The authority should strive to apply food legislation in a fair manner with all economic operators based on the frequency and intensity of control, which are key principles of the rule of law. The frequency of official control directly and effectively determines the authority's use of state.

Literature Review

Analysis and interpretation of qualitative statistical data on the results of past controls can establish high performance indicators when planning and targeting controls to FBOs with a high public health risk. At its simplest, risk-based regulation can be conceived as allocating resources in proportion to the risks to society (such as health, safety or environmental risks), taking into account both the impacts themselves and the likelihood of them occurring, in order to establish appropriate levels of control (Rothstein, et., el., 2006).Assessing the proportion of controls carried out based on the risk criterion "compliance history" is a major challenge.

Authors J. Lueckla, K. Weyermaira, M. Mattb, K. Mannerc and K. Fuchsa, (2019) develop the method for evaluating the Inc. nonconformity complaint index as a method for evaluating the official control system in the field of food safety. The Nonconformity

Complaint Index Inc is of major interest for determining the influence of control frequency on different types of FBOs according to the risk criterion "compliance history".

Materials and Methods

This paper interprets statistical data on the results of official controls in the field of food safety based on ANSA annual reports.The interpretation of data on previous controls aims to establish the influence of the criterion "compliance history" on the frequency of official controls carried out on certain categories of FBO. As a primary evaluation method the Complaint Index for non-compliance method is used to determine the Complaint Index for the criterion "compliance history" I (RI). Based on the fixed rate RW = 0.3 of the weight of each risk criterion, established by the regulations, the data are interpreted in the range of series from -30%, n1, ...+30%. The numerical range for I-indicators($_{RI}$) from -0.099, n1....+0.099%, will be considered the tolerance zone when planning controls. The $I_{(RI)}$ indexes calculated for this range demonstrate that the planned and carried out controls are equal to the fixed weight RW = 0.3 set by the methodology.If the $I_{(RI)}$ index too negative values in the range of the closed numerical series from -30% ..... $\leq$ -0.099, the control authority shall decrease the number of controls according to the set percentage of $I_{(RI).}$

Results and Discussion

Planning and execution of official controls according to the risk criterion "compliance history"

The reorientation of agri-food production exports in recent years has certainly boosted the transposition into national legislation of the 2004 EU food hygiene package as well as of risk-based official control regulations with appropriate frequency. The practice of EU countries shows that some Member States apply different models to risk assessment.In France, risk assessment focuses on inherent hazard, which concentrates inspections on large operators. In contrast, the Dutch ignore hazard in favour of compliance history and consequently inspectors rarely target large companies participating in voluntary insurance schemes. English and German risk assessment models consider both hazard and operator behaviour thus inspectors target a wider range of operators than their French and Dutch counterparts (Borraz, et al., 2020). The impossibility of assessing on a large scale the hazard behaviour of food business operators in the Republic of Moldova makes the compliance history model an important one when determining the types of establishments and the frequency of official controls. A risk-based approach should ensure that the burden of official controls is reduced for business

operators posing a lower food safety risk and that more food safety risk monitoring and enforcement activities are undertaken for those business organisations posing a higher food safety risk (Smith, et al, 2014).

The risk criteria "compliance history" and "with ANSA requirements as last checked" are applied and assessed uniformly for FBOs. The absence of violations or, where applicable, the characteristics of non-compliance existing at the date of the last inspection carried out indicates the establishment's propensity to comply, i.e. low risk. The history of compliance, as well as with the requirements issued, is assessed on the basis of data held since the last inspection carried out by ANSA at the FBO under inspection. In order to determine the degree of risk of the FBO based on the "compliance history" criterion, a classification of non-compliances established by ANSA following official controls is needed.

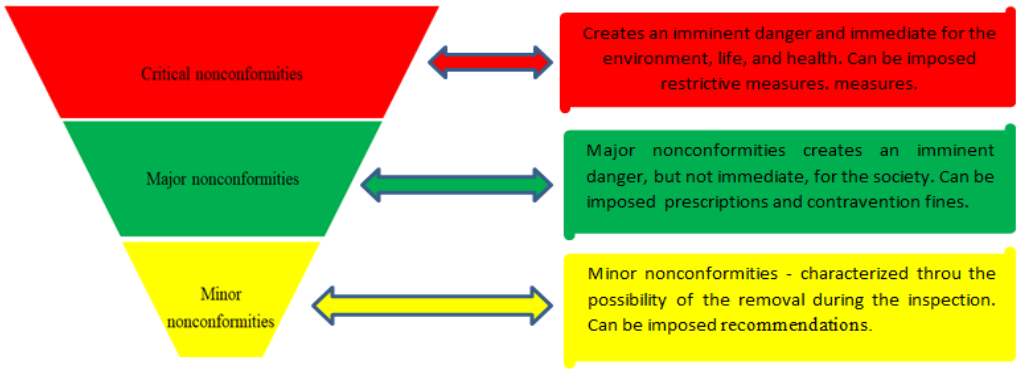

Figure 1. The frequency of official controls in Moldova by criteria "compliance history"

Source: Authors, by using Zanet and Stanciu (2020).

The weight of the risk criterion "compliance history" in determining the frequency of controls varies according to the types of official control systems. Thus, the weight of compliance history is 0.3 of the weight of each risk criterion, where the sum of the individual weights will equal unity. Only for the control system in the area of semiotic control the weight is 0.2%.(Government Decision HG no. 1280/2018, 2018).

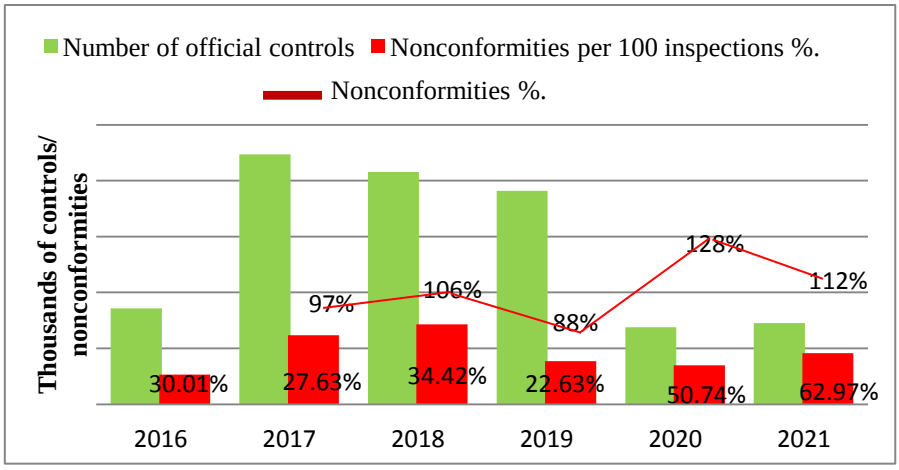

Figure 2. Official government controls and non-compliance % (2016-2021).

Source: AuthorS, by using ANSA Reports (2016-2021)

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The data presented in Figure 2 infer that non-compliances per 100 field inspections had the highest rate in 2021 with values of 62.97%. For the period evaluated 2016-2021 the lowest non-compliance rate was in 2019 with 22.63%.It is observed for the period 2020-2021 a significant decrease in the number of official inspections but a significant increase per 100 inspections of 23.11% in 2020 compared to 2019 and 40.34% in 2021 compared to 2019. The authors C. Anghelache, A. Manole (2012), propose in connection with the calculation of the average index, which characterizes several successive subperiods of time, to calculate the general index that characterizes the entire period, under the equation below. This method has also been used by the authors A. Tcaci, E. Bulgac (2012), to determine the average annual rate of increase (decrease) of crop production in comparable prices. Thus we can calculate under the equations below the average growth rates of non-conformities and their growth rate:

$$I = \sqrt[n-1]{K^1 * \dots Kn} \qquad (1)$$

where: k1, k2 ... kn - the growth (reduction) index compared to the previous year.

n - number of dynamics series.

$I=\sqrt[4]{0.97 * 1.06 * 0.88 * 1.28 * 1.12} = 1{,}067$

Calculations based on the data in Figure 2 gave an average annual growth rate of non-compliance of I = 1.067.

The calculation of the growth rate will be deduced under the equation (Anghelache, and Manole, 2012):

$$R=(I * 100) -100 \qquad (2)$$

Statistical analyses show that for the years 2017-2021 the non-compliance rate has increased at a rate of R=6.7%, even at the expense of the authority's drastic reduction in the number of official controls. In order to determine the influence of the risk criterion "compliance history" it is proposed to determine the non-compliance complaint index for each control system. The nonconformity complaint index will be calculated under the equation, J. Lueckla, K. Weyermaira, M. Mattb, K. Mannerc and K. Fuchsa, (2019):

$$Inc = Non\text{-}compliance\ rate\ [\%] - Control\ rate\ [\%] \quad (3)$$

An indicator set with positive values for the control system is the Non Conformity Complaints Index (Inc) which indicates that the rate of non-compliance is higher than the proportion of planned checks. Respectively ANSA can motivate a higher frequency in this category of FBO.Thus it is proposed to interpret the statistical data on the following official control systems:

- Control system in the sanitary-veterinary field (SCSV)
- Control system for zoo- technical surveillance (SCSZ)
- Control system of processing units for food of animal origin (SCFAO)
- Control system of processing units for food of non-animal origin (SCFVO)
- Control system of trade units and public catering, and consumer protection (SCCAP).

Starting from the fact that the weight of the compliance history criterion in control planning is 0.3 of the weight of each risk criterion, in order to determine the complaint index for the risk criterion "compliance history" I (RI) in control planning, the equation is proposed:

$$I_{(RI)} = (Inc * R_W) * 100\% \quad (4)$$

Where (Inc) is the index of non-conformity complaints for the control system assessed, R_W is the fixed rate weight for the compliance history in the control planning set by the legislator $R_W = 0.3$ where the sum of the individual weights will be equal to one unit.

Table 1. Complaint Index for Non-Conformities Inc and Complaint Index for "Compliance History" criterion $I_{(RI)}$ 2018-2020.

Year	Control system	No. controls	No. Non-conformities	Control rate %	Non-compliance rate %	complaint index -non-compliance %	Complaint index for the criterion "compliance history" I (RI) %
2018	SCSV	6486	3393	15,6	23,71	8,11	2,430
	SCSZ	10977	1201	26,41	8,39	-18,02	-5,400
	SCPAOA	1924	814	4,62	5,69	1,07	0,321
	SCFVO	1697	603	4,08	4,21	0,13	0,039
	SCCAP	15939	6907	38,35	48,28	9,93	2,979
2019	SCSV	3704	-	9,69	-	-	-
	SCSZ	11,287	1061	29,55	13,72	-15,83	-4,749
	SCPAOA	2003	1483	5,24	19,18	13,94	4,181
	SCFVO	1583	665	4,14	8,6	4,46	1,338
	SCCAP	16264	3728	42,58	48	5,42	1,626
2020	SCSV	111	-	0,8	-	-	-
	SCSZ	5003	776	36,37	11,11	-25,26	-7,578
	SCPAOA	1203	1357	8,74	19,44	10,07	3,210
	SCFVO	935	365	6,79	5,23	-1,56	0,468
	SCCAP	9002	3056	65,44	43,78	-21,66	-6,498

Source: Authors by using ANSA (2018-2020) and Zanet and Stanciu (2021).

Taking into account that R_W is the fixed rate weight, we propose to present the calculated data $I_{(RI)}$ in the model Figure with a closed range from -30% to the maximum positive value of +30%. When $I_{(RI)}$ will take values in the range of the number series ≤ - 0.099 and ≤ +0.099 the tolerance zone will be considered when planning controls according to the risk criterion of "compliance history". Thus we agree that the authority has fully respected the proportion of 0.3 of the sum of the individual weights equal to one unit, set by the national legislator.

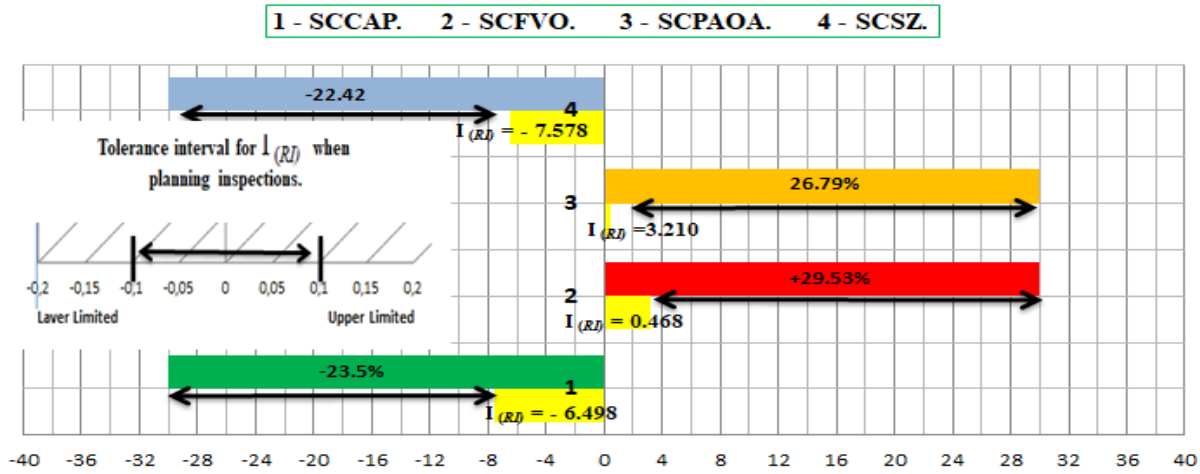

Figure 3. Proportionality $I_{(RI)}$ % when planning controls for 2020.
Source: Elaborated by authors

The statistical data presented in Figure 3 shows that for the SCZS system at setting $I_{(RI)}$ = -7.578% for the year 2020 the control authority would reduce the number of controls by 22.42% compared to the risk criterion. For the SCPAOA control system according to the risk criterion "compliance history" to increase the number of controls by 26.79%.

In order to validate the interpretation of the complaint index for "compliance history" $I_{(RI)}$ shown in Figure 3 it is proposed to statistically process the $I_{(RI)}$ in the table below in relation to the number of controls performed and non-compliances.

Table 2 . Number of non-compliances calculated after $I_{(IR)}$ as a proportion of the number of controls for 2020.

Control system	No. Controls	No. of non-conformities	No. of non-compliances calculated R_W =0,3	$I_{(RI)}$%	Number of non-compliances $I_{(RI)}$%	Number of non-conformities $I_{(RI)}$% calculated on Figureical values (30%..+30%)	Validation number of conformities (Col. 6) + (Col. 7) = Coloana (4)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SCSZ	5003	776	1500	-7,578	379	-1121	-1500
SCPAOA	1203	1357	361	3,210	39	329	361
SCFVO	935	365	280	0,468	4	276	280
SCCAP	9002	3056	2701	-6,498	585	2115	-2701

Source: Elaborated by the authors.

The calculations presented in Table 2 deduce that when the complaint indexes have negative values the authority is to decrease the number of controls according to the Index $I_{(RI)}$, determined by summing the percentage values in the closed range from -30% to the maximum positive value of +30% shown in Figure 3. The calculation model presented for the SCSZ control system whose number of non-compliances for $R_W = 0.3$ in relation to the number of controls, the number of non-compliances would be equal to 1500 units.Therefore the authority is to decrease the number of official controls based on the risk criterion "compliance history" by 22.42%, see figure 3 position 4.

Conclusions

The Republic of Moldova's official control system has achieved excellent results in the last ten years in terms of legislative regulation and alignment with the EU acquis communautaire.

The three criteria were combined in the model used for control planning: The following factors: 1) the size or specificity of the economic activity, 2) the controlled subject, a risk criterion that refers to the subject, and 3) the past compliance or lack of compliance that has been identified, result in the targeting of controls on all sizes and types of establishments. The study does, however, demonstrate that the legitimacy of some official control systems does not account for the proportionality of the risk criterion of "history of compliance." This is a result of the risk criteria assessment methodology's recent implementation, which began in 2019. The statistics on the outcomes of previous controls cannot be understood because there is no information system for the evaluation of risk criteria for FBOs managed directly by ANSA.

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Effectiveness of fungicides in controlling the causing causes of Fusariosis and Yellow Wheat Rust

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Abstract

The main role of wheat as food comes form its proteine features, which are unique among agricultual plants. Fungal diseases have a significant economical influence on wheat's quality and yield. The most important patogenes in our agro-ecological conditions are the causers of fusarium head blight and wheat rust. Fungicide application for protection from diseases in the production of small grains has been accepted for a long period as a regular technological measure. The trial is set according to standard OEPP methodes and located in Sombor (Bilić), in the wheat crop, variety Zvezdana. Eighteen fungicides were applied in the trial. The fungicides belong to the following chemical groups: triazoles, strobilurins, imidazoles, piroketsmines, morpholines, cholonitriles and thiourea. Besides efficacy of applied fungicides, the percentage of attacked plants, infected leaf surface and attack index have been identified. The percentage of attacked ears and percentage of infected ears have been identified. Examination results in the suppression of yellow rust, indicate that with double application of examined fungicides we can achieve satisfying results in the protection of wheat from this pathogen. Efficacy of examined fungicides in yellow rust reduction was between 72.7-90.2%, and the best efficacy, 90.2% was achieved in the variant 9 by the application of fungicides based on active substance chlorothalonil+ tebuconazol applied in the first treatment (T-1) and the fungicides based on prochloraz+ tebuconazol which were applied in the second treatment. Fungicides based on tebuconazol have achieved the best results in an ear protection from fusariums. In the Republic of Serbia, there are a large number of fungicides for controlling these pathogens, and therefore, it is important to examine the efficacy of registered fungicides, their positioning relative to certain pathogens, as well as the time of application in order to obtain economically acceptable solutions.

Keywords: wheat, *Fusarium* spp, *Puccinia* spp, fungicides, efficacy

Introduction

Stem rot, corn cob mold and wheat ear rot (causing agent – *Gibberella zeae* (Schwein.) Petch /telemorph/, *Fusarium graminearum* Schwabe /anamorph/)

Distribution, origin and harmfulness. The species *Fusarium graminearum* is distributed throughout the world. It was discovered here in the early fifties. It causes seedling decay, root

rot and fusarium head blight. The harmfulness of this disease manifests itself in the reduction of yield and the deterioration of grain quality. The causative agents of this disease produce DON mycotoxins in infected grains that are dangerous for human and animal health. In our climatic conditions, there are not rare years when infections of up to 50% have been recorded in some varieties and in some plots. During the last two decades, it is considered that in our country, in addition to fusarium root and stem rot, this disease represents a significant limiting factor in further increasing the yield per unit area. A special problem arises when growing seed crops. In infected grains, in addition to significantly reduced germination, germination energy also decreases because it is transmitted by seeds (Balaž et al., 1995).

Host plants. In addition to corn and wheat, the fungus also attacks barley, oats, rye, rice and other grains, as well as numerous plants from other families. *F. graminearum* occasionally causes root and flower rot of carnations and other ornamental plants, and infections with this fungus have been established in plants from the genera: Glycine, Lycopersicon, Pisum, Solanum, Trifolium and others. (Booth, 1971).

Symptoms. Fusarium wilt of wheat (*Fusarium* spp.) is a complex disease that manifests itself from sprouting to earing of wheat in the form of decay of seedlings, rotting of roots and the ground part of trees, wilting of plants and death of ears. In our country, the most harmful phenomenon is the class. Symptoms are manifested during the formation and ripening of grains. One or more spikelets on an immature spike begin to fade and turn light. The parasite moves from the ears to the spindle, and if it is completely affected, part of the ears above the infected spot dies and the grains remain small. The infection starts on the flower and spreads to other parts of the ear, causing premature ripening. Infected classics are watery at first, then die and become light-dark at the base (Figure 1.) Eventually, the chaff changes from light to dark brown. In such cases, endogenous grain contamination occurs. It becomes shriveled and permeated with parasite mycelia. In later infections, the grain is less affected by parasite mycelia and is of lower quality. Using this kind of grain for sowing causes its decay immediately after sprouting. In wet conditions, a reddish or pink coating may appear on the infected ears. On such spikes, black corpuscles can later form, which make up the perithecia of the fungus. If the entire ear is affected by moisture, it remains stunted and thin, and the ears are stuck to the stem. Infected grains are grayish brown and light. The grain content changes color and becomes floury (Ivanović, 1992).

Figure 1. Fusarium class of wheat- caused by *Fusarium graminearum* (Photo: Mrdak)

Protection measures. Since the intensity of this disease is influenced by a number of factors, by applying some preventive measures, the infection can be reduced to a tolerant level. Among the preventive measures, the following are important: selection of less sensitive varieties, crop rotation, balanced fertilization, high-quality basic and pre-sowing soil cultivation, use of healthy seeds, seed disinfection and preventive treatment of plants with fungicides (Balaž et al., 1995).

Yellow rust (caused by *Puccinia striiformis* Westend)

Distribution, origin and harmfulness. Yellow rust is among the most important wheat parasites in the temperate climate zone of the world, especially in areas with a cold and humid climate, in northern and western Europe. It is also widespread in the Mediterranean part of Europe and the northwestern part of the USA. It is also significant in East Africa, South America and the Indian subcontinent (Ivanović, 1992). Yellow rust is present in our country and until 2014 it was encountered in places. Due to the appearance of the disease before wheat sorting, yield losses in very sensitive varieties can reach 20%.

Host plants. P. striiformis exclusively develops on plants from the grass family. In addition to wheat, it occurs on barley, rye and triticale and on about 320 types of grass, distributed in 50 genera.

Symptoms. The initial symptoms of the disease are manifested in the form of lemon-yellow to orange lines between the veins of the leaf, which is why the disease got the name striped rust (Figure 2). The dashes represent linearly arranged uredosorus, the joining of which on the leaf creates lines, and at high attack intensities, yellow bands. Infection can occur from the stage of the first leaf, until the plants have green leaf color. Symptoms first appear as chlorotic spots

or streaks on the leaves and are followed by sporulation of the pathogen, which forms tiny yellow to orange colored rust pustules. Stripes are formed on the leaves of adult plants (mainly during the period of growth into a tree). Depending on the degree of resistance of the plant and the temperature, different sizes of chlorotic or necrotic spots or stripes appear, with or without sporulation. On wheat ears, pustules usually appear on the inside of the chaff and thus infect the immature grains. Since yellow rust is a biotrophic fungus, it uses water and nutrients from the host plant, which can quickly deplete the plant and cause it to die. In warm and humid weather, black teleutospores often form long strings on the leaf, leaf sheath and chaff (Jevtić et al., 2014).

Figure 2. Symptoms of yellow rust on wheat leaves - caused by *Puccinia striiformis* (Photo: Mrdak)

Protection measures. Preventive measures to control this disease agent are as follows: sow wheat varieties that have genetic resistance to rusts, avoid too early sowing, abundant nitrogen fertilization and too dense crops (Marić and Jevtić, 2005). If the mentioned preventive measures do not give satisfactory results, it is necessary to apply fungicides. Of the fungicides for foliar application, which are on the market in Serbia, the most effective preparations are based on the following active substances: epoxyconazole, prothioconazole, tebuconazole, cyproconazole, metconazole and fluquinconazole (inhibitors of ergosterol synthesis - triazoles); then preparations based on: pyraclostrobin, picoxystrobin, azoxystrobin and trifloxystrobin (respiration inhibitors - strobilurins) (Jevtić et al., 2014).

Materials and Methods

The experiment was carried out during the spring of 2016, on the experimental field of the Agricultural Expert Service in Sombor (locality Bilić) in the wheat crop of the Zvezdana variety. The size of the basic plot was 20 m2 (2x10 m). The experiment was set up in four replicates. The treatment was carried out foliarly, with a back sprayer Euro Pulve EZC (Electric compressor system), when the wheat was in the phenophase T-1 BBCH 31-33 (tall phase-emergence of the knee); T-2 BBCH 37 (flagellar stage) and T-3 BBCH 61-65 (flowering and clustering stage). In the experiment, 18 fungicides belonging to the following chemical groups were used: triazoles, strobilurins, imidazoles, pyroketalamines, morpholines, chloronitriles and thioureas (Table 1).

Table 1. Variants in the trial, applied quantities of preparations and time of application

Order no.	Variant	Dose l/ha	Time of application
1.	I 250 g/l spiroksamina+167 g/l tebukonazola + 43 g/l triadimenola II 125 g/l protiokonazola + 125 g/l tebukonazola	0,6 1,0	T-1 T-3
2.	I 250 g/l spiroksamina+167 g/l tebukonazola + 43 g/l triadimenola II 125 g/l protiokonazola + 125 g/l tebukonazola	0,7 1,0	T-1 T-3
3.	I 50 g/l biksafen + 166 g/l tebukonazol II 125 g/l protiokonazola + 125 g/l tebukonazola	1,2 1,0	T-1 T-3
4.	I 375 g/l trifloksistrobina + 160 g/l ciprokonazola II 125 g/l protiokonazola + 125 g/l tebukonazola	0,4 1,0	T-1 T-3
5.	I 375 g/l trifloksistrobina + 160 g/l ciprokonazola II 125 g/l protiokonazola + 125 g/l tebukonazola	0,4 1,0	T-2 T-3
6.	I 400 g/l prohloraza + 90 g/l propikonazola II 310 g/l tiofanat-metila + 187 g/l epoksikonazola	0,8 0,6	T-1 T-3
7.	Control	-	
8.	I 250 g/l fenpropimorfa + 84 g/l epoksikonazola II 310 g/l tiofanat-metila + 187 g/l epoksikonazola	0,8 0,6	T-1 T-3
9.	I 250 g/l hlortalonil + 90 g/l tebukonazola II 300 g/l prohloraza + 200 g/l tebukonazola	2,5 1,25	T-1 T-3
10.	I 200 g/l pikoksistrobina + 80 g/l ciprokonazola II 100 g/l pikoksistrobina + 500 g/l hlortalonil	0,6 1,5	T-1 T-3
11.	I 125 g/l epoksikonazola II 310 g/l tiofanat-metila + 187 g/l epoksikonazola	1,0 0,6	T-1 T-3
12.	I 400 g/l prohloraza + 90 g/l propikonazol II 267 g/l prohloraza +133 g/l tebukonazola	1,0 1,0	T-1 T-3
13.	I 250 g/l tebukonazol II 167 g/l tebukonazol + 133 g/l tiofanat-metil	0,75 1,5	T-1 T-3
14.	I 200 g/l pikoksistrobina + 80 g/l ciprokonazola II 100 g/l pikoksistrobina + 500 g/l hlortalonil	0,6 1,5	T-2 T-3
15.	I 200 g/l azoksistrobina + 125 g/l difenokonazola II 175 g/l tiofanat-metila + 125 g/l difenokonazola	1,0 1,25	T-2 T-3

The effectiveness of applied fungicides was determined according to Abbott (Wentzel, 1963). The percentage of attacked plants, the percentage of infected leaf area and the attack index (%) were recorded. The percentage of infected ears and the intensity of ear infection (per 100 ears) were determined on the ears. The yield and hectoliter mass were measured in the experiment.

Results and Discussion

Efficacy of fungicides in controlling the causative agent of fusariosis classes (*Fusarium* spp.)

The percentage of attacked ears ranged from 1.5 to 11.25%. The lowest percentage of attacked ears was in variants 4, 6 and 13. Infected ears were the lowest in variants 4, 6 and 8. The highest infected ear percentage was in variant 14 and amounted to 55.4%, then in variant 5 (54 .8%), variant 1 (54.5%) and in control 49%. The effectiveness of the applied fungicides was 42.2 - 86.6%, depending on the preparation. The lowest efficiency was in variants 14 and 15, and the highest in variant 4 - 86.6% (I 375 g/l trifloxystrobin + 160 g/l cyproconazole; II 125 g/l prothioconazole + 125 g/l tebuconazole), variant 6 - 82.2% (I 400 g/l prochloraz + 90 g/l propiconazole; II 310 g/l thiophanate-methyl + 187 g/l epoxiconazole) and variant 13 - 82.2% (I 250 g/l tebuconazole; II 167 g/l tebuconazole + 133 g/l thiophanate-methyl). Fungicides from the triazole chemical group achieved the greatest effectiveness in protecting wheat classes from *Fusarium* spp.

Table 2. Percentage of attacked spikes, percentage of infected spikes and effectiveness in controlling *Fusarium* spp. (06.06.2016)

Variant number	% of spikes attacked	$\bar{x}$ ±Sd	% infection classes	$\bar{x}$ ±Sd	Efficiency %
1.	2,5	2,5±1,3 ab	54,5	54,4±31,8 c	77,8
2.	4,25	4,2±3,6 bc	38,7	38,7±17,7 bc	62,2
3.	3,25	3,2±1,7 ab	28,1	28,1±8,3 a	71,1
4.	1,5	1,5±1,3 a	27,3	27,3±19,4 a	86,6
5.	2,25	2,2±1,5 ab	54,8	54,8±20,8 c	80,0
6.	2,0	2,0±0,8 ab	27,3	27,3±6,9 a	82,2
7.	11,25	11,2±1,5e	49,0	48,8±6,3 bc	/
8.	3,25	3,2±1,5 ab	27,3	27,3±15,1 a	71,1
9.	3,0	3,0±1,4 ab	50,7	50,7±19,8 bc	73,3
10.	3,0	3,0±0,8 ab	45,8	45,8±19,4 bc	73,3
11.	2,5	2,5±0,6 ab	47,7	47,7±24,1 bc	77,7
12.	2,75	2,7±1,7 ab	37,5	37,5±16,6 bc	75,5
13.	2,0	2,0±0,8 ab	27,7	27,8±16,3 a	82,2
14.	6,5	6,5±0,6 d	55,4	55,4±2,8 c	42,2
15.	5,5	5,5±1,3 cd	31,2	31,2±9,4 ab	51,1
NZR(0,05)		1,99		37,2	

Based on the achieved results in all variants, we can state a significantly lower percentage of attacked ears compared to the control. In variants 1, 3, 5, 6, 8, 9, 10, 11, 12 and 13, there are no significant differences in the percentage of attacked ears between treatments. In variants 3, 4, 6, 8, 13 and 14, the percentage of infected classes is significantly lower compared to the control.

Effectiveness of fungicides in controlling yellow rust (*Puccinia striiformis*)

At the Bilić site, in the assessment carried out on 05/27/2016, it was determined that in variant number five, where a fungicide based on active substances I was applied, 375 g/l trifloxystrobin + 160 g/l cyproconazole and II 125 g/l prothioconazole + 125 g/l of tebuconazole, the best protection of wheat was achieved, i.e. there were no yellow rust symptoms. In other varieties where fungicides were applied, the percentage of infected plants ranged from 1.1 to 36.66%, which is significantly lower than the control, where the percentage of infected plants was 92.22%.

Table 4 shows the percentage of attacked leaves, attack index and effectiveness of applied fungicides. In the control, the attack index was 85.5%, and in the varieties with applied fungicides, the attack index ranged from 8.33 to 19.25%. The effectiveness of fungicides in suppressing the cause of yellow rust in this evaluation ranged from 72.7-90.2%. The highest efficiency was achieved in variant number nine, 90.2%, where a fungicide based on I 250 g/l chlorthalonil + 90 g/l tebuconazole was applied; II 300 g/l prochloraz + 200 g/l tebuconazole.

Table 3. Percentage of plants attacked by yellow rust, percentage of infected leaf surface and attack index of examined leaves (May 27, 2016)

Variant number	Percentage of plants attacked (%)	Percentage of infected leaf area (%)	Attack index of viewed sheets (%)
1.	3,3	7,4	0,7
2.	6,8	5,2	1,0
3.	1,1	3,7	0,1
4.	3,3	3,7	0,3
5.	0	0	0
6.	36,6	15,0	1,7
7.	92,2	41,3	37,9
8.	14,4	8,1	1,7
9.	5,5	8,6	0,7
10.	11,1	12,7	1,4
11.	7,7	7,4	0,8
12.	26,6	10,5	4,5
13.	15,5	12,3	1,9
14.	2,2	3,7	0,2
15.	20,0	11,2	4,3

Based on the obtained results, variants 1, 2, 4, 5, 9, 13, 14 and 15 have a significantly lower percentage of attacked leaves compared to the control, while variants 3, 8, 10 and 12 are at the same level of significance as the control. In variants 1, 2, 4, 5, 14 and 15, the attack index is at the same level of significance, while compared to the control it is significantly lower.

Table 4. Percentage of attacked leaves, attack index and effectiveness of applied fungicides in controlling *Puccinia striiformis* (06.06.2016)

Variant number	% of flagellar leaves attacked	$\bar{x}$ ±Sd	Attack index (%)	$\bar{x}$ ±Sd	Efficiency %
1.	80	80±11,5 bc	11,50	11,5±0,8 ab	86,5
2.	75	75±23,8 b	12,65	12,6±1,8 ab	85,2
3.	100	100±0,0 d	15,20	15,2±2,9 cd	82,2
4.	75	75±12,9 b	12,70	12,7±2,3 ab	85,1
5.	67,5	67,5±32,0 b	12,80	10,4±6,4 ab	85,0
6.	97,5	97,5±5 d	17,9	17,9±5,4 de	79,1
7.	100	100±0,0 d	85,5	85,5±10,7 f	-
8.	100	100±0,0 d	18,9	18,9±4,1 e	77,9
9.	7,5	7,5±5,0 a	8,33	5,8±6,1 a	90,2
10.	100	100±0,0 d	19,25	19,2±4,1 e	77,5
11.	95	95±5,7 cd	16,91	16,9±1,8 cd	80,2
12.	100	100±0,0 d	17,4	17,4±2,8 de	79,6
13.	75	75±5,7 bc	14,3	14,3±2,4 cd	83,3
14.	80	80±11,5 bc	12,7	12,7±1,8 ab	85,1
15.	65	65±17,3 b	11,1	11,1±0,0 ab	87,0
НЗР		16,18		4,8	

Effect of fungicides on wheat yield

Based on the results achieved after the wheat harvest, it was established that the highest yield was achieved in variant number 10 (I 200 g/l picoxystrobin + 80 g/l cyproconazole; II 100 g/l picoxystrobin + 500 g/l chlorthalonil) and that was 6352 kg /ha and variant number 4 (I 375 g/l trifloxystrobin + 160 g/l cyproconazole; II 125 g/l prothioconazole + 125 g/l tebuconazole) 6346 kg/ha. The lowest yield was achieved in the control and was 5112 kg/ha. The use of fungicides in this experiment resulted in an increase in yield ranging from 10.2 to 24.2% compared to the control, as well as a higher hectoliter weight on the treated varieties. Based on the above, it can be concluded that fungicides had a positive effect on the increase in wheat yield compared to the control and that their application was justified.

Table 5. Wheat yield (kg/ha) and hectoliter mass (kg)

Variant number	Yield kg/ha	control 100%	Hectoliter mass (kg/hl)
1.	5635	110,2	79,7
2.	5920	115,8	79,4
3.	5793	113,3	80,2
4.	6346	124,1	78,8
5.	6274	122,7	80,0
6.	6307	123,4	78,6
7.	5112	100,0	77,0
8.	5837	114,2	80,2
9.	5819	113,8	80,6
10.	6352	124,2	79,7
11.	6281	122,8	79,6
12.	5766	112,7	78,3
13.	6133	119,9	77,6
14.	5925	115,9	80,2
15.	5817	113,7	80,3

Conclusion

Based on the conducted tests and achieved results in the suppression of yellow rust (Puccinia striiformis) and Fusarium species (Fusarium spp.) on the wheat crop, the following conclusions can be drawn:

- The results of the test in the suppression of the cause of yellow rust indicate that with the double application of tested fungicides we can achieve satisfactory results in the protection of wheat from this pathogen. The effectiveness of tested fungicides in suppressing the cause of yellow rust ranged from 72.7-90.2%, and the best effectiveness of 90.2% was achieved with the use of fungicides based on chlorthalonil + tebuconazole, applied in the first treatment (T-1) and fungicides on based on prochloraz + tebuconazole, which was used in the second treatment (T-3).

- The effectiveness of the applied fungicides in controlling the fusariosis class was 42.2 - 86.6%, depending on the preparation. The best results in the protection of classes from fusarium head blight were achieved by fungicides based on tebuconazole.

- By analyzing the effectiveness of tested fungicides in relation to the time of application, we came to the conclusion that there is no significant difference between the variants with the application of fungicides in phase T-1 compared to the variants where this treatment was absent and the first treatment was done in the flagellar phase T-2.

- The test results indicated that the application of fungicides in the wheat crop has economic justification, which is reflected in the preservation and increase of yields.

- The recommendation to producers is to apply fungicide twice to protect wheat from two important pathogens such as Fusarium spp. and Puccinia striiformis, in the T-2 and T-3 stages, which provides protection of the upper third of the plants, which is the most important in achieving the expected yields.

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Effect of Hormone Applications on Germination in Rosehip (*Rosa canina*) Seeds

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Abstract

In this study, the effects of different stratification temperatures (warm+cold) and applications of different doses of Gibberellic Acid (250, 500 and 750 ppm GA_3) and Jasmonic acid (1, 2 and 3 mM JA) on the germination ratio of rosehip seeds were investigated. The study was carried out in the laboratory and greenhouse of Kırşehir Ahi Evran University, Faculty of Agriculture, Department of Horticulture in 2020-2021. Rosehip seeds were first soaked in water for 24 hours, then kept in Jasmonic acid (1, 2 and 3 mM JA) and Gibberellic acid (250, 500 and 750 ppm GA_3) for 24 hours, then placed in 500 g plastic cups (100x120x55 mm) folded to a depth of about 1 cm in vermiculite medium. Seeds were first subjected to warm and moist stratification at 22±1^{o}C for 14 weeks, and then cold and moist stratification at 4±1^{o}C for 14 weeks. The experiment was set up as 3 replications according to the randomized plot design, and 50 seeds were used in each replication. At the end of the study; The highest emergence rate in rosehip seeds was found to be 18.67 % from 3 mM JA application. It was concluded that the stratification time should be longer in rosehip seeds and higher doses of the growth regulators used should be tried.

Keywords: Germination ratio, Rosehip, stratification

Introduction

Rosehip (*Rosa canina* L.) is a fruit species belonging to the genus Rosa of the Rosaceae family. It is a perennial shrub-shaped plant that grows naturally in garden borders on valleys and roadsides (Bilgener et al., 1996). To date, around 200 natural rosehip species have been defined in the world, and 35 species, three of which are endemic, naturally spread in the flora of Turkey (Aslan, 2012). Turkey is one of the gene centers of rose hips, and it is a plant species whose use for both nutritional and medicinal purposes has increased day by day and has gained significant economic value (Doğan and Kazankaya, 2006). Rosehip, which is not only used for nutritional or medicinal purposes, is also used as rootstock in landscaping and

cutting rose cultivation. It is used in landscaping aesthetically with its colorful flowers that open in early summer and bright red fruits that ripen in autumn (Koçan, 2010).

In the breeding of a species, first of all, it is necessary to know the propagation ability of that species. Rosehip can be propagated by seed and by different vegetative methods such as cutting, tissue culture and layering (Orhan, 2001). There are different variations according to the species in terms of fruit and plant characteristics in the propagation of rosehip by seed. Among the species, the highest expansion is seen in *Rosa dumalis* and *Rosa villosa*, while the least expansion is observed in *Rosa rubiginosa* and *Rosa canina* species. Propagation by seed is preferred for the propagation of *Rosa rubiginosa* and *Rosa canina* species, which show very little expansion (Nybom and Carlson, 1992). However, seed propagation is a technical process that is easy and has many problems (Kaşka and Yılmaz, 1990). Especially the seeds of the species belonging to the *Rosaceae* family generally cannot germinate or germinate at very low rates unless they undergo some pre-treatments (Kaşka, 1970). In general, the fact that the mature and sound seeds of many fruit species cannot germinate despite the appropriate environmental conditions (such as temperature, humidity, oxygen and light) is called dormancy (Çetinbaş and Koyuncu, 2005). For this reason, some preliminary applications such as stratification, soaking in water, hormone application, cracking are carried out to break the dormancy in fruit seeds. There are studies showing that in some cases, only one or a combination of these pre-treatments may not be sufficient because rosehip seeds germinate difficult due to their hard impermeable outer shell (Foster and Wright, 1983; Tansı et al., 1996; Ercişli, 2000; Belletti et al., 2003, Hoşafcı). et al., 2005, Anderson and Byrne, 2007).

Alp et al., (2009) showed that in *Rosa canina*, R. *pulverelanta* and R. *dumalis* species, they did 11, 12, 13 weeks hot stratification at 25^{o}C, then cold stratification for 1, 3 weeks at 5^{o}C, and the overall germination percentage was R. *canina*, 18.80 % reported that it was 13.80 % in R. *pulverelanta* and 13.53 % in R. *dumalis*, and that the most appropriate method for these three taxa was 11 weeks of hot and cold stratification. They also stated that germination is very difficult in *Rosa* species due to their genetic characteristics, and hot + cold stratification is an effective germination method in breaking dormancy.

Gibberalins play a very important role in eliminating seed and bud dormancy, controlling and stimulating seed germination (Hartmann et al., 1990). Gibberalins, which are formed in high amounts in developing seeds, have important functions in seed germination and control of dormancy. On the other hand, the effects of gibberellic acid (GA_3) applications on germination have been known for a long time. The applied GA_3 concentration and time have a significant effect on germination (Duman, 2006). In addition, in recent years, it has been

reported that jasmonic acid is effective in eliminating the need for rest in seeds (Sembdner and Parthier, 1993) and on seed germination (Ranjan and Lewak, 1995).

In this study, the effects of different stratification temperatures (warm + cold) and applications of different doses of Gibberellic Acid (250, 500 and 750 ppm GA_3) and Jasmonic acid (1, 2 and 3 mM JA) on sowing emergence rate were investigated to break dormancy in rosehip seeds.

Material and Methods

The study was carried out in the laboratory and greenhouse of Kırşehir Ahi Evran University, Faculty of Agriculture, Department of Horticulture in 2020-2021. The material of the study consisted of the seeds of the fruits harvested in the mature period from rosehip (*Rosa canina*) plants that spread naturally in Kırşehir. Seeds were removed from rosehip fruits, thoroughly cleaned in water and stored in the laboratory until the time of application. In order to break dormancy, rosehip seeds were first kept in water for 24 hours, then kept in Jasmonic acid (1, 2 and 3 mM JA) and Gibberellic acid (250, 500 and 750 ppm GA_3) for 24 hours, then placed in 500 g plastic containers (100x120x55 mm) folded approximately 1 cm deep. Seeds were first subjected to warm and moist stratification at 22±1^oC for 14 weeks, and then cold and moist stratification at 4±1^oC for 14 weeks. The experiment was set up in 3 replications according to the randomized plot design, and 50 seeds were used in each replication.

Result and Discussion

Seeds soaked in Jasmonic acid (1, 2 and 3 mM JA) and Gibberellic acid (250, 500 and 750 ppm GA_3) applied to rosehip seeds for 24 hours, warm and moist stratification for 14 weeks, then cold and moist stratified for 14 weeks. The sowing emergence rates of the treated seeds after they are removed from folding are given in Table 1.

Table 1. Sowing emergence rates of rosehip seeds (%)

Application	**Emergence Rate (%)**
control	2.67
1 mM JA	4.00
2 mM JA	7.33
3 mM JA	18.67
250 ppm GA_3	4.00
500 ppm GA_3	6.00
750 ppm GA_3	7.33

According to Table 1, the lowest seedling emergence rate was obtained from the control group with 2.67 %, while the highest emergence rate was obtained from 3 mM JA application with 18.67 %.

Tansı et al., (1996), kept the rosehip seeds in the refrigerator at $+4^0$C for 1 month, then kept the seeds in H_2SO_4 for 15-30-40-50-60-80 minutes to break dormancy and increase germination. Washed seeds were subjected to different doses of GA_3 (100, 500 and 1000 ppm) for 30-60-90-120 minutes and KNO_3 (0.1-0.5-1%) for 20, 30, 40 minutes. No germination was obtained after 60 days of waiting period in all applications. Similarly, Ercişli (2000) investigated the effects of different applications on the germination of rosehip seeds, and the seeds were kept in perlite medium at $+4^o$C for 0-30-60-90-120-150 and 180 days. In GA_3 application, after harvest, seeds were kept in 0, 1000, 2000 and 4000 ppm GA_3 solution for 24 hours. In the stratification + GA_3 application, the seeds were first folded for 100 days, then GA_3 applications were made at different doses for 20 hours. Considering the 8 rosehip species used in the research, none of them germinated.

Since rosehip seeds are surrounded by a hard and impermeable pericarp layer, they prevent water absorption and air permeability of the seed, thus creating a physical barrier to the expansion of the embryo (Werlemark et al., 1995; Meyer, 2008). In addition, abscisic acid, which is high in rosehip seeds, acts as an inhibitor for germination (Hartmann et al., 2002). For these reasons, rosehip seeds are difficult to germinate. The most commonly used method to break dormancy in rosehip seeds is stratification (Zlesak, 2007).

Although the emergence rate was low as a result of our research, it can be said that progress has been made based on the studies conducted by different researchers.

Conclusion

Rosehip is one of the fruit species with a bright future, which has been used for both medicinal and nutritional purposes in recent years. In order to meet the increasing demand and to create export opportunities, it is necessary not only to obtain products from nature, but also to establish orchards and to obtain seedlings. In this context, propagation by seeds is preferred in rose hips, especially since *Rosa canina* species show less genetic expansion. The rosehip species with a hard impermeable seed coat should be propagated by determining suitable pretreatments. According to the results obtained from the study; It was concluded that the stratification time should be longer and higher doses of growth regulators should be tried.

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The impact of conventional and precision farming technology and year effect on maize yields

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Abstract

Limited land and water resources, climate change and the increased number of extreme events pose a significant threat to achieving sustainable agricultural objectives.

The studies were carried out in a complex tillage field experiment at the Látókép Crop Production Experimental Station of the Institutes for Agricultural Research and Educational Farm of the University of Debrecen (N 47° 33' E 21°26'), 15 km from Debrecen, near the 33 road. The tillage variations analysed in the experiment were winter ploughing, strip tillage and ripping. The analysis of the crop years (2015-2021) was performed similarly to the work of Gombos and Nagy (2019), examining the deviation of total precipitation and mean annual temperature of the studied years from the 30-year (1981-2010) averages.

Averaged over the analysed 7 years and 3 nutrient level, the highest yields were recorded in the ripping tillage treatment (9.6 t/ha). This was significantly lower in the winter ploughed treatment (9.05 t/ha). On average, the lowest yields (8.65 t/ha) were recorded in the strip tillage treatment, which was only 0.4 t/ha less than the winter ploughed treatment. All the years of the study period were statistically different from each other. The average yield of the first examined year (2015) was 7.8 t/ha. The highest yield of all the analysed years was 11.91 t/ha in 2016.

Keywords: maize yield, year effect, soil tillage, fertilization, long-term field experiment

Introduction

Global population is expected to reach 9.8 billion by 2050. Food production will increase exponentially to meet the needs of a growing population. However, limited land and water resources, climate change and an increase in extreme events are likely to pose a significant threat to achieving a sustainable agricultural goal. Maize (Zea mays L.) is grown worldwide for cereals and animal feed (Nagy, 2007). Statistics from the Food and Agriculture Organization of the United Nations (FAO) show that maize, along with rice (Oryza sativa)

and wheat (Triticum spp L.), are the three most important cereals for human and animal consumption in the world (FAO, 2009). Sustainable agriculture ensures food security and combats climate change by minimising dependence on water resources (Széles et al., 2019). Soil moisture is the most direct and important source of the water demand of crops (Széles and Huzsvai, 2020). Changes in soil moisture levels and maize water demand will result in changes in areas suitable for maize production due to climate change (Gao et al., 2021). Water availability in arid regions is the most critical constraint for sustainable crop production; consequently, it is essential to quantify groundwater balance and optimize irrigation schedules in agricultural areas (Attia et al., 2021). Drought is currently a serious environmental constraint to crop survival and productivity due to the continuous decline in global water resources (Harsányi et al., 2022). Drought tolerance is a complex, multi-genetic trait involving a number of physiological processes (Lourtie et al., 1995). Maize yield (and plant survival) in regions with sub-optimal rainfall or limited irrigation availability can be better guaranteed if genotypes are selected for tolerance or resistance to water stress (Landi et al., 1995). Maize (Zea mays L.) yields are particularly sensitive to water deficit, which coincides with the tasseling and silking period, causing a significant reduction in grain yield (Basetti et al., 1993). The increasing costs of two controllable production inputs - water and nitrogen (N) - further demand their efficient use (Fapohunda et al., 1990). Knowledge of crop production under sub-optimal environmental conditions not only helps to maintain yields but also helps to design low-input systems (Payero et al., 2006). Effective management strategies are needed that minimize input costs and environmental damage under sub-optimal environmental conditions, but without sacrificing crop performance or limiting economic returns (Subedi et al., 2006). In the future, climate factors will change globally, mainly as a result of human activities (Juhász et al, 2020). Based on a long record of indirect and direct measurements, it is a fact that the concentration of greenhouse gases in the Earth's atmosphere is increasing (Nagy et al., 2006).

Material and Method

The studies were carried out in a complex tillage trial (crop rotation x tillage x fertilization x irrigation x plant density x genotype) 15 km from Debrecen, near the No. 33 road, at the Látókép Crop Production Experimental Station of the Institutes for Agricultural Research and Educational Farm of the University of Debrecen (N 47° 33' E 21°26'). The soil of the experiment is a calcareous chernozem formed on the loess reef of Hajdúság. From 2004 to 2014, the basic tillage of the experiment was winter ploughing, spring ploughing and spring

shallow tillage, and in 2015, in cooperation with KITE cPlc, it was modified in order to examine the long-term effect of the strip tillage technology and to compare it with the conventional winter ploughing and ripping. The tillage variations tested in the experiment were winter ploughing, strip tillage and base tillage with a ripper. The trials were carried out on 3 maize hybrids (FAO340-490) and 2 plant densities (60 and 80 thousand plants / ha). The hybrids and fertilizer levels were randomized in the experiment. The fertilizer levels were control, 80 kg N/ha + 60 kg P_2 O_5 /ha + 90kg K_2 O/ha; and 160 kg N/ha + 60 kg P_2 O_5 /ha + 90kg K_2 O/ha. Only the non-irrigated monoculture plots were included in the study, as shown in Figure 1.

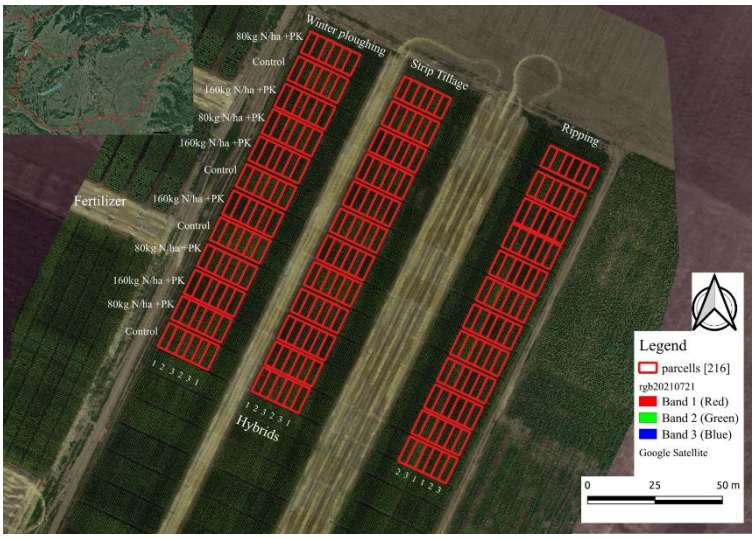

Figure 1. Location and treatments of the experiment (Debrecen - Látókép)

The analysis of the study years (2015-2021) was carried out in a similar way to Gombos and Nagy (2019), examining the deviation of total precipitation and mean annual temperature of the given year from the 30-year (1981-2010) average. The annual mean temperature of the experimental area was 10.8°C with an annual precipitation sum of 550.mm. In comparison, the first test year 2015 was 1.1°C warmer and 43 mm drier. In 2016, the mean temperature was 0.5°C above the long-term average, but in this year the precipitation was 258 mm above average. The 2017 crop year was 0.6°C warmer and 81mm rainier than the 30-year average. The annual mean temperature in 2018 was 1 degree warmer and 8mm less precipitation than average. In the next analysed year (2019), the annual mean temperature was 0.7°C above the 1981-2010 average while precipitation was 18mm above the 1981-2010 average. The year 2020 was only 0.3°C above the multi-year average, but it was rainier (+148mm) than the average. In 2021, the final year of the study, the mean annual temperature was 0.2°C below

the average, but more than one-third of the annual precipitation (-195mm) was absent (Figure 2).

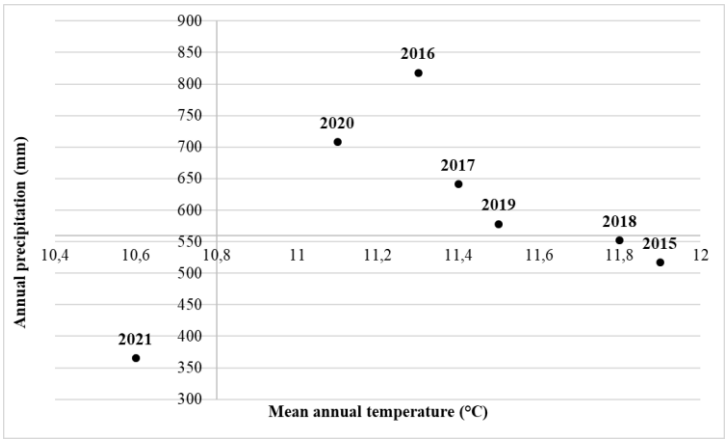

Figure 2. Average temperature and precipitation for the years 2015-2021 compared to the multi-year average (1981-2010) (Debrecen - Látókép)

Statistical evaluation was carried out using the R 4.2.1 statistical software environment (R Core Team, 2022). The Figureical interface was implemented using RStudio (RStudio Team, 2022), gplots (Warnes et. al., 2022), car (Fox and Weisberg, 2019) and agricolae (de Mendiburu, 2021) packages. Figures were created using Microsoft Excel. The type I error was set at 5%, i.e. alpha = 0.05. To investigate the effects of treatments, a repeated measures anova model was constructed based on Huzsvai and Balogh (2015), and the least significant difference (LSD) method was used to compare the mean of yields.

Results and Discussion

Averaged over the 7 years and 3 nutrient levels studied, the highest yields were recorded in the ripped tillage treatment (9.6 t/ha). Yield in the winter ploughing treatment was significantly lower (9.05 t/ha). On average, the lowest yields (8.65 t/ha) were recorded in the strip tillage treatment, which was only 0.4 t/ha less than in the winter ploughing treatment.

Fertilizer application was statistically proven to increase maize yield, with all fertilizer steps significantly different from each other. On average across years and tillage treatments, the highest yield was observed at the 160 kg N/ha + PK fertilizer level, and a significantly lower yield (9.92 t/ha) was observed at the 80 kg/ha + PK fertilizer level. The lowest yield was observed in the control plots (6.29 t/ha).

Taken together, both tillage and fertilisation had an effect on maize yields. In control plots that had not been fertilized for 33 years, there was no statistical difference in yield between winter ploughing and strip-tillage. There was no difference between ripping and winter

ploughing at a fertilizer dose of 80 kg N/ha + PK. Strip-tillage at the middle fertilizer step was lower in yield than the other two treatments. At a dose of 160 kg N/ha, there was no difference in yield between winter ploughing and strip-tillage. Among the three tillage and three fertilizer treatments, the highest yields were observed with the 160 kg N/ha + PK ripping treatment on average for the analysed years (Figure 3).

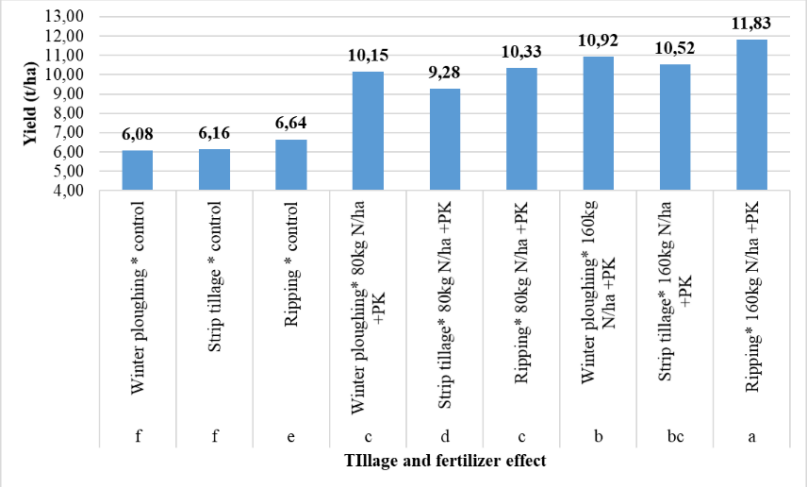

Figure 3. Impact of tillage and fertilisation on maize yields (2015-2021)

All crop years in the studied period were statistically different. The average yield of the first analysed year was 7.8 t/ha. The highest yield of all the years studied was 11.91 t/ha in 2016. In 2017, the yield decreased to 8.77 t/ha and then gradually increased significantly year by year. The second highest yield in the examined period was in the year 2020. In the year 2021, a sharp decline was observed, with the lowest maize grain yield of the period at 6.59 t/ha (Figure 4).

In the different years, tillage had different effects on maize yields. In 2015, the first year of the study, there was no difference in yield between the three tillage systems. In 2016, which was a favourable year for maize, the yield under all tillage methods was significantly higher than the previous year. This year, the ripping treatment produced the highest yield (12.47 t/ha), with the winter ploughing treatment producing a significantly lower yield (12.14 t/ha) and the strip-tillage treatment producing a significantly lower yield than both. For the 2017 crop year, maize yields were significantly lower. In this crop year, yield results for the winter ploughed and strip-tillage treatments did not differ, but were lower than the ripping treatment. In the 2018 crop year, the yield results of the autumn ploughed tillage increased significantly compared to the previous year, with no difference between 2017 and 2018 in the strip tillage.

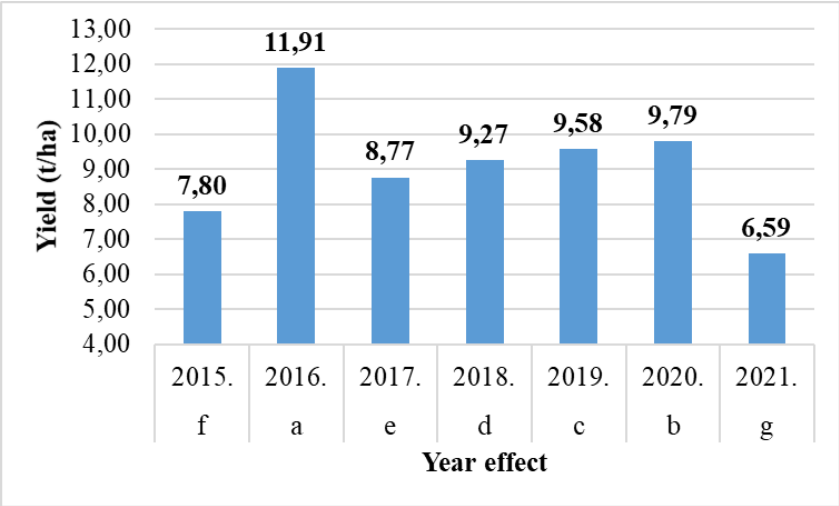

Figure 4. Impact of vintage on maize yields (2015-2021)

Yield results for the ripping treatment increased significantly from 2017 to 2018 by 0.8 t/ha. In 2018, there was no difference between winter ploughing and strip tillage, and also in this year, significantly higher yields (9.98 t/ha) were measured in the ripping treatment than in the other two tillage treatments. There was no difference between the yields of winter ploughed maize in 2018 and 2019, and the yields of the ripping treatment did not change compared to 2018. The yield of the strip tillage increased significantly by 0.62 t/ha compared to the previous year (2018). In 2019, the ripping treatment also yielded significantly more than winter ploughing and strip tillage. In 2020, all three tillage treatments were significantly different from each other. Also in this year, the highest yield (10.62 t/ha) was measured with ripping, the lowest yield (9.07 t/ha) were measured with the strip tillage. In the last year of the study (2021), the yield results decreased significantly under all three tillage options. The yield of the ploughed treatment was 6.74 t/ha, with the smallest decrease for the strip-tillage (-3.14 t/ha) and the largest decrease for the ripped (-3.52 t/ha) compared to the previous year (Figure 5).

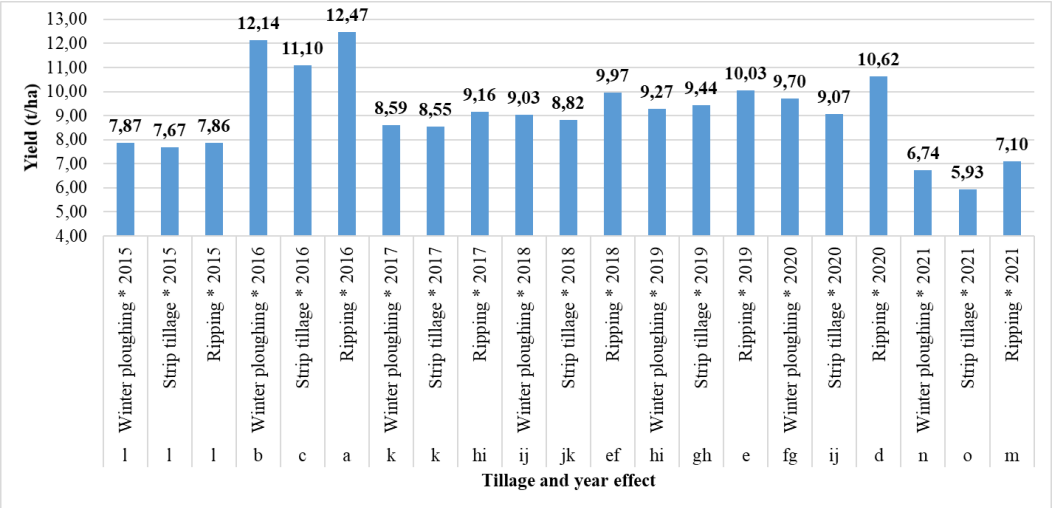

Figure 5. Effect of tillage and crop year on maize yields (2015-2021)

The combination of crop year and fertilisation also affected maize yields. In 2015, the first year of the study, the control plots without fertilisation had the lowest statistically verifiable yield. In this year, there was no yield difference between the two different nitrogen fertilizer doses. In 2016, precipitation was favourable for maize, with the highest yield (13.81 t/ha) in the average of the tillage treatments in the study period at 160 kg N/ha +PK. This year, the second highest yield was recorded at 80 kg N/ha + PK and the yield averages of the control plots in this year were also reached the yield of the high fertilizer dose of the previous year (8.93 t/ha). In this year, the yields of the three fertilizer levels were different. Compared to the control, 80 kg N/ha +PK gave a yield increase of 4.2 t/ha in this year, which was further increased by 1.76 t/ha with the highest nitrogen fertilizer dose. Yields in 2018 increased compared to the previous year at all fertilizer levels, and this year there was also a difference between the control at 80 kg N/ha and the 160 kg N/ha fertilizer dose. Compared to the control, the lower fertilizer level resulted in an additional yield of 4.12 t/ha, which was further increased by 1.51 t/ha by the higher 160kg N/ha dose. In 2020, the yield of the control plots decreased significantly (-1.45 t/ha) compared to the previous year. This year, yields at 80 kg N/ha + PK fertilizer dose (10.51 t/ha) were not different from the yields at this fertilizer rate (10.26 t/ha) in the previous year. In the 2020 crop year, the yield of the 160 kg N/ha treatment (12.96 t/ha) was significantly higher than in the previous year (11.13 t/ha), providing the second highest yield of the analysed period, i.e. not different from the yield at the 80 kg N/ha dose in 2016. In 2021, the 160 kg N/ha +PK treatment yielded 4.94 t/ha less than the previous year, while the 80 kg N/ha +PK treatment yielded 3.47 t/ha less than the previous year. The lowest yield of the study period (4.71t/ha) was measured in the control plot in this year (Figure 6).

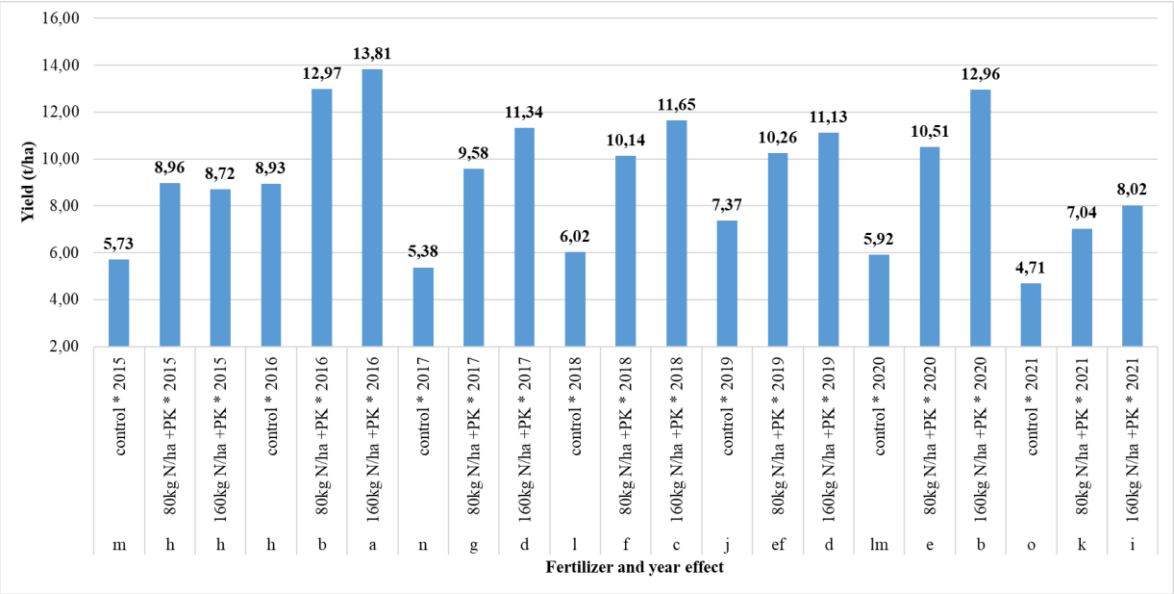

Figure 6. Impact of fertiliser treatments and crop year on maize yields (2015-2021)

Conclusion

Based on the results of the study, the maize yield of conventional, winter ploughed maize in the examined 7 years exceeded that of strip-tillage only three times. It can be concluded that the yield levels achieved with conventional cultivation technology can be achieved with precision strip-tillage of maize. The advantages of precision strip tillage are that it conserves soil organic matter. It saves soil moisture and energy, as only 30% of the soil surface is disturbed during cultivation, and the residues in the stubble have a soil-protective effect. The results show that the ripping tillage technology provided the highest yields in 6 years of the study period. The ripping technology ensures sustainable maize production by achieving high yield levels. The yield enhancing effect of 80 kg N/ha fertilizer treatment was higher compared to control plots than 160 kg N/ha treatment compared to 80 kg N/ha fertilizer treatment. High yields can be achieved in the study plot with 80 kg N/ha fertilizer dose without significant damage to the environment.

Acknowledgment

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Effect of abiotic stress factors on quality parameters of sweet corn (Zea mays L.convar.saccharata Koern.)

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Abstract

In the scope of the research, it was aimed to examine the nutritional values of sweet corn (*Zea mays L.convar.saccharata Koern*.) in relation to heat sum and to determine, on the basis of the measured parameters, the optimum maturity time of maize, which will allow the practicing farmers to produce the best quality product. In the scope of the studies, relative chlorophyll content (SPAD), NDVI, LAI and soil moisture values were measured in different phenophases of maize (V6, V12, R1) in the year 2021.

The experiment was set up in Fejér County, Hungary (N $46^0$47'56";E $18^0$48'48"), in the field of our own farm (SIMON Ltd.), with an area of 21 ha. In the scope of the experiment, two maize hybrids (Dessert R72, Dessert R78) were tested in 4 replicates.

The highest statistically verifiable SPAD and NDVI values were measured for both hybrids during the 12-leaf stage ($p<0.05$). In the case of both the Dessert R72 and Dessert R78 hybrids, N incorporation was continuous. Between V6 and V12 phenophases, the Dessert R72 hybrid showed higher nutrient incorporation dynamics (+17.55 SPAD) than the Dessert R78 hybrid (+13.73 SPAD). In R1 phenophase, N incorporation in vegetative parts decreased. Figuresynthetic activity increased between V6 and V12 phenophases, but NDVI decreased between the V12 and R1 phenophases. LAI value increased steadily with vegetation progression in both hybrids and was highest at the 50% silking (R1) stage ($p<0.05$), with Dessert R78 hybrid having more pronounced growth dynamics (3.38).

Keywords: sweet corn, SPAD, LAI, NDVI, yield

Introduction

Global maize production was 484 million tonnes in 1990, rising to 1147 million tonnes in 2018. Its production growth is the most dynamic among cereals. In many countries it is a fundamental food, in more developed countries it is used as animal feed, and it also plays a diverse role as an industrial and energy crop (Nagy 2021; Erenstein et al., 2022).

As a cereal crop with high yield potential, it is of great importance on all continents. With an annual production of 347.05 million tonnes, the United States is the world leader. China follows with 260.78 million tonnes. Brazil is third with a harvested amount of 101.14 million tonnes. As another South American country, Argentina is fourth with 56.86 million tonnes. The top-ranked European country is Ukraine, neighbouring Hungary, with 35.88 million tonnes (FAO 2019, URL[2]). Within the European Union, Hungary is also one of the most important maize producers (8.5 million tonnes; FAO, 2021).

In 2005, the sowing area of maize in Hungary was 1.2 million hectares, and it remained at this level until 2021, with slight variations. Last year, a total of 6.3 million tonnes were harvested from 1 million hectares, which is below the 8.5 million tonnes harvested in 2020 (KSH, 2021, URL[1]).

In terms of maize production, sweet corn has accounted for a total of 360-380 thousand hectares worldwide in recent years. The USA and the European Union are the world's two largest producers, with Thailand also being a major producer. In Europe, the main sweet corn producing countries are Hungary with 32-36 thousand ha, France with 18-22 thousand ha, Russia with 8-10 thousand ha, Poland with 8-9 thousand ha, Italy with 4-5 thousand ha. The two main export products are frozen and canned sweet corn. In 2016, Hungary exported 73.5 thousand tonnes of frozen sweet corn and 179.8 thousand tonnes of canned sweet corn, the former being the second in the world after the US and the latter the first.

Global population is expected to reach 9.3 billion by 2050, indicating that increasing food production with limited resources is an urgent task (Xie et al., 2017). Increasing agricultural production is inevitable to feed the world's population, which can be ensured through appropriate variety/hybrid choice, nutrient supply and increasing amount of irrigation water (Yang et al., 2006; Zhang et al., 2022).

One of the most important input fertilizers is nitrogen (Davies et al., 2020), which has a major impact on crop yields (Horváth et al., 2021; Szabó et al., 2022). However, excessive fertilization reduces the efficiency of N uptake and is highly detrimental to the environment and human health (Ahmed et al, 2017). The dynamics of N uptake becomes intensive with the V6 phenophase and slows down at the beginning of the R1 stage, but N uptake and incorporation are significant during grain filling. 61% of total N is transported to the grain yield (Berzsenyi, 2013).

The amount of precipitation is the most important meteorological factor determining crop yield (Gombos and Nagy, 2021). The amount of precipitation from sowing to silking is crucial (Huzsvai and Nagy, 2003). The most sensitive period to water stress is the period of

tasselling (Esteban and Solilap, 2016) and silking (Pandey et al, 2000) Irrigation can increase yields and reduce yield losses by supplementing any precipitation deficits (Nagy, 2008). Research shows that yield losses can occur despite irrigation, caused by inadequate nutrient and water supply coordination (Huzsvai and Nagy, 2005; Nyéki, 2021).

Material and Method

The experimental site is located in Hungary, in the southern part of Fejér county, on the border of the village of Előszállás (N 46^0 47'56";E 18^0 48'48"), on the arable land of SIMON Ltd., on loess-formed calcareous chernozem soil. The experiments were carried out under field conditions with two maize hybrids (very early maturity Dessert R72, medium maturity Dessert R78) in 4 replicates.

Soil. The average pH (KCl) of the soil is 7.18, which is neutral and optimal for plant nutrient uptake. In the upper layer (20 cm) of the soil, Arany's plasticity index is 36 and the total water soluble salts are 0.05 %, which means a low salt content. The soil is moderately calcareous ($CaCO_3$: 6,7 %). 2,9 % organic matter was found in the upper 30 cm layer. The soil has a good K (263 ppm) and P (208 ppm) content.

Experimental details. All plots in the field experiment were randomly assigned, with four replicates per hybrid. In the experiment, 170 kg ha^{-1} of nitrogen was applied in several batches. In the pre-sowing period, 92 kg ha^{-1} were applied. Sweet corn was sown on 10.04.2021. An additional 150 mm of irrigation water was added to the 148.3 mm of precipitation that fell during the growing season, 2/3 of which was applied in June.

Instrumental measurements. In each plot, the fifth plant in the third row was considered to be plant number 1, with a total of 20 consecutive plants measured in a row. The measurements were: relative chlorophyll content (Minolta SPAD 502), NDVI - Normalized Vegetation Index (Green Seeker), soil moisture (TDR soil moisture probe) and leaf area index - LAI (S1 SunScan Canopy Analysis System) measurements. In all cases the tests were carried out in V6, V12 and R1 phenophases.

Climatic characterisation of the crop years. Weather data were evaluated using the automatic weather station installed in the experimental area and data from the national meteorological service.

The year 2021 is around average (1991-2020 average: 10.8 °C), the coldest and darkest year in the last ten years in Hungary, according to the data recorded in the OMSZ network (OMSZ, URL[3]). Although the annual mean temperature does not deviate significantly from the average, there is a large variability between months. The monthly mean temperatures in

April and May were more than 2° C below the average, making it the coldest spring since 1987. The total precipitation in the experimental plot in 2021 was 463 mm, 20% below the average of 578 mm. By the time of sowing (10.04.2021), more than three months later, 50 mm of rain had fallen, which is average (43.9 mm) considering the data of ten years. After sowing, 21.8 mm of rain fell in April at an average monthly temperature of 12 °C and 115.5 mm in May at an average monthly temperature of 15.9 °C, which was sufficient for the optimum development of sweet corn. After a cool spring, June and July were dominated by heat. In June, the average monthly temperature was 19°C and the area received a total of 8.5 mm of rainfall, a record low compared to the 10-year average of 65.2 mm. During the sweet corn harvest period (7-15 July), a total of 20 mm of rain fell.

Statistical evaluation. The correlations between SPAD, NDVI, LAI values and phenophases and hybrids were evaluated using a general linear model (GLM). The comparison of mean values of phenophases and hybrids was performed using Duncan test. Evaluation was performed using the statistical software package SPSS for Windows 21.0.

Results and Discussion

The development of the SPAD of sweet corn hybrids in three different phenophases was examined. In the V6 phenophase, the Dessert R78 hybrid had a higher SPAD value (+3.36; $p<0.05$) than the Dessert R72 hybrid, which was due to the strong initial vegetative development of the hybrid. At the V12 phenophase, the hybrids showed almost identical values. In the R1 stage, the Dessert R78 hybrid showed a significant decrease of -5.88 SPAD ($p<0.005$) compared to the Dessert R72 hybrid. The highest SPAD value for both hybrids was in the V12 phenophase (Figure 1) ($p<0.05$).

N incorporation was highest between V6 and V12 phenophases for both hybrids. It increased by +17.55 SPAD value for the Dessert R72 hybrid and +13.73 for the Dessert R78 hybrid. The results are in agreement with Berzsenyi (2013), who reported that N incorporation in R1 phenophase decreases in vegetative parts, with the appearance of generative plant parts.

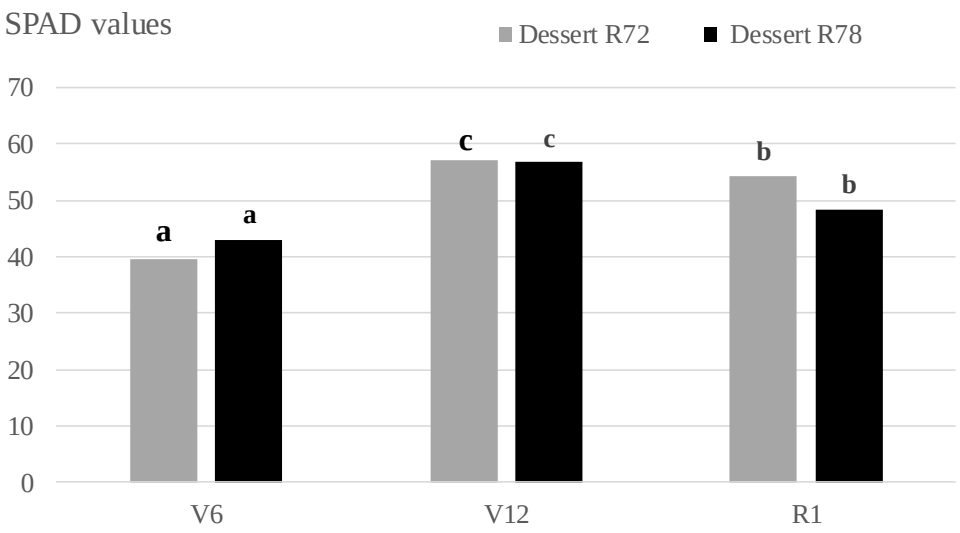

Figure 1 Development of the relative chlorophyll (SPAD value) content of sweet maize hybrids (Előszállás, 2021)

Note: SPAD values marked with *different letters are significantly* different from each other based on the *on Duncan's test at p< 0.05* probability *level.*

In the V6 and R1 phenophases, both hybrids showed the same NDVI. At the V12 growth stage, the *NDVI value of* the *Dessert R78 hybrid exceeded that of the Dessert R72 hybrid (p<0.05).* NDVI values differed between phenophases (Figure 2). In parallel with the SPAD value, the highest value for NDVI value for both hybrids was also at the V12 phenophase ($p<0.005$).

Figuresynthetic activity increased between phenophases V6 and V12 for both hybrids. The Dessert R72 hybrid had a value of +0.23, while the Dessert R78 hybrid had a value of +0.41 ($p<0.05$). Between V12 and R1 phenophases, NDVI decreased in parallel with SPAD values.

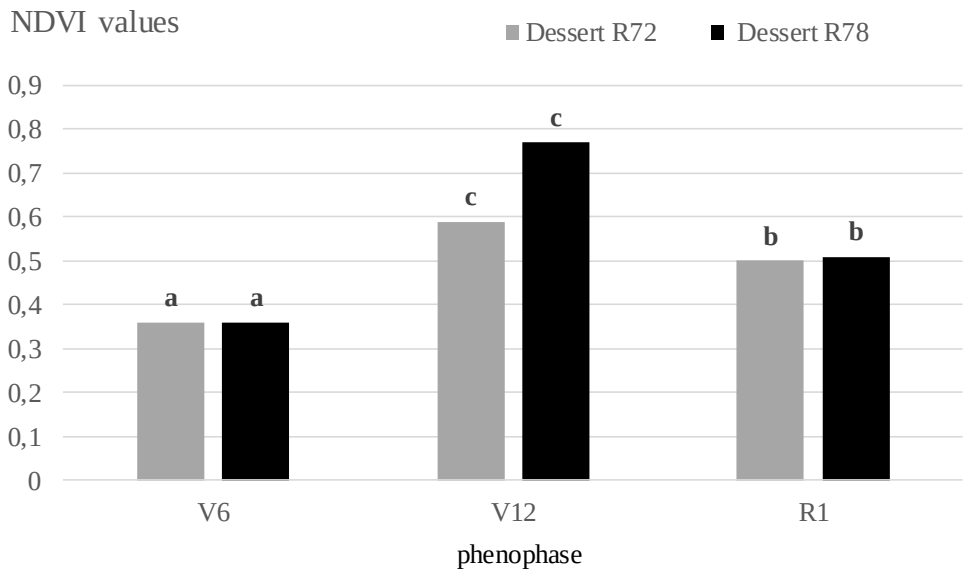

Figure 2 Development of the NDVI of sweetcorn hybrids

(Előszállás, 2021)

Note: SPAD values marked with *different letters are significantly* different from each other based *on the Duncan's test at p< 0.05* probability *level.*

As for LAI, there was no reliable difference between the LAI values of the hybrids in the V6 growth stage. At the V12 and R1 phenophases, the Dessert R72 hybrid had a lower LAI value than the Dessert R78 hybrid (Figure 3). The difference was the highest at the R1 stage (1.23; $p< 0.05$).

Between the V6 and V12 phenophases, sweet corn was subjected to hail, resulting in damage to the vegetative parts. Despite significant loss of green weight, LAI increased by 1.39 for hybrid Dessert R72 and 1.95 for hybrid Dessert R78. Between the V12 and R1 phenophases, the increase in leaf area was smaller, 0.3 for hybrid Dessert R72 and 0.89 for hybrid Dessert R78. The vegetative leaf area index (LAI) increased steadily for both hybrids as vegetation progressed until the R1 growth stage, where it reached a maximum (2.15; 3.38; $p<0.05$).

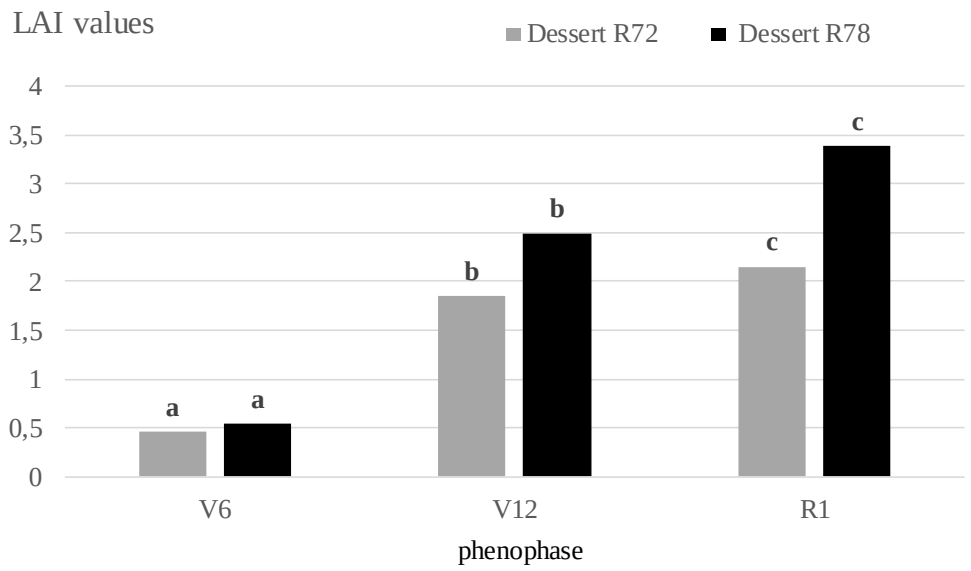

Figure 3 Development of the LAI of sweet corn hybrids

(Előszállás, 2021)

Note: SPAD values marked with *different letters are significantly* different from each other based *on the Duncan's test at p< 0.05* probability *level.*

Conclusion

Based on the performed studies, it was found that both Dessert R72 and Dessert R78 had a continuous N incorporation in the vegetative growth stage (V6;V12). Its intensity decreased in the vegetative parts in the generative stage at 50% silking (R1) with the appearance of the ear. The growth dynamics of the Dessert R78 hybrid at mid-maturity were more pronounced.

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Determination of global warming potential from livestock enterprises

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Abstract

Today, with the increase in population, livestock activities based on animal products, which are one of the main food sources, are also increasing. With the increase in livestock activities, the amount of animal waste is also increasing. In this context, manure and waste management also gains importance. Livestock activities are also the most important source of greenhouse gas emissions. In this study, the global warming potential arising from enteric fermentation and manure management of livestock enterprises in Ardahan province was determined using the Tier-1 method defined by the IPCC. The obtained results were compared with the literature on the subject and necessary calculations were made. The data of the Turkish Statistical Institute for the years 2016-2020 were used in the study. As a result of the research, it has been calculated that the global warming potential of Ardahan province is 2844,9519x103 tons of CO_2. It has been determined that the global warming potential arising from the presence of dairy cattle in the research area has the greatest effect with a total of 2010.82x103 tons of CO_2, and the global warming potential arising from the presence of broiler chickens has the least effect with 0.01x103 tons of CO_2. It has been observed that the livestock activities carried out in Ardahan province have a great impact on the global warming potential and solutions to prevent global warming have been given.

Keywords: Livestock, Manure, CO_2, Global warming

Introduction

Due to the large amount of CO_2 released in the combustion of fossil energy, CO_2 emissions are considered to be one of the main drivers behind global warming. Although air pollutants (NO and SO_2) have local effects, CO_2 emissions cause problems on a global scale and the social costs of global warming accrue internationally over time (Friedl and Getzner, 2003). Especially in recent years, air pollution and global warming, which have emerged with the deterioration of the ecological balance, have become important issues that have started to be discussed both among researchers and social platforms. The Kyoto Protocol, signed in 1997, is seen as a very important step on the subject for the signatory countries. These countries

have decided to work to reduce the emission of carbon dioxide and all gases that cause the greenhouse effect. The most important purpose of the protocol is to keep the temperatures thought to increase due to global warming at normal levels and to ensure that the climates are lived in their natural order (Zeren, 2015). However, it is seen that greenhouse gas emissions are on a worldwide increasing trend despite the internationally binding joint efforts such as the Kyoto Protocol (Friedl and Getzner, 2003). The main greenhouse gases that affect global warming can be listed as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). The impact of human activities on global warming in the IPCC 2006 (Anonymous, 2006a) guide; Energy, Industrial Processes and Product Use, Agriculture, Forestry and Other Land Use and Waste are specified under the titles (Anonymous, 2006b). The share of agricultural production in total greenhouse gas emissions is between 10-12% (Tubiello et al., 2013). Competition in the use of limited resources such as land, water and energy in livestock enterprises has increased and emissions during all production stages have serious effects on air, water and soil ecosystems (De Vries and De Boer, 2010).

These emissions cause various environmental problems such as global warming, eutrophication, acidification, energy use, ozone formation effect, terrestrial toxicity, biotic and abiotic degradation on the natural environment (González-García et al., 2014, Leinonen et al., 2014, Cesari et al., 2017).

Global warming, which is the most important of these environmental problems, threatens the future of our world and the destruction of resources directly or indirectly. Global warming; greenhouse gas emissions (mainly carbon dioxide, methane and nitrous oxide) that mostly occur as a result of human activities cause an increase in temperature on the world. The concept of carbon footprint has emerged in order to determine the effects of emissions resulting from anthropogenic activities on global warming. Carbon footprint; It is the measurement of greenhouse gas emissions from anthropogenic activities in terms of carbon dioxide equivalents. Tier 1, 2 and 3 methods have been developed to measure greenhouse gas emissions by the International Panel on Climate Change (IPCC) (Anonymous, 2006b).

The aim of this study is to determine the global warming potential arising from animal enterprises in Ardahan province. In this context, enteric and fertilizer CH_4 emissions from animal farms were calculated using the Tier 1 method, and their global warming potentials were determined by CO_2 (carbon dioxide) equivalence.

Material and Method

The research covers the province of Ardahan, which is located in the Eastern Anatolia Region (Figure 1). In choosing the province of Ardahan as the study area, the fact that the province has a high capacity in terms of animal wealth and its geoFigureical location were taken into account. In the study, the data of the Turkish Statistical Institute for the years 2016-2020 were taken into account for the numbers of dairy cattle, beef cattle, buffalo, horses, donkey-mules, sheep, goats, broilers, laying hens, turkeys, geese and ducks in the province of Ardahan.

Located in the northeast of Anatolia, Ardahan Province is surrounded by Georgia and Armenia in the northeast, Kars in the south and southeast, Erzurum in the southwest and Artvin in the west. It has important passages and straits opening to Oltu, Batumi, Artvin, Ahıska and Kars. Due to the high altitude of the region and the variability of the surface shapes, the continental climate is dominant throughout the province. Winters are long, harsh and snowy. In the province, which has an altitude of 1,829 m from the sea and 211 km from the sea by road; It is seen that the temperatures that can go up to the highest 31.4 ^{o}C in the summer, decrease to -23.2 ^{o}C in the winter (Anonymous, 2021a).

Figure 1. Location of the research area

In the study, enteric and fertilizer CH_4 emissions in existing enterprises were calculated using the Tier 1 method in the Intergovernmental Panel on Climate Change (IPCC) 2006 guideline (Dong et al., 2006). While calculating the emissions of CH_4 and CO_2, which are the greenhouse gases of animal origin, the global warming potentials of these gases are taken as 21 and 1 as carbon dioxide equivalent, respectively (Dong et al., 2006; Anonymous, 2014).

Ersoy (2017); In his study, when the way of storage of animal manures in Turkey is examined, he stated that our country is among the more developing countries in terms of manure management compared to developed countries. In this context, values in this category for Turkey have been taken into account in order to be used in emission calculations in the Tier 1 method.

Methane emission calculations cover the calculations of $_{CH4}$ emissions from both enteric fermentation and fertilizer management in the light of the IPCC 2006 (Anonymous, 2006a) guideline.

Tier 1 Method for Direct CH4 Emission:

In line with 2019 TUIK data, the average milk production amount of dairy cattle was calculated as 3158 kg animal^{-1} year^{-1}. According to the IPCC 2006 (Anonymous, 2006a) guideline, the average milk production for the Eastern European country category is 2550 kg animal^{-1} year^{-1}. Within the scope of these values, Turkey was evaluated in the category of Eastern European country.

CH_4 emissions resulting from enteric fermentation caused by animals digesting feeds in enterprises were calculated with Equation (1) (Dong et al., 2006; Ersoy, 2017; Yaylı and Kılıç, 2020).

$$\mathbf{CH_{4Enteric} = EF(E) \times (N(T)/106)} \quad (1)$$

Here;

$CH_{4Enteric}$=Methane (CH_4) emissions from enteric fermentation (103 tons CH_4 year^{-1})

EF(E) = Emission factor determined according to animal species (kg CH_4 animal^{-1} year^{-1}) (Table1)

N = Number of Animals

T = Animal type/category

Table 1. Enteric fermentation emission factors (Anonymous, 2006a).

Animal breed	Emission factor (EF) kg CH_4 animal^{-1}year^{-1}
Dairy cattle	99*
Other cattle	58*
Buffalo	55
Sheep	5
Goat	5
Horse	18
Donkey and Mule	10
* Eastern European country values were taken according to the IPCC 2006 guideline	

Poultry were not taken into account in the calculation of CH4 emissions from enteric fermentation.

Methane Emission Calculation Method in Manure

CH4 emissions resulting from manure management in enterprises are calculated with Equation (2) (Anonim, 2006a).

$$CH_{4Manure} = (EF_{(G)} \times N_{(T)}) / 10^6 \quad \textbf{(2)}$$

In equality;

$CH_{4Manure}$ = CH_4 emissions from manure management (10^3 tons CH_4 $year^{-1}$)

$EF_{(G)}$= Manure management CH_4 emission factor (kg CH_4 $head^{-1}$ $year^{-1}$)

N = Number of Animals

T = Animal breed/category

According to the Tier 1 method in the calculation of CH_4 emissions from fertilizer management, the emission factor depends on the physical (indoor or outdoor) and temperature conditions of the place where the fertilizers are stored or stored. In the IPCC 2006 (Anonymous, 2006a) guideline, it has been determined that more than two-thirds of cattle manure is stored in the form of solid storage in grassland-grassland areas, in the characteristic manure management features of the Middle East country category for methane emissions from manure management (Ersoy, 2017). In this context, Turkey has been evaluated in the category of Middle East country in the emission values arising from fertilizer management.

Emission factor (EF(G)); it depends on the type of animal and the temperature conditions in which the animal is found (Table 2). In order to calculate the emission value from manure management, the data of the General Directorate of Meteorology was used, and the average temperature of 3.6 °C, which is the last 62 years (1958-2020) temperature data of Ardahan province, was taken into account (Anonymous, 2021b).

Table 2. Manure management methane emission factor varying with temperature values for Tier 1 method (Anonymous, 2006a).

Animal breed	Emission factor (EF) kg CH_4.animal^{-1}yıl^{-1}
	<15°C
Dairy cattle	2
Other cattles	1
Buffalo	4
Sheep	0.1
Goat	0.11
Horse	1.09
Donkey and Mule	0.6
Broiler	0.01
Laying hen	0.01
Turkey	0.01
Gooes+Duck	0.01
* Eastern European country values were taken according to the IPCC 2006 guideline	

Numerical data showing the change in CO_2 emissions of Ardahan province were colored according to class values and interpreted on the maps created in the ArcGIS program on a yearly basis.

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The animal presence of the province of Ardahan for the years 2016-2020 are given in Table 3.

Table 3. Animal presence in Ardahan province 2016-2020

Animal breed		Years					Sum
		2016	2017	2018	2019	2020	
Animal Numbers	Dairy cattle	170742	175888	185150	211084	205199	948063
	Other cattles	132838	113905	121758	137794	124952	631247
	Buffalo	39	22	17	17	17	112
	Sheep	69084	59218	71476	95468	90766	386012
	Goat	3652	1696	2762	3772	4041	15923
	Horse	7904	3570	3395	3438	2216	20523
	Donkey and Mule	344	327	305	328	285	1589
	Laying hen	149451	119743	113098	142282	135870	660444
	Turkey	17220	12297	9764	14216	12824	66321
	Gooes+Duck	118970	78525	80433	106738	79550	464216
	Broiler	0	0	2119	0	0	2119
	Sum	499502	565191	590277	715137	655720	**3025827**

When the animal presence of Ardahan province is examined, it is seen that the lowest animal presence was reached in 2016 and the highest animal presence in 2017. It is seen that dairy cattle constitute 34.18% of the animal assets in 2016 and 29.52% of the animal assets in 2017.

It can be mentioned that the widespread production of cheddar cheese in the province has an effect on the fact that dairy cattle have the largest slice of animal assets. However, in the high number of goose and duck compared to meat chicken; In particular, the effect of the goose being another source of livelihood and food in the province can be mentioned. In Table 4, CH_4 emissions resulting from enteric fermentation caused by ingestion of feed by animals in the research area are given.

Table 4. CH_4 emissions from enteric fermentation in the research area (10^3 tons CH_4 $year^{-1}$)

Animal breed		Years					Sum
		2016	2017	2018	2019	2020	
Enteric fermentation (10^3 ton CH_4.$year^{-1}$)	Dairy cattle	16,903	17,413	18,330	20,897	20,315	93,858
	Other cattles	7,705	6,606	7,062	7,992	7,247	36,612
	Buffalo	0,002	0,001	0,001	0,001	0,001	0,006
	Sheep	0,345	0,296	0,357	0,477	0,454	1,929
	Goat	0,018	0,008	0,014	0,019	0,020	0,079
	Horse	0,142	0,064	0,061	0,062	0,040	0,369
	Donkey and Mule	0,0034	0,0033	0,0031	0,0033	0,0029	0,016
	Sum	25,1184	24,3913	25,8281	29,4513	28,0799	**132,869**

It is observed that the CH_4 emissions resulting from enteric fermentation in the research area have been calculated as 132,869 103 tons of CH_4 at the end of 5 years. As a result of the calculations, it is seen that 70.64% of CH_4 emission originating from enteric fermentation in Ardahan province originates from dairy cattle, 27.55% from other cattle and 0.0045% from buffaloes. Poultry presence was not taken into account in CH_4 emissions from enteric fermentation. Considering that poultry constitutes 39.43% of the total animal wealth in the research area, it can be said that the necessity of taking poultry into consideration in determining the global warming potential of Ardahan province and calculating the CH_4 emissions resulting from manure management come to the fore. In Table 5, CH_4 emissions from the manure management of animal enterprises in the research area are given.

Table 5. CH_4 emissions from manure management in the research area

Animal Breed		Years					Sum
		2016	2017	2018	2019	2020	
CH_4 manure (10^3 tons CH_4 $year^{-1}$)	Dairy cattle	0,341	0,352	0,370	0,422	0,410	1,895
	Other cattle	0,133	0,114	0,122	0,138	0,125	0,632
	Buffalo	0,0002	0,00009	0,00007	0,00007	0,00007	0,0005
	Sheep	0,007	0,006	0,007	0,010	0,010	0,04
	Goat	0,0004	0,0002	0,0003	0,0004	0,0005	0,0018
	Horse	0,009	0,004	0,0037	0,0038	0,002	0,0225
	Donkey and Mule	0,00021	0,000196	0,00018	0,000197	0,00017	0,000953
	Broiler	0	0	0,00002	0	0	0,00002
	Laying hen	0,0015	0,0012	0,0011	0,0014	0,0013	0,0065
	Turkey	0,0002	0,0001	0,00001	0,00014	0,00013	0,00058
	Goose+Duck	0,0012	0,0007	0,0008	0,0011	0,00079	0,00459
	Sum	0,49371	0,478486	0,50518	0,577107	0,54996	**2,604443**

When Table 5 is examined, it has been calculated that the CH_4 emissions caused by the fmanure management of the enterprises are 2.604443x103 tons of CH_4. In CH_4 emissions from manure management, as well as CH_4 emissions from enteric fermentation, the highest CH_4 emissions came from dairy cattle with 72.76%. Among poultry, it is seen that it originates from laying hens with 0.25%.

In various studies on farm animals, it has been stated that the greatest contribution to greenhouse gas emissions is caused by CH_4 formed as a result of enteric fermentation (Robertson et al., 2015; Buratti et al., 2017; Kılıç and Amet, 2017; Kiggundu et al., 2019; Yaylı and Kılıç, 2021). When Table 4 and Table 5 are examined together, it is seen that the results of the research show parallelism with previous studies.

The sum of CH_4 emissions caused by enteric fermentation caused by the animals in the study area digesting the feed and the CH_4 emissions caused by the manure management of the animal enterprises are given in Table 6.

Table 6. Animal origin CH_4 emission amounts in Ardahan province

Animal breed		Years					Sum
		2016	2017	2018	2019	2020	
Animal Origin CH_4 Emission Quantities (10^3 tons CH_4 $year^{-1}$)	Dairy cattle	17,244	17,765	18,7	21,319	20,725	95,753
	Other cattle	7,838	6,72	7,184	8,13	7,372	37,244
	Buffalo	0,0022	0,00109	0,00107	0,00107	0,00107	0,0065
	Sheep	0,352	0,302	0,364	0,487	0,464	1,969
	Goat	0,0184	0,0082	0,0143	0,0194	0,0205	0,0808
	Horse	0,151	0,068	0,0647	0,0658	0,042	0,3915
	Donkey and Mule	0,00361	0,003496	0,00328	0,003497	0,00307	0,016953
	Broiler	0	0	0,00002	0	0	0,00002
	Laying hen	0,0015	0,0012	0,0011	0,0014	0,0013	0,0065
	Turkey	0,0002	0,0001	0,00001	0,00014	0,00013	0,00058
	Goose+Duck	0,0012	0,0007	0,0008	0,0011	0,00079	0,00459
	Sum	25,61211	24,86979	26,33328	30,02841	28,62986	**135,47345**

In the sum of the values calculated in Table 4 and Table 5, it was calculated that the total amount of CH_4 emission of animal origin in Ardahan province for the years 2016-2020 was 135,47345x103 tons of CH_4, the highest amount of CH_4 emission was in 2019 and the lowest amount of CH_4 emission was in 2016. It is seen that the highest effect on the amount of CH_4 emission is provided by dairy cattle and the least effect by meat chickens. The CO_2 equivalents of the animal-derived CH_4 emissions of Ardahan province are given in Table 7.

Table 7. CO_2 equivalents of animal sourced CH_4 emissions of Ardahan province

Animal breed		Years					Sum
		2016	2017	2018	2019	2020	
CO_2 equivalent (10^3 tons CO_2 $year^{-1}$)	Dairy cattle	362,12	373,07	392,70	447,70	435,23	2010,82
	Other cattle	164,60	141,12	150,86	170,73	154,81	782,12
	Buffalo	0,05	0,03	0,02	0,02	0,02	0,14
	Sheep	7,39	6,34	7,64	10,23	9,74	41,34
	Goat	0,39	0,17	0,30	0,41	0,43	1,70
	Horse	3,17	1,43	1,36	1,38	0,882	8,222
	Donkey and Mule	0,076	0,073	0,069	0,073	0,064	0,355
	Broiler	0	0	0,01	0	0	0,01
	Laying hen	0,032	0,025	0,023	0,029	0,027	0,136
	Turkey	0,004	0,002	0,0002	0,003	0,0027	0,0119
	Goose+Duck	0,025	0,015	0,017	0,023	0,017	0,097
	Sum	537,857	522,275	552,999	630,598	601,222	**2844,9519**

Considering the 5-year animal presence data of Ardahan province, it has been calculated that the global warming potential is 2844,9519x103 tons of CO_2. It has been calculated that dairy cattle have the highest impact on the global warming potential of Ardahan with 70.68%, and ducks and geese have the least impact with 0.003%. It is seen that the CO_2 emission, which was 552,999 103 tons CH_4 $year^{-1}$ in Ardahan in 2018, is 601,222 103 tons CH_4 year-1 in 2020. The numerical map of the CO_2 emission level for the years 2016-2020 is given in Figure 2.

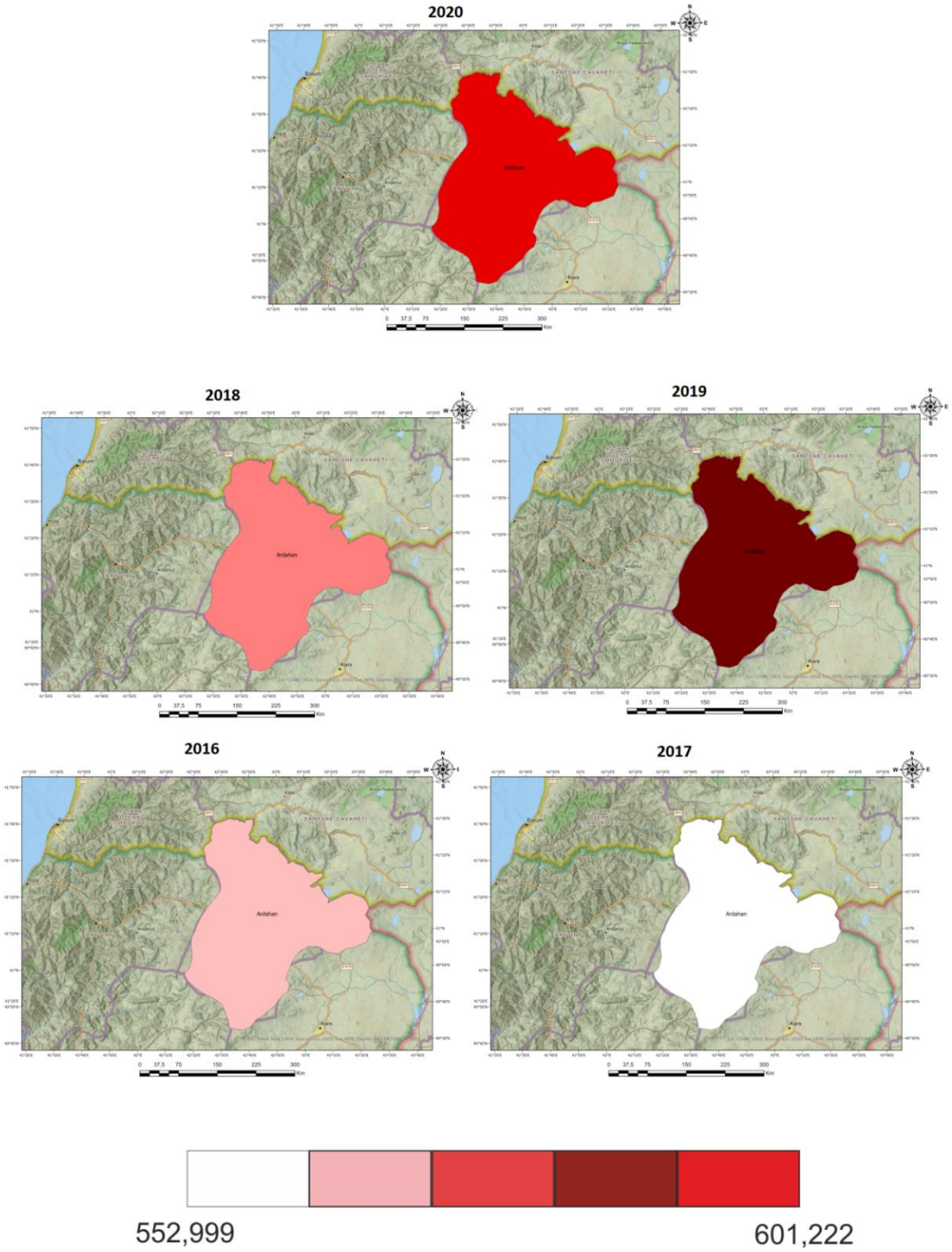

Figure 2. Change in CO_2 emission level of Ardahan province (10^3 tons CH_4 $year^{-1}$)

It is observed that the level of CO2 emission in 2017 was lower than the level of 2016, but the level of CO2 emission started to increase again as of 2017. It was determined that the lowest CO2 emission level was in 2017 and the highest CO2 emission level was in 2020.

The reason for fluctuations in CO_2 emission levels can be considered that manure management is not within the framework of a certain standard and the number of animal assets varies annually.

Conclusions

Animal husbandry activities have a great importance in Ardahan province. Therefore, the effect of global warming that may occur as a result of these livestock activities cannot be ignored. It has been determined that the global warming potential of livestock enterprises in Ardahan province is 2844,9519x103 tons of CO_2 in total. Total CH_4 emissions were determined to be 135,47345x103 tons of CH_4, however 132,869 x103 tons of CH_4 constituting 98.08% of these CH_4 emissions were enteric CH_4 and 1.92% of these CH_4 emissions were 2,604443 x103 tons CH_4 resulting from fertilizer management. As a result of the research, it is seen that enteric CH_4 constitutes a large part of the total CH_4 emissions. For this reason, it is thought that CH_4 emissions can be controlled by choosing silage feeds in feed selection and adding minerals and vitamins in silage feeds. In order to reduce and control manure-based CH_4 emissions, manure and waste management systems must be modernized and implemented within certain standards.

Future generations need a clean and green environment to live a quality life. For a green environment, we believe that CH_4 emission values should be minimized and this awareness should be spread. The dissemination of this awareness will contribute to both reducing global warming in the long run and bringing an environmentally friendly waste management approach to the fore. As a result, it was concluded that these solution proposals in order to reduce the greenhouse gases originating from livestock should have validity for the whole of the enterprises, not for some of them.

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An innovative feasibility example with the role of the code of good agricultural practices in climate change and conservation of water resources

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Abstract

As a result of the increase in the concentration of greenhouse gases due to the activities of our people that threaten our world, 'global warming' has begun to manifest itself in different forms in different places. This situation is one of the most important problems. The effects of global warming and natural variability in the climate are inevitable on the following areas; Water resources, which are indispensable for nature, especially in agriculture, food production and health, industry and sustainable ecosystems. The importance of water management is increasing because with the impact of global warming on water resources, many areas of the earth will face the risk of desertification. Global climate change is reaching dimensions that prevent sustainable ecology. Because global climate change is increasing temperatures. As the increase in temperatures will increase the frequency and severity of disasters, water resources decrease as a result. Our water resources are very important for sustainable ecology. In order to protect the natural ecological balance and to ensure the sustainable development of humanity, first of all, water resources must be managed in a balance between protection and use. Climate change must also be tackled so that the impact of global warming on water resources can be reduced.

The Code of Good Agricultural Practices, which aims the sustainability of agriculture with the use-protection balance of the environment and natural ecological resources, together with nitrate and food safety in waters, is included in this statement. Because the purpose; It is to explain the role of the Good Agricultural Practices Code in the protection of climate change and water resources by presenting an innovative feasibility example. An 'Environmental Sustainability Analysis' was carried out according to the Good Agricultural Practices Code and an innovative feasibility example was given by revealing ecosystem services. Issues on which Environmental Sustainability Analysis was made; Especially in the Küçük Menderes Basin, where mixed agricultural activities in our country are intense, it is the protection of water resources against pollution caused by livestock enterprises and the fight against climate change. In addition, applications that can contribute to this struggle are also mentioned. In this study, it is emphasized that the "Code of Good Agricultural Practices" and the "Protection-use balance process of natural resources" should be a sustainability tool in terms of the effects of mixed farming livestock enterprises on global warming and water resources and the precautions to be taken.

As a result, the infrastructure of livestock enterprises within the scope of micro planning was examined according to the Good Agricultural Practices Code, and it was

revealed that the results would be beneficial at different scales within the framework of culture-technical engineering and an example innovative feasibility study.

Keywords: Sustainable agriculture, nitrate pollution, farmyard manure, good agriculture practices code, climate change, feasibility.

Introduction

Today, although the ecological problems in the ongoing rural area are numerous, the unplanned rural built environment brings with it the main problems such as the pressure exerted by the urban population growth on agricultural lands, the need for food, conventional agriculture and livestock activities, fossil fuel energy and environmental pollution due to them. In our country, modern practices have become widespread instead of traditional agricultural practices. This situation has led to an improvement in farmer incomes due to the increase in agricultural productivity. However, it is a big problem that agricultural waste management is not done properly in modern agricultural practices. Researches reveal that 90% of medium and large-scale enterprises (producing 3500 kg or more nitrogen per year) have fertilizer management system design and facility, not in compliance with the standards, and fertilizer management practices in the field and similar problems exist (Çardakçı., 2020). These problems cause nitrate pollution in waters by causing both direct (enteric fermentation-induced) and fertilizer management-related emissions to increase each year, as well as the leaching of the nitrate in the fertilizer, especially due to the chemical properties of the fertilizer, by precipitation and other factors (Atılgan, 2013).

Therefore, the duty of producers today is to protect and develop the environment and cultural heritage together, as well as increasing production. In order to solve the problems and ensure the continuity of the appropriate activities, it is important for the farmers to apply the relevant regulations called "Sustainable Agricultural Practices". In response to these regulations in our country, the “good agricultural practices code” prepared in accordance with Article 7 of the Regulation on the Protection of Water Against Nitrate Pollution from Agricultural Origin published in the Official Gazette dated 23/7/2016 and numbered 29779, provides agricultural methods and practices for farmers to prevent water pollution originating from agricultural activities. It includes some method applications to minimize the risk of nitrate pollution in waters. Sustainable agricultural practices for the pollution of water resources within the scope of micro-planning of the agricultural enterprises in question should

be based on the management of nitrate pollution in waters. Code implementations are in a perspective that reveals effective and appropriate ecological methods to evaluate the agro-ecosystem and are of critical importance in terms of reducing the degradation caused by agricultural activities.

In this context, the elimination of these aforementioned problems often requires sustainable agricultural practices such as good İTUK (Good Agricultural Practices Code) as well as micro-planning based on cultural and technical science with a comprehensive ecological approach. The concepts of ecosystem and sustainability, which are in the working phases of ecology science, can be discussed in the planning and implementation processes of the ITUK in the solution of these problems. One of the concepts that will help in determining the boundaries of these concepts is the "hierarchy order" used in biology. The systems in which both living and non-living elements are present are called biosystems. Biosystems start from genetic systems and gradually progress to the landscape level and from there to the ecosphere level in a hierarchy order. The stages of the hierarchy order in biology are listed as cells, tissues, organs, organ systems, organisms (living individuals), populations, communities, ecosystems, landscapes, biomes, and ecospheres (Odum and Barrett 2008). In this case, ecological sustainable agricultural planning and management includes the management of different ecosystems, the functional analysis and analysis of the relations between ecosystems and ecosystem services. Ecosystem services are defined as the services provided by the natural environment and used by people. Although there are different methods in the classification of ecosystem services, the most widely accepted classification is as follows within the scope of the Millennium Ecosystem Assessment (MEA); Food & Beverage Services; Food, fibrous products, clean water, etc. products obtained from ecosystems. Regulatory Services; Benefits derived from regulating ecosystem processes, such as regulating the climate or water resources. Cultural Services; Intangible benefits of ecosystem services related to recreation and spiritual rest. Support Services; Biomass production, oxygen supply, soil formation and protection, water cycle are essential elements that are vital for the continuity of human life and other ecosystem services (Anonymous, 2011/c)

As a result of the inadequacy of traditional agricultural approaches in solving these environmental problems, it has come to the fore that studies on ecosystem services are important. Because, with the implementation of sustainable agricultural methods and cultural-technical measures in rural areas with an ecologically-based agricultural planning approach,

the potential of "ecosystem services" increases, contributing to both productivity increase and reduction of environmental pollution, such as nitrate and greenhouse gas emissions originating from livestock.

In this study, fertilizer management infrastructure, nitrate pollution in waters, greenhouse gas emissions and environmental sustainability in medium and large-scale cattle farms in İzmir's Ödemiş District, which has a high livestock potential, were analyzed; An example of a sustainable infrastructure feasibility that reduces nitrates and emissions is given for these enterprises. In line with the purpose of the study, some eco-innovative feasibility studies and suggestions have been made regarding the use of rural infrastructure for sustainable livestock breeding and the use of the ecosystem in the planning and implementation process of the Code of Good Agricultural Practices against nitrate pollution and greenhouse gas emissions in waters in Turkey.

Since the aim of this study is to carry out the sustainability analysis of water pollution from livestock and carbon footprint management according to the Good Agricultural Practices Code, the "rules within the scope of the Code of Good Agricultural Practices" given in the above paraFigure have been fully examined within the framework of sustainable environment-oriented vegetative measures and fertilizer management. The necessity and applicability of starting a pilot basin on the basis of good practice models were discussed. The current situation was evaluated and suggestions were made.

Materials and Methods

As the project material, cattle breeding enterprises operating in the districts of Bayındır, Beydağ, Kiraz, Menderes, Ödemiş, Selçuk, Tire and Torbalı, which are located in the Küçük Menderes Basin of İzmir Province, producing nitrate of 3500 kg/year and above, were selected. The study was carried out within the scope of 2627 cattle breeding farms (Table 1).

Table 1. Number of businesses selected for the project in Districts in Küçük Menderes Basin

DISTRICT DISTRIBUTION OF CATEGORIZED LIVESTOCK FACILITIES PRODUCTION OF 3500 KG AND OVER NITROGEN IN KÜÇÜK MENDERES BASIN								
Bayındır	**Beydağ**	**Kiraz**	**Menderes**	**Ödemiş**	**Selçuk**	**Tire**	**Torbalı**	**TOTAL**
380	40	313	68	450	6	550	79	**1886**

The bovine structure in these selected enterprises, the manure management infrastructure related to them, and the ecosystem services used for vegetative protection and measures constitute the material of the study.

The research was carried out in three stages: selection of cattle breeding enterprises, field studies and office studies. In this study, sustainability analysis will be made according to the Code of Good Agricultural Practices for the management of water pollution originating from livestock. In addition, greenhouse gas emissions produced as a result of cattle breeding activities in the basin were calculated according to IPCC Guidelines. In this analysis, the infrastructure of livestock enterprises, which are agricultural enterprises that form the basis of rural physical existence, has been examined according to the Good Agricultural Practices Code, and it is aimed to explain the ways of sustainable strategic spatial planning of the results according to the ecological planning approach and culture-technical engineering.

Evaluation of the results, the "rules within the scope of the Good Agricultural Practices Code" were completely examined within the framework of sustainable environment-oriented vegetative measures and fertilizer management; The necessity and applicability of starting a pilot basin with ecosystem services models that are examples of good practice were discussed. A sample eco-innovative feasibility study was given by evaluating the current situation and some suggestions were made.

Research Findings and Assessment

In the study, livestock and related agricultural activities in Küçük Menderes Basin will be discussed together with ecosystem services in the perspective of sustainable agriculture and Good Agricultural Practices Code. Sustainable agricultural practices in the basin and the factors that risk sustainable agricultural activities and provide spatial sustainability will be examined and the integrity of the subject will be tried to be achieved. In this section, the adequacy of the findings on the effects of vegetative methods (mulching, good agricultural practices, erosion, legume cultivation, crop rotation, etc.) and ecosystem services on environmental pollution and their compliance with the Code of Good Agricultural Practices in the mixed livestock farms where the research was carried out are discussed. Accordingly, the infrastructure of livestock enterprises, which are among the agricultural enterprises that form the basis of the rural physical existence, are examined within the scope of the Good Agricultural Practices Code within the scope of micro planning, and it is aimed to evaluate the

ways of ecosystem services within the framework of cultural-technical engineering with the sustainability approach of the results.

In order to calculate the total nitrogen production that may pose a risk to water resources due to mixed livestock breeding in the examined enterprises, the total nitrogen production (kg/year) of the enterprise was found after the number of animals was learned from the field and their breakdown was given in Table 2.

İzmir is very suitable for animal husbandry in terms of natural resources and ecological conditions. However, low productivity and living conditions prevail in rural areas as a result of factors such as insufficient use of technology and basic inputs, poor land distribution and no or lack of rural infrastructure. Elimination of this situation often requires a "Rural Settlement Arrangement" with a comprehensive ecological planning approach. Considering the most important problem in these rural settlements, which is also seen in İzmir in general, according to the research findings; The risk of nitrate pollution and greenhouse gas emission in waters originating from animal production is very high, since approximately 95% of animal production structures do not have a sealed storage facility of appropriate quality and size, which was built considering both the location and distribution problem and the annual amount of nitrogen produced.

Table 2. Annual Nitrogen Amount and Affecting Factors in the Enterprises in the Research Area

İLÇE	**Project Site Annual Nitrogen Amount and Affecting Factors**				
	Bovine Business Asset	**Numbers of Bovine Animal Units (BBHB)**	**Annual Nitrate Quantity**	**Number of Businesses with Fertilizer Storage**	**Businesses Providing Ecosystem Services with ITUK**
Bayındır	380	46.867,84	3.304.186,30	4	Yok
Beydağ	40	3509	245.654,50	2	Yok
Kiraz	313	30034,75	2.102.433	4	Yok
Menderes	68	1062,7	893761,4	5	Yok
Ödemiş	450	94878,28	6641480	10	Yok
Tire	550	57011,32	3990792	2	Yok
Torbalı	79	13300,82	931057,4	23	Yok
Selçuk	6	1205,2	84.364	5	Yok
GRAND TOTAL	**1886**	**247.869,91**	**18.193.728,60**	**46**	**-**

This situation is classified as a physical problem in rural settlements and requires the Planning of Animal Farms (operation yard). However, in order to prevent and protect nitrate and methane gas pollution, it is necessary to establish an animal production structure by taking into account the flow diagram of manure management.

The potential solution for nitrate methane gas pollution caused by manure management, which is in this physical problem class in livestock; In addition to cultural and technical engineering, which is technical studies based on engineering knowledge and agricultural culture in this square, with vegetative measures (raising crops by protecting the soil by increasing the potential of regulating ecosystem services on sloping lands, embankments and terracing, plant fences, ditches and pits, mulching with stones, mixed planting and planting shade trees, planting fields. plowing parallel to the slope and planting the plants in the same way reduces erosion compared to planting vertically. Mixed sowing and alternation of grains with legumes restores soil fertility and reduces the need for artificial nitrogen fertilizers. Mulching the soil and adding compost and animal manure to the soil enrich the soil in terms of nutrients and organic matter; supports earthworms and other earth life. Lime scale lowers the acid level. When it comes to vegetative measures, it appears as a "code of good agricultural practices" that includes improvement practices (stopping the flow of water by planting grass, bushes or trees, holding the soil and slowing down the speed of the wind).

The Sustainable Fundamental Principles of the Code are also given below.

All animal manures (solid manure, liquid manure, and slurry/slurry) and liquid waste should be collected and stored in a safe place until applied to the field by making comprehensive sustainable Manure Management Plans in livestock enterprises. In addition, the spread of greenhouse gases and other pollutants from all animal manures, liquid fertilizers and chemical fertilizers to be applied to the soil should be prevented. In other words, taking into account the annual fertilization plan produced in these enterprises, a sealed storage facility of appropriate quality and size should be built or arrangements should be made for the maturation or application of animal manure in order to safely transport and store against methane gas and other greenhouse gas emissions and evaluate it as fertilizer. Mass ripening is carried out by two methods as hot and cold. While greenhouse gases are emitted at a lower rate with these animal manure evaluation methods, these methods also increase the level of utilization of organic farm manure in the soil. Because the animal manure warehouse should be built in a way that keeps its pollution to a minimum.

The establishment of enactment and pilot studies on the basis of participation by the public for an innovative eco-model for a functional livestock farm that enables the pilot-qualified sustainable compost management for the implementation of the strategic objectives to be determined by the sustainable spatial strategic planning proposed for the rural area in İzmir, and the continuity of the appropriate ones with updates should be applied in an appropriate manner. In this context, the study on the structure and feasibility of the model of the proposal for an innovative fertilizer management system, which will shed light on the livestock enterprises in the transition to the sustainable agriculture model, is given in the section below.

Conclusion and Recommendations

As the effects of global warming and climate change, which are among the most discussed issues and environmental problems experienced in the world public opinion in recent years, are observed, the interest of human beings is increasing and threatening humanity. Global warming is an important problem that disrupts the balance of nature and poses a threat to the life of all living things, and it requires taking the necessary measures as soon as possible to protect the continuity of the living life of nature.

The results of the research show that the İTUK (Good Agricultural Practices Code) includes almost all the measures that should be taken in terms of environmentally sustainable agriculture in adaptation and struggle with climate change, but it is not enough for these measures to be taken and adopted by the producers in terms of obligations.

In addition to being an agricultural method for the safety of water resources against nitrate pollution, in order to make it useful for ecosystem services with environmentally sustainable practices such as adaptation and combating with climate change. It is important to review and revise the compliance levels of the İTUK criteria from year to year, and to impose a higher level application condition on the advisory criteria. The important step to be taken in this process is to increase the support and dissemination of exemplary feasibility projects for fertilizer infrastructures, to inspect livestock structures, to make producers work more meticulously on sustainable fertilizer management through training and innovative extension studies.

An Innovative Example of Sustainable Manure Management System and Feasibility Study

The proposed exemplary sustainable manure management system is planned for livestock enterprises with a cattle capacity of 3500 kg and above. The reason for this is that the livestock enterprises that produce 3.500 kg or more nitrogen per year, which is the target group of the project, are selected as an example for the transition to the sustainable agriculture model. In addition, Küçük Menderes Basin lands, which are within the project target area, have 74.8% of İzmir cattle assets. Because İzmir is very suitable for animal husbandry in terms of its geoFigureical location, natural resources and ecological conditions. When evaluated on the scale of the country, İzmir ranks 3rd after Konya and Erzurum provinces with 694,517 head of cattle.

This study covers an exemplary innovative fertilizer management system and its feasibility, for the greenhouse gas and nitrate pollution caused by livestock and the problems it causes in the transition to the aforementioned sustainable agriculture model. According to the Good Agricultural Practices Code, a planning is presented in which the environmental conditions of the shelter can be arranged according to the Code's predictions, taking into account the environmental effects of fertilizers.

The basis of the proposed manure management system is to ensure that the solid and liquid manures of the animals fall into the manure channels under the grating as a result of the gravitational force and the pressure effect of the animals while they are walking, from the grating spaces on the barn floor. In project scope; A plan has been made to ensure that the floors are kept dry and clean by using the "manure scraper robot" that can provide automatic cleaning of the floor in the grilled part of the barn floor at planned or optional times, and it is foreseen that this management system will set an example for the manufacturer and other relevant stakeholders. Thus, by ensuring barn hygiene, both raising herd individuals in a clean and healthy environment and methane gas emission will be reduced to a minimum. The manure poured from the grates or scrapers on the barn floor will be conveyed to the manure scraping band established between the barn floor and the ground, and from there to the manure storage structure, at regularly planned and regular intervals with hydraulic scrapers (Figure 2).

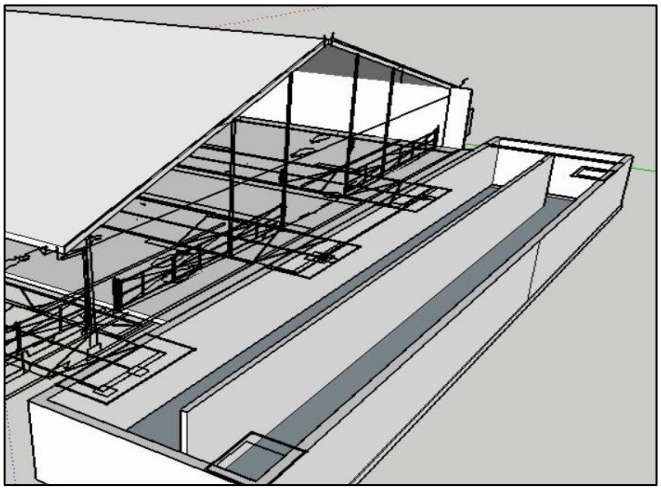

Figure 1. A perspective view of the grate manure management system in a dairy barn.

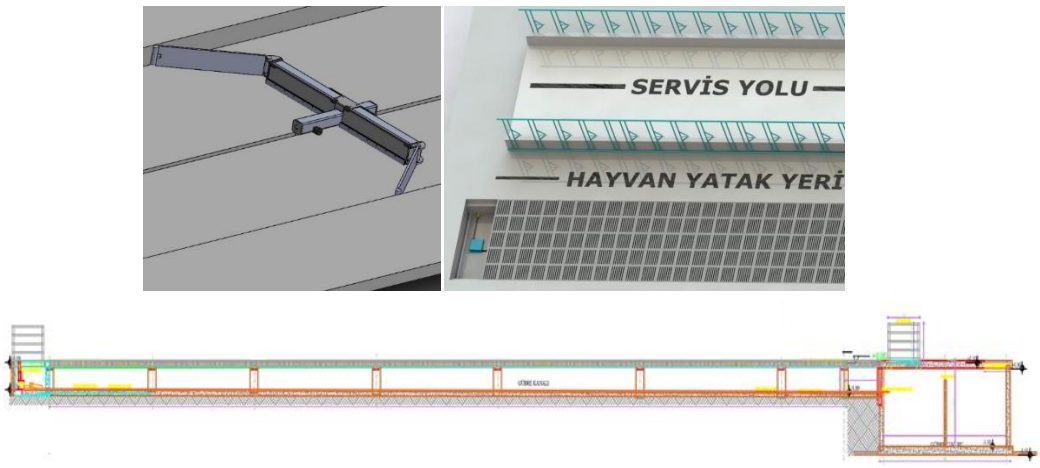

Figure 2. Schematic view of the manure stripping system and the warehouse.

Although grate-based systems are generally planned with liquid fertilizer management in mind, in fact, solid and liquid fertilizer management can be done simultaneously and together (Olgun, 2011). According to this, solid manure and liquid manure management systems will be used together in the manure cleaning application of dairy cattle barns, and it is essential that the under-grid channel in the system is established in such a way that it does not affect the carrier elements.

In the dairy cattle barn planned as the manure management infrastructure above, Çardakçı (2020), in his feasibility study, found that the "grid sustainable innovative dairy cattle investment" with in-house environmental control technology is more profitable than fixed capital investments in all areas in Turkey and the region, states that the payback period

is shorter and the return on investment is high on an annual basis. Considering these feasibility evaluations, the innovative grilled dairy cattle business enterprise with a sustainable product life cycle suitable for nitrate pollution management in waters in the transition to basin-based sustainable agriculture, especially in İzmir Province, is extremely important, correct and necessary as an example for other livestock enterprises. The benefit-cost ratio of the investment was found to be 2.19, the payback period was 3 years, and the profitability ratio was 306%.

Compared to the fixed capital investments in every field in Turkey and the region, the "innovative grilled dairy investment" is more profitable, has a shorter payback period and has a higher annual return on investment. When the feasibility results are shared with the public, it is expected that a large number of potential entrepreneurs will be willing to allocate and invest.

On the other hand, the appropriateness of the investment; The environment-focused innovative “Dairy Cattle” facility planned to be built in İzmir will be among the important investments in the region

In this way, strengthening the clean production infrastructure, providing more efficient and effective production, preventing methane gas and nitrate pollution in the agricultural sector, and indirectly ensuring denitrification in industrial products, increasing the quality and added value and improving the regional competitiveness, and the additional employment it will create, makes a significant contribution to the economic development. seen as an investment.

The following benefits will be provided by the realization of the investment:

1. To solve the employment problem of the region in the short term by developing the livestock sector,
2. Establishing a transition to sustainable farm model businesses together with environment-oriented animal husbandry, and spreading such businesses first in the province and then in the region,
3. Increasing the income of the farmers due to the increase in milk production,
4. Sustainable modern livestock techniques becoming applicable,
5. Collecting these enterprises under the roof of cooperatives and producer unions for sustainable purposes, and our farmers playing an active role in the sustainability of the organized structure.

Considering the whole of the study and the evaluations explained above, it is extremely important, correct and necessary to attempt to establish sustainable, innovative grilled dairy cattle farms suitable for nitrate pollution management in waters in the transition to basin-based sustainable agriculture, especially in İzmir Province, in order to set an example for other livestock enterprises.

According to the results of the research, it is clearly seen that 90% of the existing livestock enterprises in the basin have insufficient ecological assessments in spatial plans in terms of culture-technical infrastructure, geotechnics and technologies that do not pollute nitrate and methane gas, and that especially regulatory and supportive ecosystem services are reduced. As a result, it is of great importance to start studies to eliminate the lack of ecological assessments in the fertilizer infrastructure planning and management process in mixed enterprises, and to start the correction works for the integration of a culture-technical focused İTUK.

Accordingly, Çardakçi (2020) stated that in his feasibility project, the document, which is an application guide in which the project development process is explained within the framework of the integrated structure design approach in accordance with the code, which will be handled with the livestock building life cycle management, deals with the design processes within a general structure and many aspects of the process at the same time. states that it should be structured in such a way that Considering that the conditions we are in are constantly changing, this document should not be perceived as a finished and singular document, but should be seen as a renewable document that is open to changes, feedback, additions and deletions depending on technological and socio-economic developments (Fig. 3).

Even though the Code of Good Agricultural Practices recommends a fertilizer infrastructure that generally prevents greenhouse gas pollution in addition to nitrate, it should have a mechanism to prevent all agricultural pollution, and it will have both agrotechnical and cultural-technical features that can provide environmental sustainability conditions with the mentioned qualities.

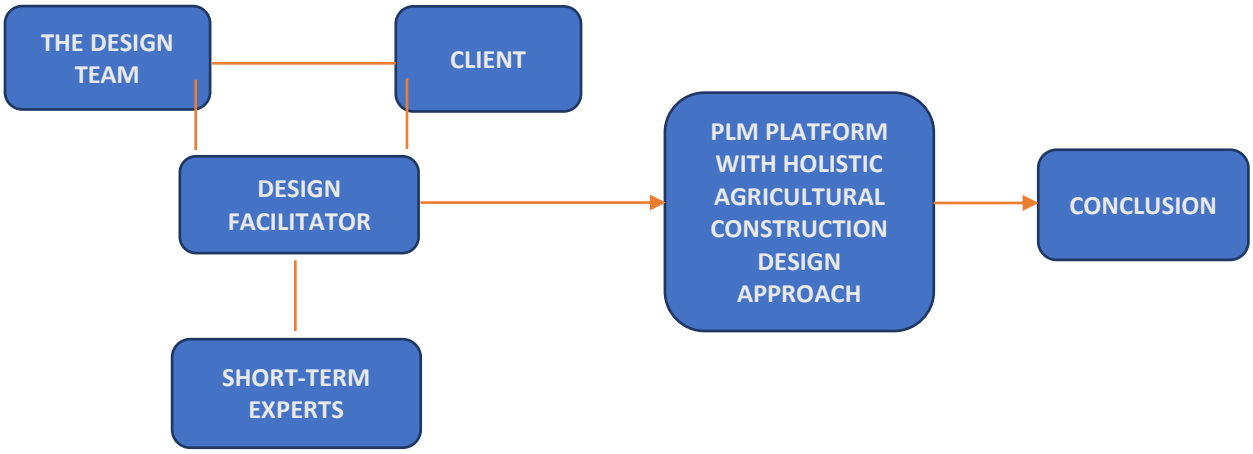

Figure. 3 Stages of the Integrated Agricultural Structure Design Approach

It is inevitable that global warming will affect water resources. Considering that the majority of people are suffering from water shortages today, it is seen how important the dimensions of the danger are.Water, which is the source of life, will become one of the most important problems of the world if necessary precautions are not taken against climate changes, water resources in arid and semi-arid areas will add to the problems and the need for water will increase.The first thing to be done against global climate change is the planned and efficient use of water resources.It is necessary to raise awareness of people in order to delay the effects of climate change by protecting the water balance and ecological balance in the world.

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Modeling of Iron removal from drinking water by using Gene-Expression Programming

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Abstract

The prime indicators of the water quality are ph value, electrical conductivity, suspended solids, turbidity and dissolved oxygen concentration etc. Aeration is the process by which the oxygen in the atmosphere is replenish into the water. Different hydraulic structures used for aeration process. Venturi is one of them. Iron is a heavy metal and can be found different concentrations in water. Iron can be oxidized from Fe^{+2} to Fe^{+3} form. This oxidation can be realized by venturi with aeration process. This paper is aim to generate a mathematical function to estimate the iron removal from drinking water. For this aim Gene Expression Programming was used. GEP is a new technique of genetic algorithm and genetic programming. This technique simulates biological evolution to develop a computer program encoded with linear chromosomes in fixed length. As a results R^2 value was obtained as 0.866. Therefore, it has been shown that the GEP method can be used to modelling the iron removal from water successfully.

Keywords: Venturi, iron removal, Gene-Expression programming (GEP).

Introduction

Many natural biological and chemical reactions occur in water. These reactions cause the dissolved oxygen concentration in the water to decrease. Oxygen is transferred from the atmosphere to the water to raise the dissolved oxygen concentration in the water. Because the dissolved oxygen concentration in the water is the most important parameter that determines the water quality. There are various hydraulic structures used to bring oxygen to the water [Yucel 2018]. With hydraulic structures, the transfer of oxygen to water can be achieved easily and it is more economical than aeration with different methods. In other methods, the electrical energy to be used to pump water and compressed air increases the operating cost.

Hydraulic structures such as venturi, weirs, water jets and conduits are actively used for aeration of waters [Yagci et al. 2020]. In this study, the iron removal performance of the venturi system from drinking water was investigated. The changes in the removal of iron from water depending on the aeration performance in venturis with different shrinkage rates were investigated. The measurements made in the laboratory environment were modeled with the Gene Expression Programming.

Venturi

Venturi is one of the aeration methods is popular. In the venturi, a narrowing is made in a throat area with a smaller cross-sectional area than the pipe section at the inlet. The reason for this is to increase the velocity of the liquid flow in the pipe (Fig. 1). In the contraction zone, there is a decrease in pressure in parallel with the increase in fluid velocity. Thanks to this pressure drop, air is injected through the intake holes and dynamically directed into the flow. As the jet stream spreads to the venturi tube outlet, the velocity drops and is converted to pressure energy (but at a lower level than the venturi tube inlet pressure)

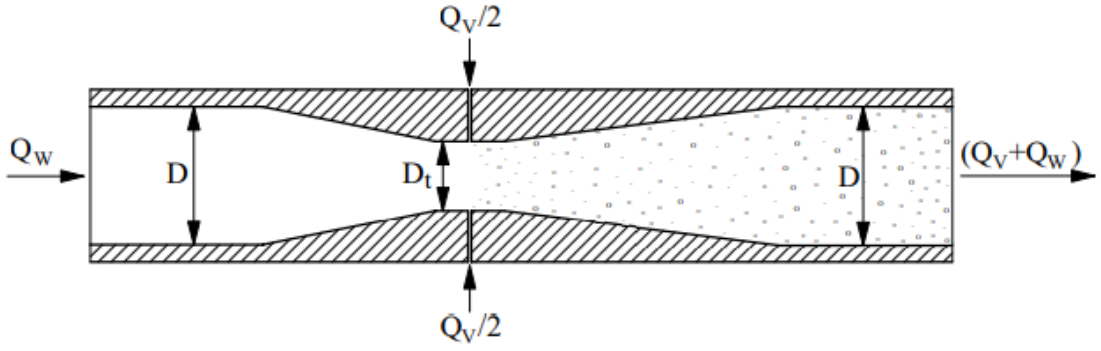

Figure 1. Venturi [Baylar et al. 2008]

Gene Expression Programming

Genetic algorithms and basic principles of genetic programming are used in Gene Expression Programming [Ferreira 2001]. Gene expression programming methodology uses character linear chromosomes that consist of genes structurally organized in a head and a tail. The problems are encoded in fixed-length linear chromosomes as a computer program. The gene consists of two parts, the head and the tail. The head of a gene contains the main variables used to encode any mathematical expression, such as some functions, variables, and constants. At the beginning of the gene are trigonometric and arithmetic functions (+, -, *, /,

sin, cos, tan). The tail contains variables and constants that may be required if the leading variables are insufficient to encode a function. In the tail are the constants and arguments of the problem. A mathematical function is defined as a multigene chromosome using GEP and is developed using the data available to it [Unsal et al. 2014].

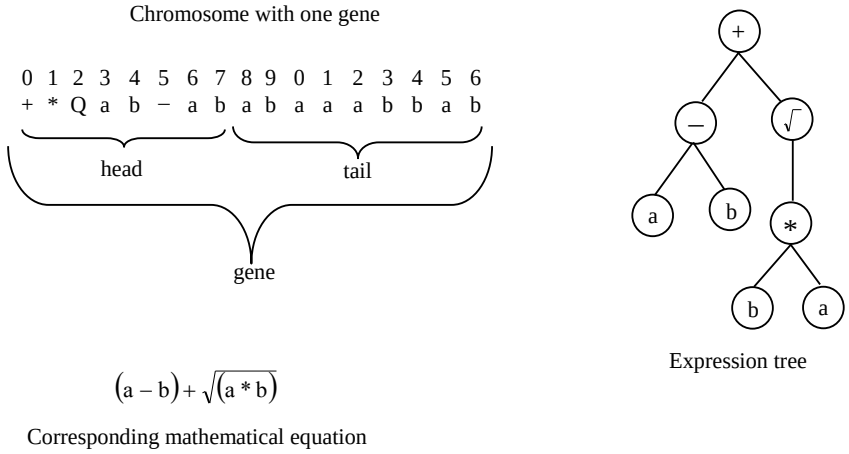

Figure 2. Schematic Indication of a Chromosome with One Gene and Its Expression Tree and Corresponding Mathematical Equation [Baylar et al. 2014]

Material and Method

In this study, the iron removal performance in the experiments performed depending Reynolds number and the contraction rate of the venturi were modeled with GEP. Equation was created with GEP. Reynolds number, venturi contractions rate are input parameters, iron removal is output parameter.

Results and Discussion

In the model combination created, the Reynolds number, the contraction rate of the venturi are the input parameters, and the iron removal is the output parameter. The formula of the combination, the R^2 value and the Figure are shown in the figure. The R^2 value of the model was 0.866. Accordingly, it has been shown that the GEP method can be used to modelling the iron removal from water successfully.

Equation:

$$Y = \left[Re^{6/5} - \frac{1}{Cos2Re} \right] + \left[\frac{1}{Cos\left[\sqrt[5]{\left(Re + \frac{DT}{D}\right) - \left(\frac{DT}{D}\right)^9} \right]} \right] + \left[e^{\sqrt[3]{(DT/D)}} \right]^{3/5} + \sqrt[3]{Re} \quad (1)$$

Y= %Fe (iron removal),

d0= Dt/D (The contraction rate of the venturi),

d1= Re (Reynold number),

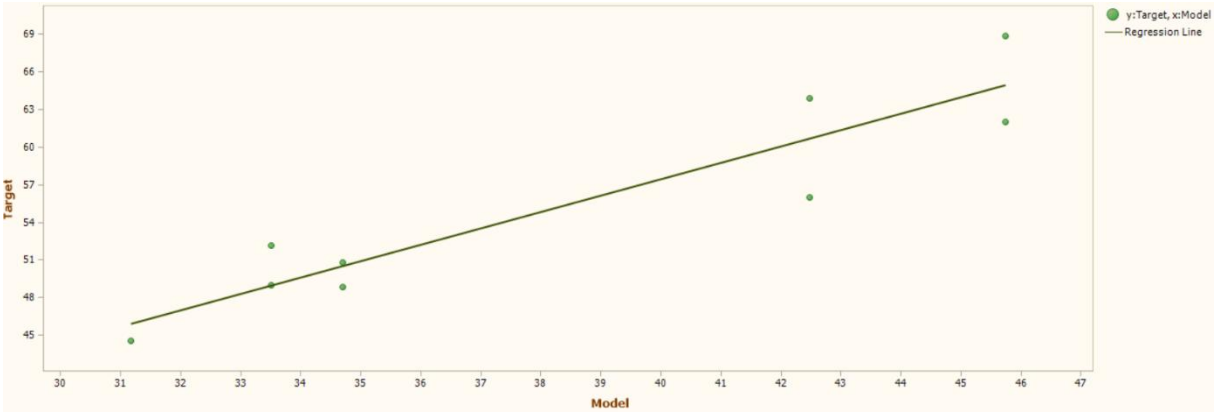

Figure 3. The predicted and measured iron removal value of GEP Model

Conclusion

In this study, the iron removal for drinking water was modeled using Gene Expression Programming. Dt/D= 0,5 and Dt/D=0,75 mm diameter venturi was used. A formulation was produced for the model result iron removal. An R^2 value of 0.866 was obtained. This article presents a viable approach to estimating the ratio of iron removal for different contraction ratio venturis with the model formula obtained using GEP. It has been observed that there is a concordance between the previous experimental results and the model results. As a result, it has been seen that the GEP method can be used in the estimation of the flow rate. In addition, it is seen that the mathematical formulas of the models developed with the GEP method can be obtained, and if new data are added, it can be applied in the estimation of the iron removal in future studies.

Acknowledgement

In this study, iron removal by venturi was modeled with GEP using the data obtained as a result of the study by Bozkurt, S. 2019.

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Distributed pollutant load calculation of animal wastes in Ardahan Province

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Abstract

With the rapid population growth, the demand for animal products is increasing. In this direction, with the increase in livestock activities, the amount of waste generated in livestock enterprises also increases. If these wastes are not stored properly, they reach water sources in the form of leakage and cause pollution of these sources. In this study, the annual distributed total nitrogen and total phosphorus loads were calculated by using the number of cattle, ovine and poultry in 2020 in Ardahan province. Total phosphorus load for Ardahan province as 231,089 TP/year and nitrogen as 2132,343 TN/year were calculated. However, it was determined that the highest total radiated nitrogen and phosphorus were in the Central district and the lowest dispersed load was in the Posof district. In order to prevent these wastes from polluting the ground and surface waters, it was concluded that the wastes should be kept in appropriate storage structures within certain standards and the standards on manure management should be implemented by all enterprises.

Keywords: Animal waste, Pollution, Nitrogen, Phosphor

Introduction

Rapid population growth, urbanization and technological developments in the world have brought various environmental problems to the agenda (Xiaoyan, 2005). In addition to these developments, the demand for animal products and livestock activities increased with the rapid population growth (Karaman, 2006).

As a result of livestock activities, a large amount of waste is generated. Solid and liquid wastes accumulating in these enterprises should be stored in suitable conditions so that they do not have a negative impact on nature (Atılgan et al., 2006). If the manure produced in animal enterprises is evaluated in an appropriate and controlled manner, it can be an additional source of income for the enterprise (Atılgan et al., 2015). In cases where the wastes generated in livestock enterprises are not stored under appropriate conditions, they may cause nature pollution (Çayır et al., 2012).

Orhon et al., (2002) grouped pollutant sources as point and diffuse sources. These sources are controlled, measurable point discharge and the source of the pollution mixed with the environment as point source and diffuse.

As a matter of fact, animal wastes, which are described as diffuse sources of pollution, mix with groundwater or surface waters, causing the quality of water resources to deteriorate or become unusable (Aydın and Derinöz, 2013; Yetiş et al., 2018).

Animal waste, which is one of the widespread sources of pollution, can pollute surface and underground water resources as a result of uncontrolled waste management. This event; Animals reach a water source directly, surface water flows from manure piles, shelters and open feeding areas, seepage from manure storage areas, flooding of storage areas, and surface water flows from fertilizer applied areas (Polat and Olgun, 2009).

Depending on the chemical properties of the nitrate in the fertilizer, washing it with the effect of precipitation and other factors causes nitrate pollution in the waters (Atilgan et al., 2013). The mixing of animal wastes into water resources during manure management reduces water quality and causes the death of aquatic life. Ammonia, pathogens and organic substances with biological oxygen values contained in waste cause water pollution (Saltuk et al., 2016). For this reason, animal manure should be kept in a way that does not cause environmental pollution by taking necessary precautions before applying it to the land (Karaman, 2006; Tırınk, 2021).

The aim of this study is to calculate the distributed total nitrogen (TN) and total phosphorus (TP) loads originating from animal wastes in Ardahan province and to raise awareness against the damage of these pollution loads to water resources and to offer solutions.

Material and Method

The research covers the province of Ardahan, located in the Eastern Anatolia Region (Figure 1).

Figure 1. Location of the research area

Located in the northeast of Anatolia, Ardahan Province is surrounded by Georgia and Armenia in the northeast, Kars in the south and southeast, Erzurum in the southwest and Artvin in the west. It has important passages and straits opening to Oltu, Batumi, Artvin, Ahıska and Kars. Due to the high altitude of the region and the variability of the surface shapes, the continental climate is dominant throughout the province. Winters are long, harsh and snowy. In the province, which has an altitude of 1,829 m from the sea and 211 km from the sea by road; It is seen that the temperatures that can go up to the highest 31.4 ^{0}C in the summer, decrease to -23.2 ^{0}C in the winter (Anonymous, 2021a).

In choosing the province of Ardahan as the study area, it was prioritized that the province has a high capacity in terms of livestock. Dairy cattle and beef cattle in Ardahan province as cattle; sheep and goats as small cattle; layer hen, turkey, goose and duck were accepted in the poultry category, and the data of the Turkish Statistical Institute for the year 2020 were taken into account. It was not included in the assessment because there was no presence of broiler chickens in the research area.

As a result of these data, the distributed pollutant loads that may arise from cattle, sheep and poultry in Ardahan province were also calculated.

Animal manure production and N and P unit loads dispersed in the environment can vary greatly depending on the feeding habits of these animals, the type of food, and the frequency of drinking water (Kocabey, 2019; Tırınk, 2021).

The total amount of dispersed pollutants originating from animal wastes belonging to the Eastern Anatolia Region was calculated with the following equation (equation 1).

$$Q_T = Q_{YK} * A_{CH} * Y_U * 365/1000 \quad (1)$$

Here;

Q_T is the distributed pollutant load that will occur annually (kg animal number^{-1} year^{-1}), Q_{YK} is the distributed pollutant load, which varies according to the daily pollutant type (kg tons^{-1} animal number^{-1} day^{-1}), A_{CH} expresses live animal weight (kg) by animal type species.

A_{CH} is the live animal weight. It was taken as 500 kg for cattle, 45 kg for ovine animals and 2 kg for poultry. However, Q_{YK} is the distributed pollutant load (kg/ton number of animals/day) that varies according to the daily pollutant type. Nitrogen was taken as 0.3 in bovine animals, 0.42 in ovine animals and 0.52 in poultry. The Q_{YK} value for phosphorus was taken as 0.1 in bovine animals, 0.06 in ovine animals and 0.22 in poultry (Yontar, 2009; Biçer, 2011; Derin et al., 2019; Tırınk, 2021).

Y_U is the percentage of dispersed pollutants reaching the receiving environment; calculations were made assuming that 15% for N and 5% for P could reach the receiving environment (Yontar, 2009; Biçer, 2011; Derin et al., 2019; Tırınk, 2021).

TN load calculation (equation 2)

$$Q_{TN} = Q_T * N_{CH}/1000 \quad (2)$$

Here;

Q_{TN} is the total annual nitrogen load (ton year^{-1}), Q_T is the annual distributed pollutant load (kg animal number^{-1} year^{-1}) and N_{CH} is the livestock number.

TP load calculation (equation 3);

$$Q_{TP} = Q_T * N_{CH}/1000 \quad (3)$$

Here;

Q_{TP} is the total annual phosphorus load (ton year^{-1}), Q_T is the annual distributed pollutant load (kg animal number^{-1} year^{-1}) ve and N_{CH} is the livestock number.

The total amount of dispersed pollutants originating from animal wastes of Ardahan province was calculated using equations (1), (2) and (3) (Yontar, 2009; Biçer, 2011; Derin et al., 2019; Tırınk, 2021).

Research Findings and Discussion

Cattle, ovine and poultry presences of Ardahan province are given in Table 1.

Table 1. Animal existence in the research area (number)

Animal species	Damal	Göle	Hanak	Merkez	Posof	Çıldır
Cattle	12833	55987	36883	95835	12779	31801
Ovine	1074	14984	5356	41361	1255	30777
Poultry	8250	60500	28608	118673	11663	550

When the animal presence in the research area is examined, it is seen that the total number of cattle is 246118, the number of ovine animals is 94807 and the number of poultry is 228244. It has been determined that the highest cattle presence is in Merkez and Göle districts, the highest ovine presence is in Merkez and Çıldır districts, and the highest poultry presence is in Merkez and Göle districts. When the animal presence of the central district is examined, it is seen that it is the district with the highest value in terms of cattle, sheep and poultry. From here, it can be said that the Central district is the livestock center of Ardahan.

The total nitrogen amount of the pollution loads arising from livestock activities in the research area is given in Table 2 and the total phosphorus load is given in Table 3.

Table 2. Total nitrogen pollution load resulting from livestock activities (tons $year^{-1}$)

Animal species	Damal	Göle	Hanak	Merkez	Posof	Çıldır
Cattle	105,391	459,793	302,901	787,045	104,948	261,166
Ovine	1,111	15,505	5,542	42,799	1,299	31,847
Poultry	0,470	3,445	1,629	6,757	0,664	0,031
Total TN Load	106,972	478,743	310,072	836,601	106,911	293,044

Table 3. Total phosphorus pollution load resulting from livestock activities (tons year-1)

Animal species	Damal	Göle	Hanak	Merkez	Posof	Çıldır
Cattle	11,710	51,088	33,656	87,450	11,660	29,018
Ovine	0,053	0,738	0,264	2,039	0,062	1,517
Poultry	0,067	0,486	0,230	0,953	0,094	0,004
Total TP Load	11,83	52,312	34,15	90,442	11,816	30,539

When the table of the total nitrogen load in the research area is examined, it is seen that the total pollution load is 2132,343 tons/year. It was determined that the highest value in total nitrogen load was in the Central district with 39.24% and the lowest value was in Damal with 5.017% and Posof with 5.014%. In the Central district, which has the highest nitrogen load, 94.08% of the annual pollution load of 836,601 tons is from cattle; It has been determined that 5.11% is due to ovine and 0.81% to poultry farming activities. Similarly, when the chart of the total phosphorus load in the research area is examined, it is seen that the total pollution load is 231,089 tons year^{-1}. It was determined that the highest value in total phosphorus load was in the Central district with 39.14%, and the lowest share was in Damal with 5,119% and Posof with 5,113%. In the Central district, which has the highest phosphorus load, 96.7% of the annual pollution load of 90,442 tons is from cattle; It has been determined that 2.25% is ovine and 1.05% is due to poultry farming activities.

In the lower Basin of Lake Burdur, the TN load resulting from livestock activities is 611 tons year^{-1} and the TP load is 93 tons year^{-1} (Biçer, 2011). It has been calculated by Yetiş et al (2018a) that the TN load is 180,084 tons year^{-1} and the TP load is 4,854 tons year^{-1} throughout the province of Bitlis. Yetis et al. (2018b) stated that the TN load of Muş province is 543,412 tons year^{-1} and the TP load is 16,918 tons year^{-1}. It has been determined that the TN burden of animal origin in Mardin is 270,626 tons year^{-1} and the TP load is 7.89 tons year^{-1} throughout the province (Derin et al. 2019). The total amount of dispersed pollutants of the province of Iğdır was calculated as 2509,697 tons year^{-1} and the total amount of phosphorus was calculated as 203,521 tons year^{-1} (Tırınk, 2021). It has been determined that the total distributed pollution load that may originate from total nitrogen in Bursa is 3241,944 tons TN year^{1}, and the distributed pollution load that may originate from total phosphorus is 341,327 tons TP/year (Hacısalihoğlu, 2022). In the study conducted by Ertop et al., (2022), it was determined that the TN load of Ardahan province was 2021,244 tons year^{-1} and the TP load

was 224,583 tons year^{-1}. Although previous studies belong to different animal numbers and species, it can be said that the results obtained in our study show parallelism with previous studies.

Kura River located in the central district of Ardahan province; Kür Stream, Kayinli Stream, Turkmen Stream in the Göle district; Hanak Stream in Hanak District and Posof Stream in Posof District are the main streams of the province (Anonymous, 2022a). It can be said that these streams in the research area are likely to be polluted as a result of livestock activities. Determination of the transport processes and amounts of pollutants is important to evaluate the environmental impacts on underground and surface water resources (Akdoğan et al., 2015). In this context; As can be seen in Table 2 and Table 3, it can be assumed that the analysis points to be established along the Kura River in the Central district, which has the highest pollution level, may be important in terms of controlling the pollution.

Çıldır and Aktaş Lakes in Çıldır district and Fish and Trout Lakes located in Posof district are lakes with fish populations in Ardahan, and Çıldır Lake also creates a habitat for aquatic birds such as cormorants, herons, jumpsuits and seagulls (Anonymous, 2022a) . Diffuse sources of pollution; It threatens life in water resources through sedimentation, turbidity, depletion of dissolved oxygen, algal blooms and fish deaths (Yontar, 2009; Biçer, 2011). In order for the life cycle of both the fish population and the populations of other living species in the water resources to continue in a healthy way, the pollution load can be reduced by preventing the direct release of animal manure into these water resources.

There are 7 flood traps used as drinking water ponds in total, 3 in the central district, 3 in the Göle district and 1 in the Hanak district (Anonymous, 2022a). Considering that 76.2% of the total nitrogen load and 76.55% of the phosphorus load in the research area are in these three districts, it can be mentioned that the water in these flood traps, which are used as animal drinking water ponds, should be protected. Manure mixing into the water supply is one of the water quality problems affecting animal production. Therefore, it is very important that the water source is safe for farm animals (Cemek et al., 2011). In the study conducted by Cayley et al., (2004), it was stated that the distance of manure piles to water resources such as lakes should be at least 300 meters. For this reason, it will be important to design the manure storage structures in livestock enterprises considering this criterion in order not to deteriorate the water quality.

When the wastes are not stored properly, they cause contamination of surface water resources and accumulation in permeable soils, infiltrating deep through the soil, mixing with groundwater and causing pollution (Atılgan et al, 2006; Karaman, 2006; Boyacı et al, 2011; Yagli and Yıldız, 2019). Animal manures, which are defined as diffuse pollution sources, mix with underground or surface waters, causing the quality of water resources to deform or become unusable (Aydın and Derinöz, 2013; Yetiş et al, 2018b). It has been determined that Ardahan has groundwater potential at 18 points. In addition, thermal springs and springs are generally collected in Çıldır and Göle districts. Öncül Village Thermal Spring and Deveboynu Thermal Spring are the healing water resources of Çıldır district, Koruvenk Thermal Spring and Göle Thermal Spring and Göle Mineral Water are the healing water resources of Göle district. Ur Village Mineral Water is located within the borders of the Central district (Anonymous, 2022a). According to the long annual precipitation data of Ardahan province, the average total precipitation amount is 556.5 mm and the average number of rainy days is 126.4 days (Anonymous, 2022b). It can be said that the probability of contamination of surface and underground water resources is higher in the province of Ardahan, which receives high precipitation. Especially in underground water resources, pollution is more difficult to determine than surface water resources, since the elements of pollution cannot be seen with the naked eye. For this reason, it will be important to frequently control the values and monitor the pollution by the provincial directorates of agriculture. In addition, obligatory monitoring stations at underground water resources locations will be important in order to monitor the pollution level regularly.

Conclusion and Recommendations

Animal waste, which is one of the widespread sources of pollution, can contaminate surface and underground water resources when they spread to the environment in an uncontrolled manner. In the province of Ardahan, where livestock activities are carried out intensively, it is important to calculate the pollutant loads and to draw attention to the damage they may cause to water resources in terms of creating environmental awareness.

It should not be forgotten that with the pollution of surface water resources, the habitats of fish, aquatic birds and other animals will decrease, and at the same time, the living space and recreation areas for humans will decrease. However, with the pollution of underground water resources, the existing thermal springs facilities and clean utility water areas may decrease.

In order to monitor the pollution in both surface water resources and underground water resources, it may be important for public health to establish monitoring stations at the points where water resources are located and to know the pollution level. Estimating the pollution load in the future by making the projection of the number of animals for the coming years will also facilitate taking measures against the damages that may be caused by the pollution.

It is easier to prevent pollution of water resources because it is a costly and difficult process to treat water resources after they become polluted.

The importance of manure storage structures in livestock enterprises is understood from the damage caused by pollution to the environment. For this reason, it should be ensured that manure storage structures have standards and all businesses should be made aware of waste management through an effective training program.

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Significance and content of zinc (Zn) in agricultural land in the area of the City of Sombor

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Abstract

Zinc belongs to the group of essential elements for plants, animals and the human body. It acts as a plant growth stimulator and increases their resistance to biotic and abiotic stresses. The content of zinc in plants is different and ranges from 20-100 ppm. At a lower content of 10 ppm, symptoms of zinc deficiency begin to appear. Spinach, lettuce and onion leaves contain the most of it, over 100 ppm. In field plants, it is present from 10-80 ppm. Marine plants and some types of fungi can accumulate large amounts of zinc. The total content of zinc in the soil depends on the content in the parent substrate. It is usually found between 10 and 300 μg/kg of soil. Soils contaminated with zinc have it even up to 10,000 μg/kg. Only those amounts of zinc that are in soluble or potentially soluble forms are accessible to plants. The content of 300 μg/kg of soil is also the maximum permitted amount of zinc in agricultural soils in Serbia. Zinc is found in different forms in the soil. Zinc dynamics are primarily influenced by pH and CaCO3 content. Calcium carbonate reduces the mobility of zinc, while increased acidity increases it. In recent decades, the lack of zinc in corn and apples has been observed more and more often. Large doses of phosphorus contribute to the lack of zinc in accessible forms for plants, because phosphorus and zinc are antagonists. The greatest sensitivity to zinc deficiency is shown by corn, beans, soybeans, apples, etc. The optimal content of readily available zinc in the soil ranges from 1-3 ppm. Increased amounts of zinc can be caused by municipal sludge if uncontrolled use in agriculture, composted materials, pesticides, mineral and organic fertilizers, etc. According to the analyzes of agricultural land in the area of the city of Sombor for the zinc content in the soil, it was determined that it ranged from 26.76 mg/kg to 228.20 mg/kg. The average value of this soil fertility parameter in the 0-30 cm layer is 71.34 mg/kg, and the maximum determined value is 228.20 mg/kg. This zinc content is far from the maximum allowed amount of zinc in the soil.

Keywords: zinc, soil, essential elements, content, amount

Introduction

Zinc is widely distributed in nature, but in very low concentrations. In addition, it had extremely high economic and biological importance. Zinc belongs to the group of heavy metals whose specific density is greater than 5 g/cm3. In the surface layer of the soil, the concentration of total zinc ranges from 10 to 300, on average around 60 mg/kg. Kabata-Pendis (2011) state that the concentration of zinc in the surface layers of different soil types around the world ranges up to 125 mg/kg. The total zinc content in the soil depends on the mineralogical composition of the parent substrate from which it was formed under the influence of physical, chemical and biological factors. The most important processes of pedogenesis related to heavy metals in soil are the release of metals from the parent substrate through decomposition and movement and accumulation of metal-adsorbing soil constituents, such as clays, hydrated oxides, and organic matter. Zinc is found in the soil in different forms, in a mobile form and in a form that is difficult for plants to access. Their importance in providing plants with zinc is unequal. It is found in the soil in the form of minerals, in water-soluble form, adsorbed on organic and mineral colloids, in the form of zinc, organo-mineral complexes and complex metal-organic compounds.

The concentration of total zinc in certain soil types varies widely. It is the lowest in light sandy soils, on average around 30 mg/kg. In acidic sandy soils with intensive leaching, the concentration of zinc can be even lower, of 30 mg/kg. The average concentration of zinc in soils around the world is about 64 mg/kg. According to Mertens and Smolders (2013), in soils that are not contaminated with zinc, its concentration ranges widely, from 10 to 100 mg/kg. The concentration of total zinc also depends on the mechanical composition of the soil. The content of zinc in the arable layer ranges from 90 to 450 kg/ha. Of the total amount of zinc, only about 1% falls on the mobile part on average, which means that its amount in the arable layer from 0 to 20 cm is only about 1-5 kg/ha. Insoluble zinc represents >90% of the total zinc in the soil and it is inaccessible to plants. The level of provision of zinc to plants is not correlated with its total concentration in the soil.

The total content of zinc in the soil depends on the content in the parent substrate. It is usually found between 10 and 300 μg/kg of soil. Soils contaminated with zinc have it even up to 10,000 μg/kg. Only those amounts of zinc that are in soluble or potentially soluble forms are

accessible to plants. The content of 300 μg/kg of soil is also the maximum permitted amount of zinc in agricultural soils in Serbia.

Zinc is found in different forms in the soil. Zinc dynamics are primarily influenced by pH and $CaCO_3$ content. Calcium carbonate reduces the mobility of zinc, while increased acidity increases it. In recent decades, the lack of zinc in corn and apples has been observed more and more often.

Figure 1. Corn crop in the area of the town of Sombor

Zinc belongs to the group of essential elements for plants, animals and the human body. It is an integral part of a large number of enzymes, and it also plays a very important role in the synthesis of auxin, in the oxidation of proteins and the like. It acts as a plant growth stimulator and increases their resistance to biotic and abiotic stresses (causing diseases, drought, etc.). The content of zinc in plants is different and ranges from 20-100 ppm. At a lower content of 10 ppm, symptoms of zinc deficiency begin to appear. Otherwise, the zinc content in plants is higher compared to other microelements (Mo, Cu, Co). Spinach, lettuce and onion leaves contain the most of it, over 100 ppm. In field plants, it is present from 10-80 ppm. Marine plants and some types of fungi can accumulate large amounts of zinc. There are a number of plants that fall into the category of "accumulators" or "indicators" of zinc. They are used for land remediation or for discovering zinc deposits. In most cultivated plants, the critical concentration of zinc is around 150 μg/g of dry matter, while a content of 200 μg/g is considered toxic. For soy and sugar beet, the values are 10-20 times lower.

Zinc is a very important element for the normal functioning of the human and animal organism. It is part of more than 100 enzymes (metallo-enzymes) and therefore participates in

a large number of physiological reactions. It has a particularly important role in the processes of cellular replication and gene expression, in the metabolism of nucleic acids and amino acids. It affects the strengthening of the immune system in humans and animals. It belongs to very important antioxidants. A particularly important role of zinc is in the sexual maturation of male individuals.It is used in industry, in the production of alloys, in the galvanization of iron objects, for the production of fungicides (and other pesticides).

Large doses of phosphorus contribute to the lack of zinc in accessible forms for plants, because phosphorus and zinc are antagonists. Increased use of manure works in the same direction. The greatest sensitivity to zinc deficiency is shown by corn, beans, soybeans, apples, vines, plums, etc.

The optimal content of readily available zinc in the soil ranges from 1-3 ppm, depending on the data source.

Materials and Methods

The origin of zinc in the soil is different. Increased amounts of zinc can be caused by municipal sludge if uncontrolled use in agriculture, composted materials, pesticides, mineral and organic fertilizers, waste materials near mines, iron foundries and the like. The burning of coal, fossil fuels and smoke from metal smelters pollute the soil from the air. This includes volcanic eruptions, aeolian ash and the like. Considerable amounts of heavy metals (Cu, Ni, Cr) and even zinc can be found in waste sludge. The use of waste sludge in the soil can significantly increase the presence of heavy metals, including zinc, whose toxic effects on plants, humans and animals can cause serious consequences.

However, it can be said that much greater damage to all living organisms occurs in cases of zinc deficiency. The toxic effect depends on the type of organisms. In animals, the maximum permitted amounts of zinc in food range from 1,000 μg/g (poultry) to 2,000 μg/g (in other domestic animals). Poisoning in humans is rare, because zinc ingested orally causes strong vomiting, which prevents its resorption.

Results and Discussion

According to the analyzes of agricultural land in the area of the city of Sombor for the zinc content in the soil, it was determined that it ranged from 26.76 mg/kg to 228.20 mg/kg. The average value of this parameter of soil fertility in the 0-30 cm layer is 71.34 mg/kg, and the

maximum determined value is 228.20 mg/kg in the sample from point number 70 in the area of the Nenadić farming settlement. This zinc content is far from the maximum allowed amount of zinc in the soil.

The most common content of zinc at a depth of 0-30 cm is in the range of 60-80 mg/kg, and that is in 31.41% of the examined samples of agricultural land in the area of the city of Sombor (Figure 2), while with zinc content below 30 mg/kg only 0.64% of soil.

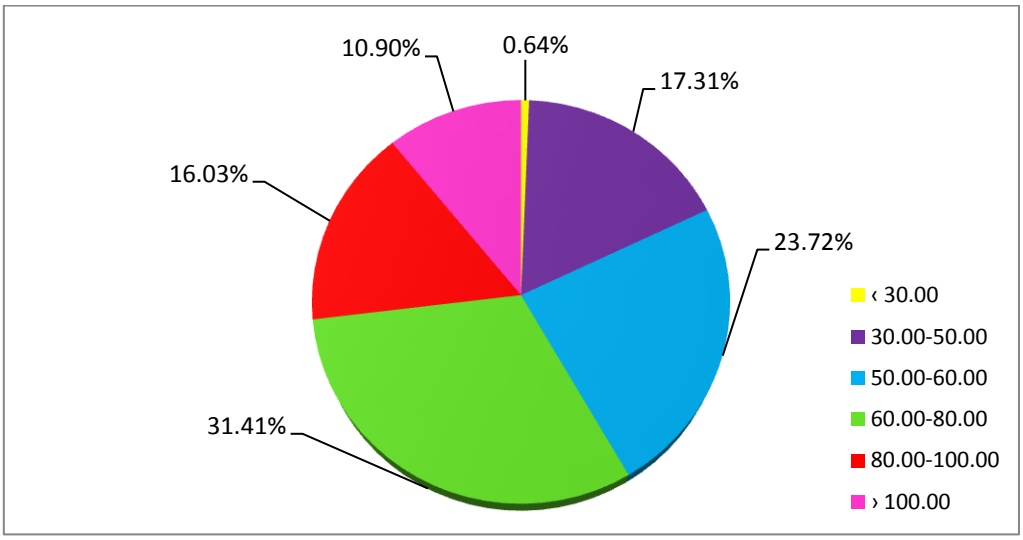

Figure 2. Percentage representation of examined samples of agricultural land in relation to zinc content (mg/kg) in the area of the city of Sombor

Regarding the zinc content in the soil in the layer of 0-30 cm, and based on the type of soil, the highest average zinc content is found in alluvial soils, 85.56 mg/kg, while the lowest average zinc content is in fens, 65 .33 mg/kg of soil (Figure 3 and Table 1).

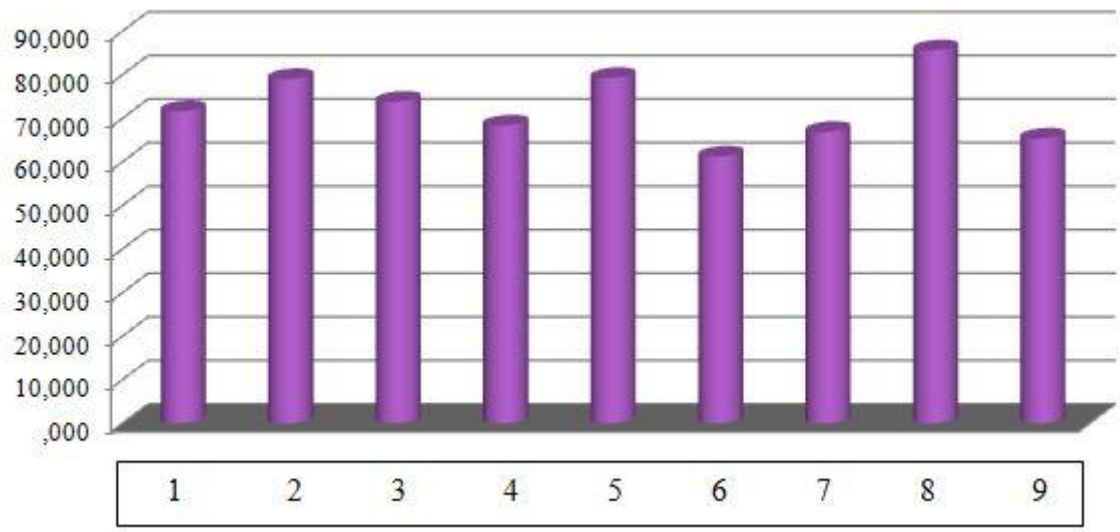

Figure 3. Average zinc content (mg/kg) by type of agricultural land in the area of the city of Sombor

1. chernozem on the loess plateau, 2. carbonate chernozem on the loess terrace, 3. chernozem, 4. chernozem on sand, 5. meadow carbonate on the loess plateau, 6. meadow carbonate on the loess terrace, 7. salty land, 8. alluvium, 9. rite black mold

Table 1. Zinc content (mg/kg) in the 0-30 cm layer of agricultural land in the area of the city of Sombor by land type

dubina	chernozem on the loess plateau		carbonate chernozem on the loess terrace	chernozem	chernozem on sand	meadow carbonate on the loess plateau	meadow carbonate on the loess terrace	salty land	alluvium	rite black mold
0-30	min	47.5	40.66	44.01	40.95	52.69	42.36	26.76	44.2	45.01
	max	157.1	228.2	98.23	150.3	125.0	147.0	160.1	130.6	93.12
	sred.	71.62	78.98	73.77	68.32	79.22	61.18	66.86	85.56	65.33

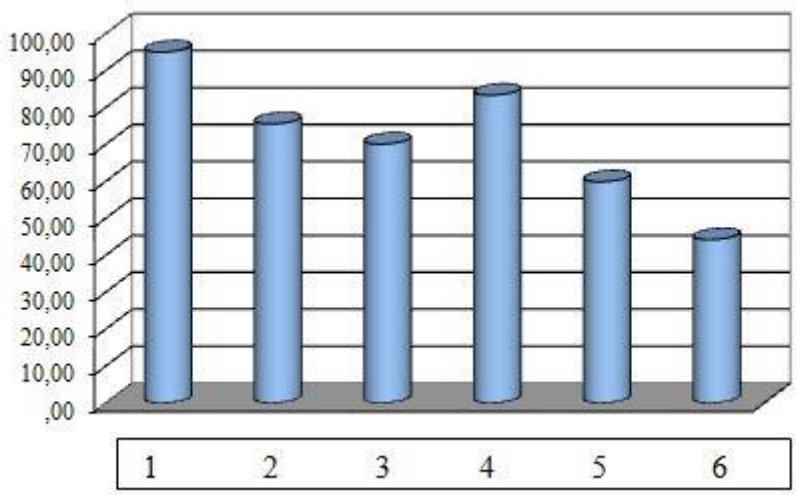

Figure 4. Average zinc content (mg/kg) in the 0-30 cm layer of agricultural land in the area of the city of Sombor by method of use

1. gardens, 2. pastures, 3. arable fields, 4. forests, 5. orchards, 6. Landfills

Observing the content of zinc in the soil in samples of agricultural land by ownership, it can be concluded that the highest content of zinc in the land is in state ownership (Fig.5).

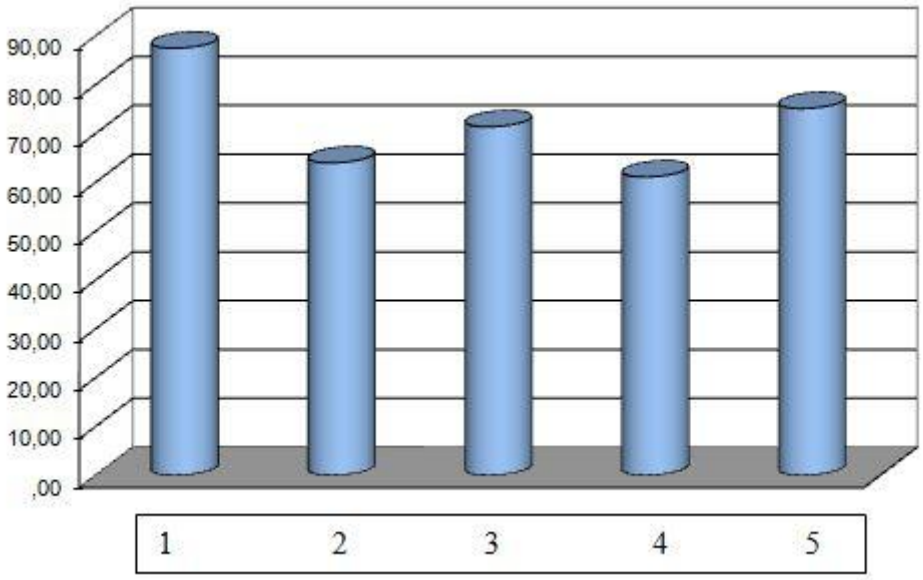

Figure 5. Average zinc content (mg/kg) in the 0-30 cm layer of agricultural land in the area of the city of Sombor by ownership

1. state land, 2. state land leased by natural and legal persons, 3. state land by agricultural enterprises, 4. ownership by legal persons and cooperatives, 5. ownership by natural persons

These tests and results give us a precise scheme with the content of zinc, parts of the land that have a high percentage of zinc, and this gives us the possibility of planning the sowing or planting of agricultural and vegetable crops. The influence of certain elements on life

processes and thus the growth and development of plants also depends on their concentration. A high concentration of zinc, like other heavy metals, has a toxic effect on plants. Approximately six million tons of zinc circulate annually in nature, carried by wind, running water and precipitation. The anthropogenic emission of zinc into the atmosphere as a result of human activity amounts to 62,000 tons per year. It is believed that only about 10% of the zinc circulating in nature is accessible to living organisms.

Rainwater that is collected from galvanized gutters in galvanized vessels usually contains larger amounts of zinc, which is why when plants are watered with this water, the soil is also enriched with it. Wastewater from lead mines can also lead to soil pollution with zinc. Damage to plants can also be caused by dust containing zinc, which is discharged from industrial plants. Zinc is deposited from the atmosphere on the aerial organs of plants and causes necrosis on the leaves. The most sensitive fruit species are the plum and then the apple, and the pear proved to be the most tolerant. Among field plants, peas, lettuce, alfalfa and spinach are moderately sensitive to increased zinc concentrations in the soil, while potatoes, beans and clover are resistant.

It is considered that it is critical for plants if the concentration of available zinc in the soil is greater than 150 mg/kg, and that plant uptake is reduced if its concentration in leaves is between 300-1000 mg/kg. The typical critical phytotoxic concentration of zinc in plants is about 500 mg/kg, and symptoms of excess, depending on the plant species, appear when its concentration in all matter is 3,000-5,000 mg/kg.

A good indicator of excess zinc is the ratio of the concentration of phosphorus and zinc in the dry matter of plants. Signs of excess zinc in plants most often appear on acid peat soils, on soils that were formed on a parent substrate rich in zinc, as well as on zinc-polluted soils. The toxicity of zinc also depends on the plant species, the time of onset of stress caused by an excess of zinc, and the properties and composition of the nutrient substrate. Only plants that are resistant to high concentrations of zinc can survive on contaminated land.

The distribution of zinc content in soils in the 0-30 cm layer in the area of the city of Sombor is given on Figure 6.

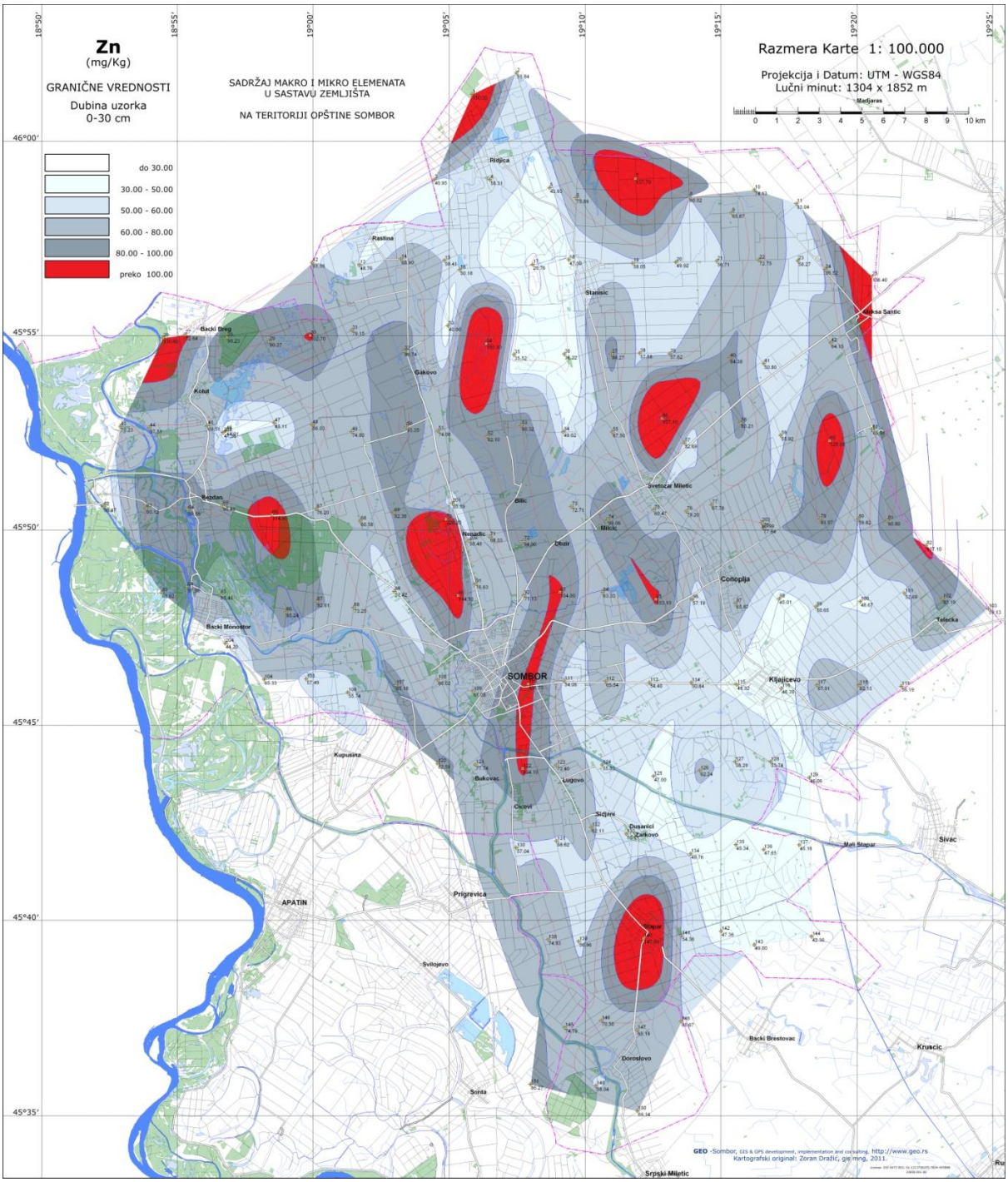

Figure 6. Values of zinc content (mg/kg) at a depth of 0-30 cm in the area of the town of Sombor

The adoption factors are different: ion concentration in the external environment, soil reaction, interaction with other elements, temperature, light, partial pressure of oxygen, soil moisture, rhizosphere microfolia, influence of genotype, properties of the root system, plant health

Conclusions

The main focus of this research on zinc content is primarily due to the zinc content, but also due to the amount present in the soil and the possibility of using the land and growing crops. A high concentration of zinc, like other heavy metals, has a toxic effect on plants. The average zinc content in the soil, according to the method of agricultural land use, is the lowest in the land that was used today or in the past as landfills for garbage and other municipal waste. The highest zinc content is in soils used as gardens and it is among the optimal, so this microelement should not be added by fertilizing, nor does it affect yields and product quality. Approximately six million tons of zinc circulate annually in nature, carried by wind, running water and precipitation. Zinc is one of the most toxic metals. Their toxicity is less than copper. Accumulation of zinc in the soil can also occur during regular fertilizing with a large amount of manure, especially pig dung or compost from municipal waste, during the wear of motor tires, corrosion processes, burning of coal and urban and industrial waste.

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Influence of biostimulant on growth characteristics of strawberry

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Abstract

Biostimulants are substances that are applied to plant or soil may enhance plants ability to assimilate applied nutrients which results with better development. The aim of this study was to evaluate the effect of biostimulants (Amiksol and Slavol), applied with an organic fertilizer (Stallatico) on the yield and morfological characteristics of strawberry (Fragaria x ananassa Duch.) cultivar Clarity. An experiment was carried out in the 2021 in the open field as a complete randomly design with four replicates, and treatments were: Stallatico (Control), Stallatico + Slavol (T1) and Stallatico + Slavol + Amiksol (T2). Morphological properties were measured in four terms of vegetative growth and fruiting. Twenty plants were selected randomly from each experimental unit to measure the length of canopy (cm), length of roots (cm), total length of plant (cm), as well as weight of canopy (g), weight of roots (g) and total weight of plant (g), number of leaves and stolon and yield (number and weight of fruits). Data were processed by ANOVA and LSD was detrmined at $P<0.01$. All measured parameters were significantly higher with combined application of organic fertilizer and biostimulants (T2). The results revealed that application of biostimulants with different content active substances improved growth and yield of strawberry.

Keywords: biostimulant, growth, strawberry

Introduction

Strawberry (Fragaria x ananassa Duch.) belong in the family Rosaceae, genus Fragaria (Taha and Haji, 2015), and it is well knowm by its fruits which have important role in human nutrition. Regarding growth conditions strawberry can be grown in the field and/or in glasshouses, greenhouses and plastic tunnels (Špoljarević et al., 2010). However, adequate

mineral nutrition have a strong inleunce on high yield and good quality of strawberry fruit independent about growth condition. Hence, modern agricultural production strem to higher yield by all available agrotechnical means. However, number of researches points on negative influence of aplication of chemical fertilazers on enviroment beacause of the residual phosphorus (P) and nitrogen (N) (Wilson, 2013). Therefore the only solution is to use ecologically acceptable technologies in agricultural production such as biostimulants. According to Rouphael and Colla (2020a, 2020b) biostimulants (microbial and non-microbial) bringing benefits to the environment. Microbial biostimulants includes: arbuscular mycorrhizal and plant growth promoting rhizobacteria: Azotobacter, Azospirillum and Rizhobium spp. and non-microbial are: humic substances, silicon, animal- and vegetal-based protein hydrolysate and macro- and micro-algal extracts biostimulants. Beside the favourable influence on enviroment such as humic substances, protein hydrolysates, seaweed extracts and microorganisms have a proven potential in improving plant growth, increasing crop production and quality, as well as reducing the effects of stress. There are many reports connected with growth, yield and quality enhancement in different plant species (Baltazar et al., 2021, Špoljarević et al., 2010). Also, several authors reports about positive influence of biostimulant on growth and fruit quality of strawberry (Celiktopuz et al., 2021, Dong et al., 2020, Soppelsa et al., 2019, Filipczak, et al., 2016, Špoljarević et al., 2010). Also, Soltaniband et al., (2022) reported to improve crop sustainability, yield and berry quality and propose alternative production systems such as organic farming and the use of biostimulants. However, the same author quote that effects of various biostimulants on strawberry yield and quality imply the need for further investigation and Parađiković et al. (2019) added that biostimulant modes of action as well as optimal cultivation practices, such as dosage and timing is necessary. Hence, aim of this research was determine the influence of biostimulants on growth, in spring period, of strawberry in field condition.

Material and Methods

Plant materials and growt conditions

Experiment was conducted during (2021) spring season in the open field, Jaruge, Brod-Posavina County, Croatia which is located on the latitude (45°11′46″ N), and longitude (18°42′16″ E) and at an altitude of 73 m above the mean sea level. Strawberry (*Fragaria x ananassa* Duch) cultivar „Clery“ from ownfarm production were treated with different biostimulants. The experiment was set up in triple rows on two raised beds, which are covered

with black PVC foil. The distance between the two beds was 1 m, inside the bed on black plastic foil, strawberries were placed in three rows with an inter-row distance of 20 cm, and 25 cm within the row of strawberries. The experiment was carried out with treatmants: organic fertilizer Stallatico (Control), Stallatico + Slavol (T1), Stallatico + Slavol + Amiksol (T2).

Treatment with fertilizer and biostimulants

Two commercial biostimulants including Slavol and Amiksol were obtained from the market and applied with certain dilutions into soil (Slavol) and plant (Amiksol) once a week after transplanting. Slavol was applied by watering the root zone of the plant with 0.20% concentration in the water, and Amiksol by drench (foliar spray) with concentration of 0.25%.

Before planting, 20g of organic pelleted ecological fertilizer of the trade name "Stallatico Pellettato", produced by TerComposti from Italy, was manually added to the soil. Fertilizer is characterized by rapid decomposition in the soil, thus ensuring a high input of nutrients into the soil, while improving the fertility and overall quality of the soil. The pellet is 5mm to 6mm in diameter. The fertilizer is obtained from a combination of fermented, humified and bacteriologically active cattle and horse manure, and is suitable for use in all agricultural productions. Regarding the composition: pH value 6-7, total nitrogen (N) 2-4%, organic nitrogen (N) 2-4%, organic carbon (C) 26% of biological origin, C/N ratio 12.12, phosphorus (P O) 3-4%, potassium (K O) 3-4%, humidity 15%, organic matter 75%, dry matter 84.51%, the fertilizer stands out for its quality and safety in application to different crops, and there is no danger of excessive intake or pollution of the environment, which is very important in ecological production. The recommendation for soil fertilization depends on the quality and composition of the soil itself, however, according to the manufacturer's recommendation, basic fertilization implies an amount of 160 g/m2 for very poor soils, then for soils rich in organic substances, an amount of 90 g/m2 represents a sufficient amount for one growing season. Fertilizer was added in the same amount (20g/seedling) to the entire plantation in all three growing methods included in this experiment, and was buried in the soil during planting.

According to declaration Slavol is a liquid microbiological fertilizer and growth stimulator that has a certificate for use in organic and ecological agriculture as well as in classical, traditional agriculture. The product is without chemical additives, and has a positive effect on the plant-soil-environment system. Fertilizer is applied foliarly, using sprinklers. It is used in arable and vegetable crops and in the production of flowers. The product is rich with bacteria

that have been extracted from the surface of the roots and multiplied on nutrient media. During the process of bacterial reproduction, secondary metabolic products auxins are produced, which are exclusively of natural origin, as well as auxins synthesized by the plant. Slavol contains: nitrogen fixers; that is, groups of bacteria that naturally synthesize nitrogen from the atmosphere and convert it into a form accessible to plants in the soil, phosphomineralizers; bacteria that break down organic phosphorus compounds and convert them into an accessible form for the plant and have the ability to bind to the plant's root system, then auxins; which represent plant growth regulators that enter the plant via the stomata and then simulate physiological processes in the plant. The effect of application is manifested through accelerated growth and development of plants, increased development of adventitious and lateral roots, increased leaf mass and Figuresynthetic activity, increases plant resistance to diseases, low temperatures and drought.

According to declaration Amiksol is a liquid organic fertilizer rich in amino acids. It has a certificate for use in organic production, and it is also applicable in traditional agricultural production. It is rich with amino acids obtained by microbiological hydrolysis. The product contains 16% free amino acids of plant origin. Biologically active amino acids with an extremely significant role in plant metabolism were obtained by special procedures of hydrolysis of plant material, with the use of enzymatic activity of bacteria. By using amino acids, we directly affect: protein synthesis because they act as carriers for their formation, resistance to stressful conditions and establishment of balance in the plant's physiological functions, then Figuresynthetic activity, shoot movement, fruit formation and pollination, and plant hormonal activity. The effect of the application is manifested through the stimulation of Figuresynthesis and transpiration, increasing the synthesis of proteins that act as buffers in the plant, increasing the content of chlorophyll and encouraging the opening of the stomata for the absorption of micro and macro elements.

Measurement of morfological properties

Morphological properties were measured in four terms of vegetative growth and fruiting. Twenty plants were selected randomly from each experimental unit to measure the length of canopy (cm), length of roots (cm), total length of plant (cm), as well as weight of canopy (g), weight of roots (g) and total weight of plant (g) number of leaves and stolon and yield (number and weight of fruits).

Statistical analysis

The experimental units were arranged as complete randomized design with four replicates. The data were statistically analyzed with Statistica 13 (StatSoft, Inc., Tulsa) and the significant differences between treatment were determined with program MS excell (2019).

Results

The outcomes of the morphological analyses of the experiment are shown in Table 1. Results revaled that all measured morphological properties were significantly affected by application of biostimulant and/or biostimulants. The length of canopy (aboveground tissue) in plants T1 were significantly higher then in control plants (14.38%). Simultaneously application of biostimulant (T2) resulted with significantly higher abovegrand tissue (29.78 %). Additionaly, significanly differences determined between T1 and T2 (Table1). The lenght of roots were significantly larger in T1 treatment then in control treatments (20.98 %). Also significantly larger root lenght were in T2 plants then in control plants (32.34 %) as well as between T2 and T1 plants (Table 1). According to previous, total lenght of plants were significantly different between T1 and control (16.55 %), T2 and control (30.59 %) and between T1 and T2 (Table 1).

Weight of canopy were under significant effect of biostimulant (T1) in regard to control (35.42 %). Simultaneous application of biostimulant were increased weight of canopy in T2 plants (54,71 %). Also, statistical differences were established between T1 and T2 plants in regard to weight of canopy (Table 1). Biostimulant (T1) showed a significant increase (39.17 %) in weight of root compared with the control. We also observed that the biostimulants treatments (T2) induced higher values of weight of root (59.95%) compared with their respective control treatments. Regarding to biostimulant treatments, T1 plants had 36.45% higher values of total weight of plant than control plants, while T2 plants showed even bigger total weight of plant than control (56.22 %). Also statistical difference were determined between T1 and T2 plants (Table 1).

Treatments with both biostimulants were significantly increased number of leaves in regardes to control (42.37%) and T1 treatment (Table 1). On the other hand, statistically significant difference in number of stolon were established between T1 and T2 treatments and control (45,45% and 62,11 %, respectively) as well as between T1 and T2 treatment (Table 1).

Table 1. Morfological properties of strawberry treated with different biostimulant products and control. Length of canopy (LC) (cm), length of roots (LR) (cm), total length of plant (LP) (cm), weight of canopy (WC) (g), weight of roots (WR) (g) and total weight of plant (WP) (g), number of leaves (NL) and stolon (NS). Significant differences between a single treatment and control according to Fisher′s test. A, B, C $p<0.01$.

Treatments	LC	LR	LP	WC	WR	WP	NL	NS
Control	25 C	11,3 C	36,3 C	30,56 C	10,94 C	41,5 C	6,8 B	1,8 C
Treatment 1 (T1)	29,2 B	14,3 B	43,5 B	47,32 B	18 B	65,31 B	8,3 B	3,3 B
Treatment 2 (T2)	35,6 A	16,7 A	52,3 A	67,48 A	27,32 A	94,8 A	11,8 A	4,75 A

Dry matter of aboveground tissue (canopy) were significantly different between C and T2 (Figure 1) as well as between C and T1 (Figure 1). Also, significant difference were determined between dry matter of roots C and T2 and C and T1 (Figure 1). Dry matter distributions in strawberry plant organs were significant different between T1 and T2 (Figure 1).

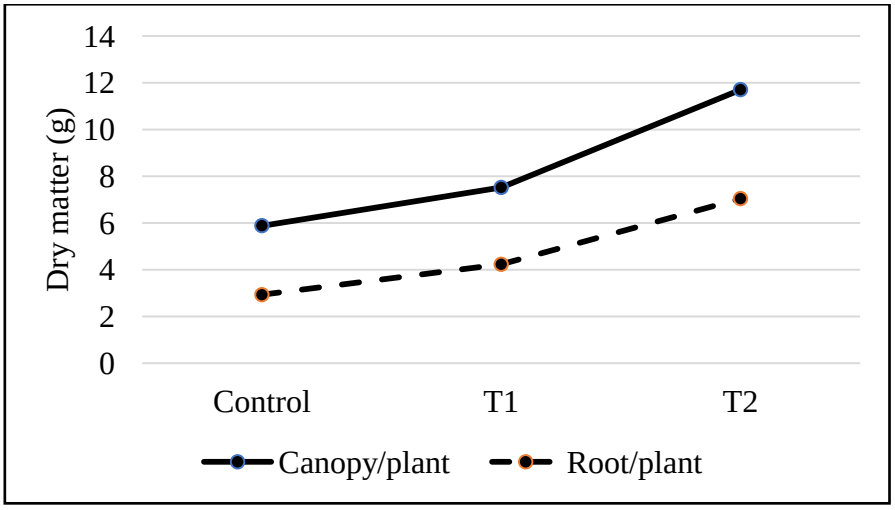

Figure 1. Dry matter distribution in strawberry plant organs (canopy and root) treated with different biostimulant products and control.
Significant differences between a single treatment and control according to Fisher′s test. A, B, C $p<0.01$.

The majority of strawberrys were picked during second period (Figure 2) of the harvesting time in this research. Number of strawberry during first harvesting date bio je najmanji. Regarding treatments, the highest difference was in number of strawberies between C and T2 and the smallest one between T1 and T2 (53.17% and 28. 52%, respectively) (Figure2).

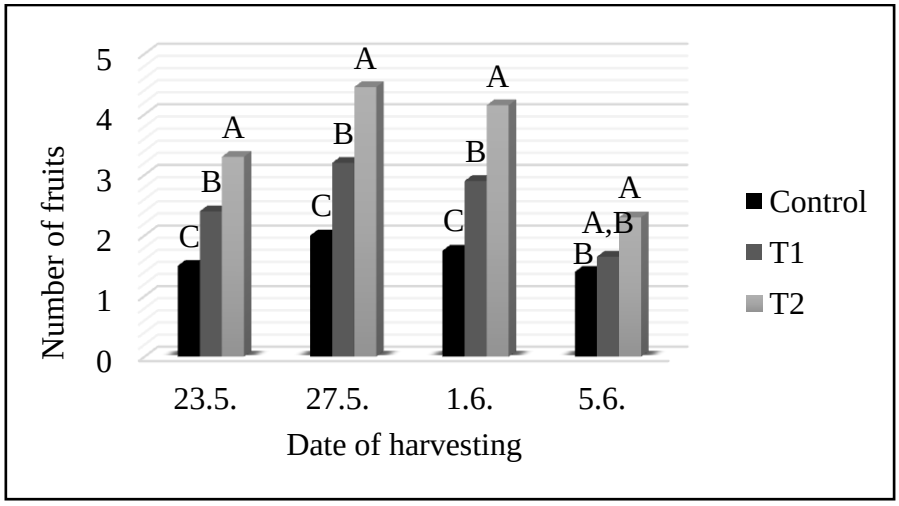

Figure 2. Number of fruits harvested during the four harvesting dates as affected by biostimulant products.
Significant differences between a single treatment and control according to Fisher′s test. A, B, C $p<0.01$.

Regarding weight o fruits, the highest weight had strawberrys that were picked during second period of the harvesting time in this research (Figure 3). In average, statistical differences between weight of strawberrys has been determined between C and T2 (36.98%) (Figure 3). The smallest differnece has been determined between T1 and T2 (20.08%) and then C and T1 (21.14 (Figure 3).

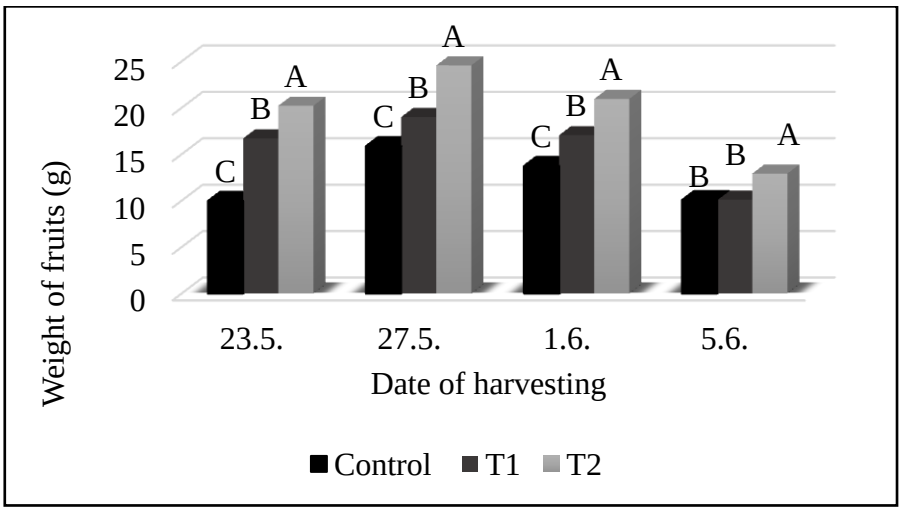

Figure 3. Weight of fruits harvested during the four harvesting dates as affected by biostimulant products.
Significant differences between a single treatment and control according to Fisher′s test. A, B, C $p<0.01$.

Discussion

Biostimulant are substances, including micro organisms, that are applied to plant or soil that may enhance the plant's ability to assimilate applied nutrients. Hence, improved plant growth and yield may be linked with microbial inoculants with nutrient uptake and improved nutrient status of the plant. In a current study biostimulant have been aplied at plant and in soilsu with added organic fertilizer. According to Calvo et al. (2014) biostimulants stimulate plant growth and nutrient uptake by following mechanisms: asymbiotic nitrogen fixation and solubilization of nutrients. In this research was used biostimulant which contain bacteria that decompose organic compound of phosphorus and makes it available for plant. Organic phosphorus plays an important role in the phosphorus cycle of soils and presence of bacteria like as *Pseudomonas* spp. and *Bacillus* spp. contribute to plant growth promotion (Calvo et al., 2014) as it was showed in this research.

Also, presence of bacteria with the capacity to fix atmospheric nitrogen in used biostimulant could result with higher content of nytrogen in strawberry plants, which has been showen in research of other agricultural species (Calvo et al., 2014).

Hormone auxin influencing many plant functions such as cell division and elongation, apical dominance, root initiation, differentiation of vascular tissue, ethylene biosynthesis, mediation of tropic responses, and the expression of specific plant genes (Pevalek, 2005). Hence, presence of auxina in applied biostimulant could also have a positive role in strawbery development.

Aplication of biostimulants in strawberry production caused significant increase in the leaf area, shoot dry weight and root dry weight, significantly increased the number of fruits per plant, fruit fresh weight, and plant yield (Taha and Haji, 2015) which is in acordance with this research. Špoljarević et al. (2010) proved that biostimulant treatment resulted in the highest values of leaf fresh and dry mass, as well as the greatest canopy mass per plant of strawberry which confirms results of this research. Also, used biostimulants increased dry shoot plant biomass of strawberries in research which have conducted Soltaniband et al. (2022).

Dong et al. (2020) observed significant promotion effects of biostimulant on strawberry underground tissue growth, aboveground tissue growth after transplanting including enhanced fresh and dry weights, and plant height.

The use of biostimulant was able to promote biomass accumulation in roots and fruits as well as total leaf area of treated plants in research of Soppelsa et al. (2019).

Soltaniband et al. (2022) and Kirschbaum et al. (2019) quote with regard to number of fruits, total yield, significant difference was measured between the biostimulant treatments and their respective control as well as in our research.

In research which was conducted by Filipczak et al. (2016) with the biostimulants applied to the soil, and also in conjunction with foliar biostimulants, significantly increased fruit yield, and plant growth vigor as well as in this research.

Also, numerous studies were proved positive effect of biostimulants on morfological characteristics of other plants. Parađiković et al. (2009) determined, that biostimulants significantly affect increasing of canopy and root fresh and dry mass of Mexican marigold, and Zeljković et al. (2010) determined significant effect of biostimulant on root growth and development of scarlet sage (*Salvia splendens* L.) transplants. In experiment Vinković et al. (2013) physiological indicator of leaves development of tomato where the leaf area index (LAI), specific leaf area (SLA) and dry matter were under signifficant influence of treatment with biostimulants. Japundžić-Palenkić et al. (2020) determined increased decorative value of *Zinnia elegans* by treatment with biostimulant.

Significant effect of biostimulants on growth of strawberry plants in current study can be explained with content of biostimulants which was able to improve the nutrient use efficiency of the plant and enhance tolerance to biotic and abiotic stresses (Bulgari et al., 2014). Also, according to Celiktopuz et al. (2021) use of biostimulants increase the root volume and promotes the uptake of more plant nutrients from the soil which can explaine the reults of this research. Simultaneus aplication of biostimulants with differnt content in thus research increase the plant capacity for nutrient uptake and probably increase resistance on stress which resulted with higher marks of growth and yield.

Conclusion

The aim of the present research was to dermine if the simultaneous application of two biostimulants with different content of products could help the growth and yield performances of cultivated strawberry plants in soil with added organic fertilizer. The main findings suggest that different biostimulants could be effective in stimulate vegetative growth and final fruit yield if aplicated silmutaneously. Further work is need to be done to clear the understanding

of interaction with the different biostimulants, fertilizer and growt condition (i.e. protected cultivations, different soil etc.).

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Tradition Weave of Satranji: Solapur Durries of Maharashtra

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Abstract

India is a worldwide pioneer in durries, carpets, and hand-made rugs. Solapur is one of the greatest focuses of handloom weaving in India. Solapur has a mixed population from different states of Maharashtra, India thus the lifestyle shows heterogeneous shades of tradition. Maharashtra is known for its rich and exquisite traditional handloom textiles and handicrafts. The sheer humbleness of the people spoke volumes about their simple lifestyle and their culture. The entrance of the house was decorated with a rangoli and the chaukhat (door frame) and some doorways were painted with Warli imaginary and other decorative elements. Most of the population of Solapur is engaged in the activity of weaving and thus their entire life revolves around it. Looms are kept inside the house and the household chores run simultaneously. In many places, the entire process of making the products range from the dyeing of the yarn to the final finished products takes place in the house. At first, these durries were purely built-in cotton with authentic seven colors and were hand woven by the weavers. Shuttle, bobbin, and yarns together helped to fabricate this beautiful piece of cloth. The tools used in the weaving of durries are not very different from what is used in weaving other fabrics. The technique is just warp rib weave and it is done so that warp is hidden and weft is dominant in the fabric. This study focused on process and design intervention by keeping the basic elements of Satranji. To develop new products with the playing colors, sizes, and patterns and new possibilities in the field of product diversification. The textiles were produced in a bulk in such a small area out of so much love, that each piece was tempting to buy and the techniques used were traditional.

Keywords: Cotton, Durries, Pattern, Satranji, Stripes, Weaving etc.

1. Introduction

Indian textiles are as diverse as its culture. With their sheer beauty, colour and artistry, they have woven their way to win the hearts of both loyalty and common people across the country. The wealth of knowledge and skills passed down from one generation of master craftsmen to the next, it will continue to do so for a long time to come. The Indian textile

industry has an overwhelming presence in the economic life of country (Potdar, 2018).

Maharashtra is known for its rich and exquisite traditional handloom textiles and handicrafts. Hand-woven textiles like Paithani brocades that have existed for more than 2000 years in original patterns, and woven with the same techniques even today, are prized heirlooms and possessions for many. Handlooms and handicrafts have played a crucial role in the state economy in providing employment and income. One of them which is known since many years and is said to be one of the most important textile centre of Maharashtra is Solapur. (Finn, 2014).

Solapur is an ancient historical and religious place in Maharashtra. Now, an important industrial city, Solapur is a leading centre for cotton mills and power looms. Solapur is one of the greatest focuses of handloom weaving in India. All the handloom weaving genres at Solapur, have been sorted out under co-operative overlay. (Potdar, 2018)

Figure 1. Weavers cooperatives at Solapur (Maharashtra)

In Solapur best weavers are gradually ascending in the name of co-operation; particularly in the eastern part of the city. Weavers were using cotton yarns of 60s, 100s count and rayon yarn of 24 deniers. Yarns are dyed with naphthol, vat and reactive dyes. For sizing gum, sheep tallow and rice starch are utilized; gum starch is utilized for sizing rayon and silk yarn.

There is a need of the co-operatives for credit, which is now channelled through the directorate of handloom and its district level functionaries. These societies comer a large share of the credit made available to the handloom sector by NABARD. (National Bank for Agriculture and Rural Development). (Anon., 2018)

India is a worldwide pioneer in sewed and hand- made rugs. Geographical Indication must be fortified and secured with the goal that merits items, incorporating floor coverings made in the

district and get GI tag for acknowledgment. The "Punja" loom is a customary manual loom that utilizes one of the most established systems to weave durries and floor coverings. These semi-automated weaving machines empower better efficiencies by cutting down the time required to weave a floor covering (diverse sizes, for example, 6x l0 feet) in 2-4 days.

2. History and Origin

Solapur has a rich history in textiles and known as the labour city of Maharashtra located at the southern part of Maharashtra. It consists of 11 talukas. The name 'Solapur' is supposed to be derived from 'Sola' means 16 and 'Pur' meaning village viz. Aadilpur, Ahmedpur, Chapaldev, Fatehpur, Jamdarwadi, Kalajapur, Kahadarpur, Khandervkiwadi, Muhammadpur, Ranapur, Sandalpur, Shaikpur, Solapur, Sonalagi, Sonapur and Vaidakwadi. Subsequently the British rulers pronounced Solapur as Sholapur and hence the district was called so far a while before it was renamed Solapur (Anon., 2020).

2.1 Geographic Location and Demographics

It is located between 17.10-18.32 ° N and 74.42 to 76.15 °E longitude on the south-east fringe of State and lies entirely in the Bhima and Seena basins. The district has flat or undulating terrain covers geographical area of 14844.6 sq. KM, which is 4.82% of the State (Anon., n.d.) The city is well linked with rail and road network among Hyderabad, Mumbai, Bijapur and Gadag (Karnataka). The dialect of people is Marathi and Kannada. It is the 4^{th} region in Maharashtra and 43^{rd} populated district in India with an average literacy rate of 83.88 %, (Male: 91.31%, Female:76.30%). Hinduism is the majority religion 75.73% population followed by Islam 20.64%, Buddhism 1.62%, Jainism1.00% and Christianity 0.73%, others, not stated 0.28 %. (Prof. Pritam P Kothari, 2016).

2.2 Lifestyle and Culture

The sheer naiveté of the people spoke volumes about their simple lifestyle. The entrance of the house was ornamented with a rangoli and the chaukhat the doorway was painted with warli imaginary. Most of the population is engaged in the weaving and thus their entire life revolves around it. Looms are kept inside the house and the household chores runs simultaneously. The other occupations were that the women of the household were involved in beedi making which is second largest income generating occupation in Solapur. Despite the off springs of the weavers being educated they are still continuing in the same trade as they are religiously attached to it and this helps in keeping the crafts alive (Prof. Pritam P Kothari,

2016).

2.3 Crafts of Solapur

Solapur and textiles are words that have become synonyms to each other. The various migrations in the small town has been possible majorly because of the boost of textile mills in the city. Along with textiles, it also boosts of many crafts like Bidriware, Mashru and Himroo where silk and cotton fabrics are used. The surrounding areas of cities are famous for bed sheets and towels that are known for novel designs and durability. Bed sheets (Chaddars) have received the geographical Indication tag for its unique design and color palette (Penkar & Thorat, 2016).

2.3.1 Wall Hanging

Solapur wall hangings were first made in 1970s and it all started with single tone colors and linear designs which were inspired from Picasso's abstract paintings. Wall hangings are not a utility product but it serves a piece of ornamentation in our houses. The two tones color palette normally uses in wall hangings.

2.3.2 Terry Towels

The terry towel work has been protected under the Geographical indication (GI) of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) agreement.

2.3.3 Bed sheets (Chaddar)

Solapuri chaddar is a cotton bed sheet manufactured using hand looms and known for their design and durability. That were the first product in Maharashtra to obtain Geographical Indication (GI) status. The Jacquard mechanism is using to make the chadders.

3. Satranji (Durry)

The craft of making durries is as old as the Aryan migration to India. The durries can be defined as a pile less cotton fabric with simple designs. They usually have geometric patterns in bright colours. Weaving is a craft which was introduced to the people of Solapur through migrant weavers. Thereafter the craft grew as a profession and flourished in Solapur. It is made by using the seven colours combinations in the form of stripes.

Now expensive and more ornate objects are replaced with more practical and maintenance free objects. “Simplicity is beauty” and one such simple object that replicates as “durries”. The most striking features of a durries are its dynamic colours. In India variety of floor coverings are made by cotton.

It is said that originally black and white checks were woven into durries. They were inspired by the game of Satranji. Later with the evolvement of time new designs mainly geometric were incorporated. These durries are identified with the city of Solapur.

Table 1. Standards Size of Durries and Pricing

S. No	Size (Feet)	Price (approximate) INR
1	6X8	900-1000
2	6X9	1000-1100
3.	8x15	2000-2500
4.	10X15	3000-3500
5.	12X15	4500-5000

Durries are made by handloom and power looms. The handloom used for weaving some durries is a fly shuttle frame loom. Initially, throw shuttle pit looms were used. There are no special attachments in this loom as the weave used is plain weave and there are no complicated designs. At present the use of frame looms has declined drastically. Handlooms are replaced by power looms which are faster and require less labour. (Bedi, 2009)

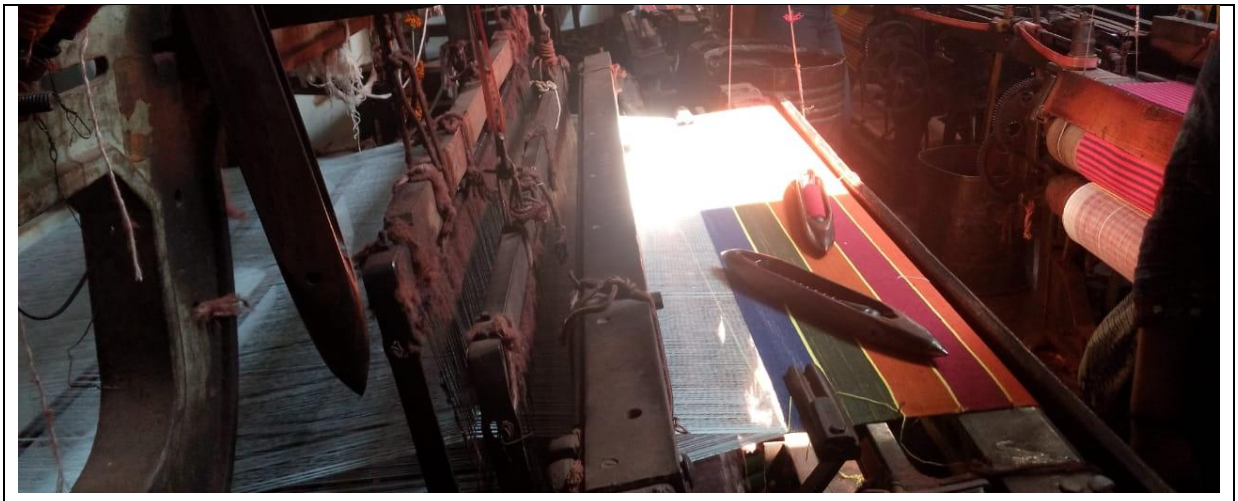


Figure 2. Traditional Satranji

3.1 Designs/Patterns of Durries

Durries are made in plain weave with simple designs. The durries are characterized by their stripes. Initially durries had all over checks but now the designs are limited to stripes only. On the basis of placement of the designs of durries, they can be classified as: all over stripes and stripes only at the ends. Apart from these, the designs of durries vary according to the width

of the stripes, which maybe equal or unequal in width. A vast collection of designs can be obtained by playing with the placement of stripes of different thickness. Moreover, the combination of colours in the stripes creates various designs.

3.2 Colours

Durries incorporate wide range of colours. The colours used are very bright and attention grabbing. The most common colours are red, yellow, blue, orange, violet and green. The well-balanced combination of warm and cool colours is strikingly achieved.

3.3 Classification of Satranji on the basis of the Loom

Durries can be divided on the basis of the loom as handloom and power loom.

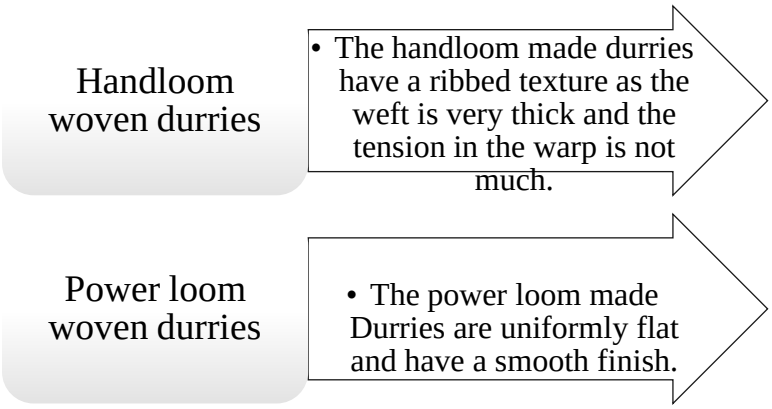


Figure 3. Types of durries at Solapur

4. Raw Materials

Durries are made manually by skilled artisans on a traditional horizontal loom or vertical loom. The rising cost of raw materials suggests the reason for the decrease in number of weaves practicing the craft. The rise in the price of raw materials also affects the prices of final goods and thus, the decrease in demand. The basic raw material and their sources are as follows .

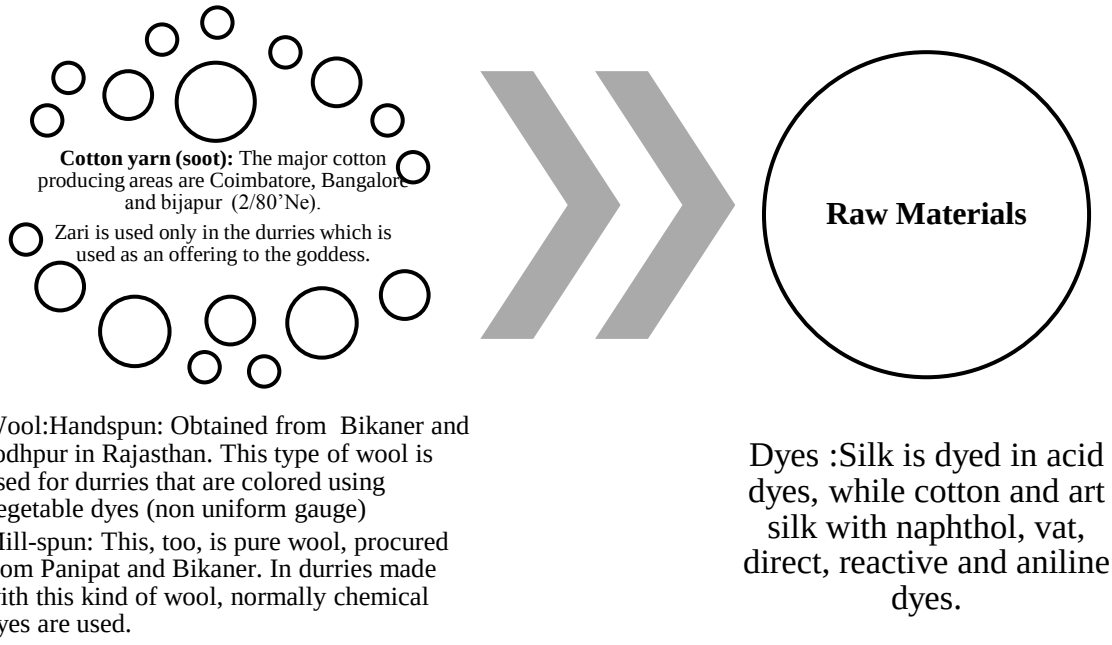


Figure 4. Raw materials used at Solapur durries cluster

5. Tools and Techniques

In durries weaving following tools were required to make the process smoother:

5.1 Hook (Ghundian): A long metal hook, fixed into a wooden handle was used to thread the warp yarns through the dents of the reed.

5.2 Bobbin (Phirki): A few bobbins, each 7-8.5 cms long were required to hold the weft yarns. The yarn was wound around the bobbins. These were either made of wood or plastic.

5.3 Shuttle: A single bobbin boat shuttle was used to throw the weft yarn across the shed. A bobbin containing the filling yarn was put in to the iron shaft of the shuttle and the jam was threaded through its eye. This made the movement of weft yarns across the shed easy and smooth, thus checking the warp breakage.

5.4 Shuttle Harnesses Frames: These frames were very important accessory of the pit loom. 2-4 harness frames were simultaneously used on a pit loom. These frames consisted of heddles, each having a hole in the middle. Each warp yarn is passed through the hole of a heddle which are fitted in a wooden frame. The movement of the harness frames is controlled by the peddles to lift a particular warp group of warp yarns to form the shed to create a design.

Figure 5. Tools and raw material (Fly shuttle, pirn, yarn etc)

5.5 Wooden plank (Panakh): A long wooden plank was used as a tenter to keep the width of durries even. The plank had nails on both the ends and after weaving a little of durries, it was fixed into the woven material. It kept the woven material stretched, thus maintaining the width of the durries even and uniform.

5.6 Iron rod (Rich): A heavy iron rod was used as a lever to rotate the ratchet and roll the woven durries on to the, simultaneously releasing more length of the warp yarns. Besides these accessories, a pair of scissors, measuring tape and several different types of twines and cords was also used.

5.7 Warping Frame: A wooden rounded structure with horizontal frame is used for the preparation of the warp beam.

6. Manufacturing Process of Satranji

The dyed yarns are freed from tangles and stretched using a charkha for weft yarn. The master weavers used the yarns in the desired color combination by using a warp machine. The ends of different colored threads are taken from the rolls, passed through a smaller frame that guides threads into a larger octagonal frame till the entire cylinder is wrapped with thread. The warp yarns are wound on the warp beam. The ends are tightened regularly by adjusting the beams of the loom. The shrinkage issues are taken care of at this stage using clipper (for clips the ends) for knots them and finishes.

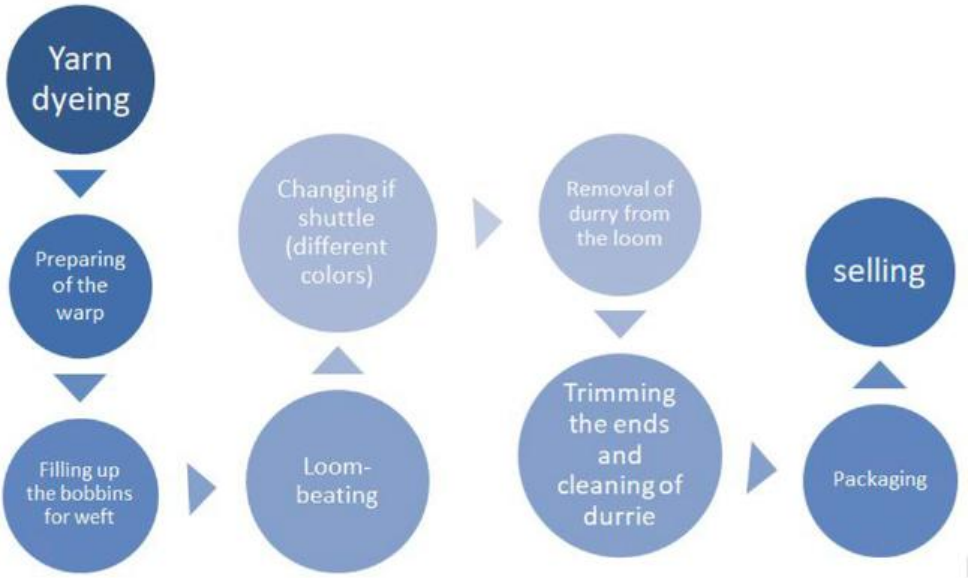


Figure 6. Production Process Flowchart of Satranji

6.1 Dyeing

The yarn was previously colored in vegetable dyes but now naphthol dyes are more widely using by weavers only. Cotton yarn is locally purchase, washed and dry in open space. After drying the dyeing is carried out in hot water using natural or chemical dyes as per the types of dyes and order. The dye is filtered through mesh or plain fabric to remove any solid impurities and then mixed with motor stirrer and after that yarn bundle put in dye bath. After certain time when desired shade is obtained yarn is obtained as per shade %, it is dried in hank form using sunlight. For the quick drying the hydro extractor is also using before drying to remove the excess amount of the liquor from the dyed yarns.

Figure 6. Yarn dyeing and drying at Solapur for Satarangi Durries

6.2 Warping

At a time, the warp for two durries is wound onto the warp beam. After this the warp is passed through the various parts of the loom. The loom is then ready for weaving.

6.3 Winding

These bobbins are then placed in the shuttle which carries it through the shed of the warp. The warp (lengthwise threads or taana) is measured for the correct length for durries and the threads are kept in order so that they can be wound onto the loom. Charkha is used for winding the raw cotton to be made into yarn and warping frame is used for warp beam. Normally white threads are used as warp (finer count then the weft).

6.4 Pirn Preparation (Kandis)

Pirn is made on spinning wheel from the dyed yarn as per the order or colour palette. It is wound on plastic tubes by spinning wheel by women artisans that makes satranji more attractive and unique.

6.5 Weaving

The weaving of durries is a very simple process as the weave is plain. The fly shuttle carries the weft yarn (bana) across the loom during shedding operation of healed shafts. The pirn (kandis) which carry different coloured weft yarns for making the coloured stripes. The white warp (taana) and the colour of the weft (bana) makes a beautiful stripe according to the design. Normally 2/40's warp and 18-20's single ply weft is used for the process.

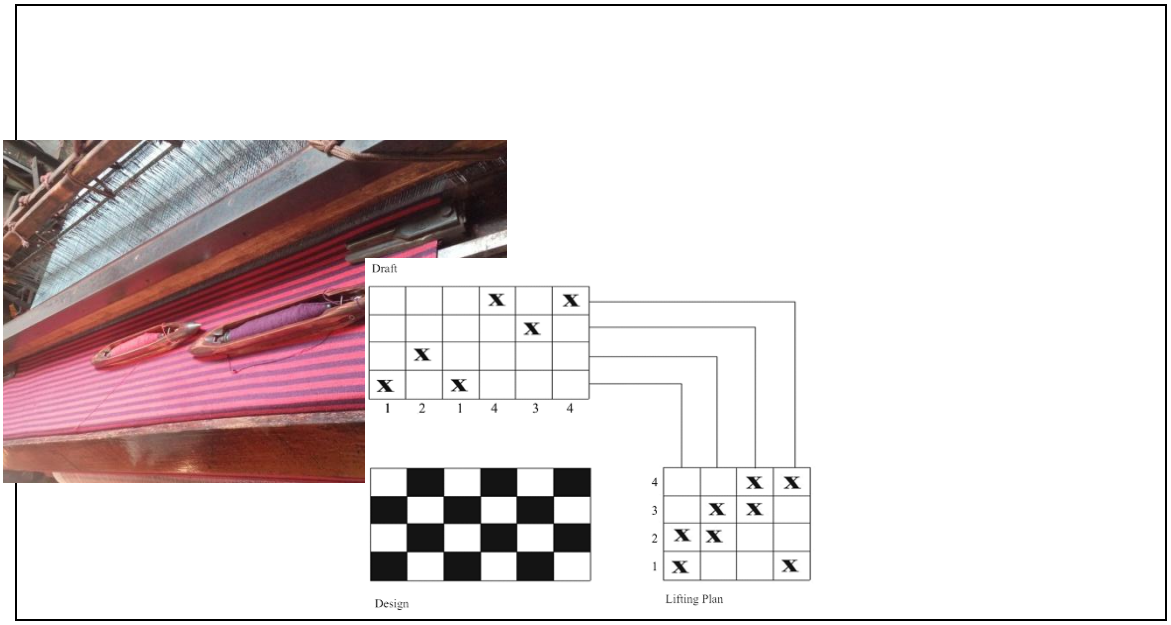


Figure 7. Weaving of Solapur durries by using traditional loom

The loose warp ends on either side of the durries are knotted to form tassels. Durries can be classified on the basis of the loom used, the types of dyes used and the ply of the yarn are used to give different textures. The durries are then folded, stamped, packed and are ready for the consumers.

7. Evolution/Innovations in the Satranji

According to the demands of consumer's innovations and developments are needed. Although now it comes in variety of colours such as, yellow, red, blue, green, violet, etc. Usually, these days it is produced in similar patterns and colours, but, there can be exceptions with personalized orders by the customers. Since the last decades, the artisans have been using power looms for manufacture the durries to increase the productivity. Initially the durries were made of pure cotton but now a day's polyester cotton (P/C) blends are more used as cost friendlier and durability. The fancy yarns or novelty yarns are also make it more attractive and fashionable in growing trends. (Srivastava, 2014)

There has been remarkable evolution in various fields such as:

7.1 Raw Materials

The materials have also evolved in the time being, the artisans have started to use cotton blends, Zari and other individual yarns. While earlier it was 100%cotton.

7.2 Color Variation

Earlier, only 2-3 colors were used in one durries while now it is made up of at least 7-8 colors and bright colour combinations. Plain durries were more popular before, while now the striped bands of different colors make it look eye-catching and contemporary.

7.3 Design/Pattern

Durries have always been a major priority in Maharashtra houses as their home furnishing set. It has been observed that, these durries are very durable and are widely available in many places. Earlier it used to be only striped but with the time artisan made changes in the design too and came up with different sizes, shapes, and motifs.

7.4 Technological Advancement

Origin of durries was on a handloom from the 2 decades back run on handlooms but from last decades the industry has shifted on power looms. (Diwanji, 2015)

7.5 Design Possibilities & Products Diversifications

The market need is declining day by day with more and more popularity of synthetic durable sheets and fancier durries. The design is not very appealing and hardly thought over by the

makers and hence the market is barely functional and not aesthetics based. Durries incorporate wide range of colours. The colours used are very bright and attention grabbing. The well-balanced combination of warm & cool colours and products diversifications are beautifully achieved and that can attract the consumers.

Figure 8: Innovative Satrangi durries and products

8. Findings of the Research

The primary research carried out at Solapur cluster with the questionnaire developed for getting information about the craft, techniques, processes and marketing. The 43 weavers interrogated about the same and findings are as follows:

- Most of the artisans (94%) are from Maharashtra and rest from Andhra Pradesh. 23% craft persons learn craft through artisans, majority of workers learned the durries making during their job. The weavers continued by their choice for earning their livelihood because a hereditary craft and making livelihood easier.
- 88% artisans use cotton yarns rest other yarns are rayon, polyester, wool, novelty yarn for the aesthetic purpose.
- Majority of weavers are using the reactive dyes (31%) for dyeing of cotton yarns for bright colours and others dyes are used as direct, natural and napthol dyes. Majority of weavers using traditional colour palette, patterns and design schemes for aesthetic improvements. Bright colours and novelty yarn are parameters which can increase the sales and the demand by the customers.
- Fly shuttle (49%) looms is mostly used with followed by pit loom, back strap loom. The introduction of power loom increase the productivity in limited amount of time. Majority of durries fabric is in plain weave and derivatives like weft rib where weft is dominant then warp rib.
- Majority of weavers (93%) selling their product through the retail market. The better quality of raw material is only selling parameters as per discussion with weavers. The other problem facing by the weavers is shortage of skill weavers as new generation are not ready the learn the intricacy of the craft and health issues (41%) like dust, less contemporary designs (41%) and more working hours (18%).
- The size of product (59%) is major parameter followed by product diversification (28%) from last two decades.

The majority of durry making artisans are not getting appropriate support from the internal corporations like NGOs, government bodies, social enterprises etc.

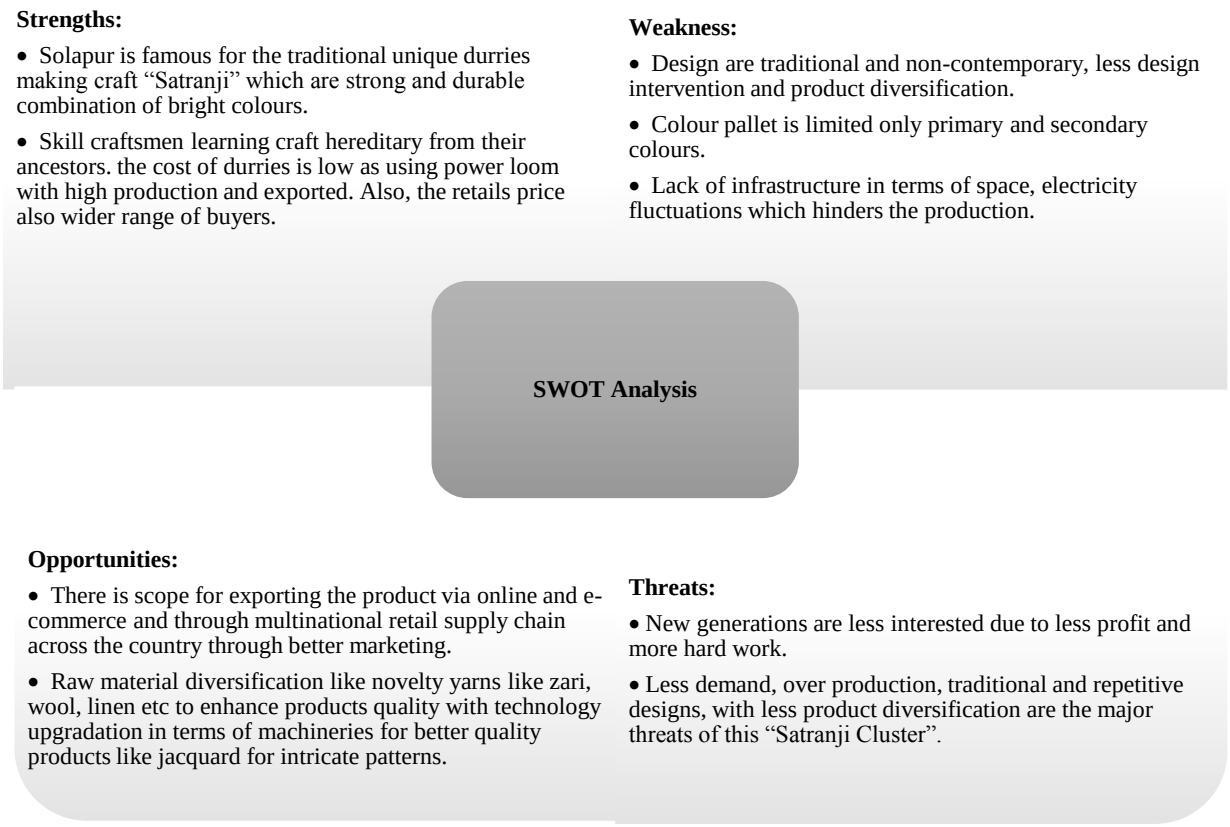
9. Existence Market of Satranji

The local market of satranji durries caters the demand of the schools, hostel and domestic needs etc. In Maharashtra, the manufacturers sell durries to places like Mumbai, Pune,

Ahmednagar, Nasik, Kolhapur, etc. Now the advent of e-commerce broad e-retailing spectrum by all major platforms like Amazon, shop clues, eBay etc. Some of the major suppliers are Gangji textiles, Divya Mantra, Gmk Exim Pvt Ltd. etc. at Solapur. The major export countries are Bangladesh, China, New Zealand and Europe regions etc. In the international market the cost could go up to 300$ - 700$ as per the design, raw materials like cotton, viscose or wool blends etc. (Anon., 2015).

There is the need of contemporary design, patterns and colour palette which meet the customer demands with durability. So, market is shifting from convectional durries to more sturdy and fancier durries. (Bhor, 2015)

10. SWOT Analysis



11. Conclusion

The Indian textile industry has an overwhelming presence in the economic life of country. Apart from providing one of the basic necessities of life, the textile industry plays a pivotal role through its contribution to industrial output, employment generation and the export earnings of the country. Solapur, being the hub of textiles, the way the artisans chose to

construct these products with such complicated techniques was immensely astonishing and inspiring. The decorative painted doors in bright yellow, turquoise or creams, gave a very artistic and traditional vibe to the Solapur. The rich traditions of hand woven cotton durries manufacturing with seven colours in are sighted member's coordination and contribution that generate happiness is an example that wealth is not only benchmarks of happiness. Presently using shuttle power looms and polyester cotton blend yarn has transformed the craft. The warp rib technique in which weft is concealed, it provides, the freedom of changing weft. Satranji is widely using to develop the other aesthetics and functional products as per the demand of the consumers.

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Endosymbiont Bacteria composition in Granary Weevil *Sitophilus Granarius* populations

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Abstract

Wheat is one of the most important crops cultivated in the world. The biggest post- harvest problem in wheat is the presence of storage pests. The granary weevil *Sitophilus granarius* (Coleoptera: Curculionidae), which causes serious product losses, is one of the important pests of wheat. Endosymbionts are commonly found in arthropods and have many different effects on them. So, they have the potential to be used in pest control. In this study, the presence of *Wolbachia* (W), *Rickettsia* (R), and *Spiroplasma* (S) endosymbionts and multiple infections were investigated in *S. granarius* individuals taken from five provinces representing four different regions of Turkey. *Wolbachia*, *Rickettsia*, and *Spiroplasma* infections were found to be 68.75%, 41.66%, and 37.50%, respectively. When it was looking at multiple infections, W+R, W+S, and W+R+S ratios were recorded as 16%, 18.75%, and 12%, however, S+R infection was not found.

Keywords: *Sitophilus granarius*, *Wolbachia*, *Rickettsia*, *Spiroplasma*, Türkiye

Introduction

Symbiosis was first defined by Albert Frank in 1877 as "the presence or living of one of two different species in the other", then in 1879, Antenna de Bary defined symbiosis as "the coexistence of two different organisms", which allowed it to enter the literature (Sapp, 1994). Symbiotic life is a common way of life seen in many multicellular creatures. Approximately 10-20% of insect species depend on obligate bacteria to maintain their viability and reproduce. Bacteria constitute the most important members of the microbial flora of the insect, insects and microorganisms suitable for creating food, to assist in the digestion of nutrients, beneficial enzymes produce, synthesize vitamins, nitrogen, and pathogens of insects produce pheromones bind by having to provide important contributions to compete with insect life. However, despite all these beneficial effects, there are also bacteria that kill, sicken, deactivate and control insects (Stouthamer et al., 1999). In recent years, research on the microflora of the insect body, especially the intestinal microflora, has increased. There seem to be two main reasons for this. Insect pathogens of this microflora can be used for

biological control of harmful insects (Dillon et al., 1997). Endosymbiont is the general name given to organisms that live in the body or cells of another living thing in a mutualistic relationship.

Symbiotic bacteria affect the reproductive behavior of their hosts in four main ways. These; cytoplasmic incompatibility, promoting feminization, promoting parthenogenesis, are male lethality (O'Neill et al., 1992).

Infection with more than one genus of reproductive parasitic endosymbionts (RPE-reproductive parasitic endosymbionts) or multiple races of the same genus is common (Malloch et al., 2000; Jaenike et al., 2010). Benefits of hosting multiple symbionts simultaneously may include improved resistance to natural enemies (Oliver et al., 2006; Guay et al., 2009). Co-infections with several different endosymbiont species in the same host are common in various insect groups (Goto et al., 2006).

In the studies, endosymbiont composition differs in different region and/or country populations of the same species of insect. *Wolbachia, Rickettsia* and *Spiroplasma* were commonly diagnosed when endosymbiotic bacteria analyzes with stored crop pest species were examined (Gündüz and Douglas, 2009). Identification of endosymbionts in pest populations in stored grain is crucial for the development of population management strategies. In this study, the presence of endosymbionts and multiple infections in *S. granarius* populations were revealed.

Material and Method

Insect collecting

Eight different *S. granarius* populations collected from different provinces in Turkey (Ankara, Diyarbakir, Konya, Isparta, Burdur, Elazığ) were studied. Six individuals randomly selected from the populations were placed in eppendorf tubes in 96% ethanol and kept at -20 ºC until used in the experiments (Table 2.1).

Table 2.1. *Sitophilus granarius* populations used in the study

Population	City
C3	Diyarbakır
D2	Elazığ
E3	Konya
E16	Konya
G1	Isparta
G2	Isparta
B2	Ankara
H2	Burdur

DNA Extraction

Individuals were incubated in a water bath at 56 °C for 60 minutes in the mixture, which was completed by adding 5 ml of commercial colorless detergent and 2 grams of salt, and the final volume was completed to 50 milliliters. Then, DNA extractions of 48 individuals in total were performed in accordance with the commercial kit protocol.

The samples taken from the hot water bath were removed from the mixture and washed three times with distilled water and then dried using blotting paper. Individuals of the samples were crushed separately in a sterile 1.5 ml eppendorf tube using liquid nitrogen and sterile crushing sticks until the brownish color turned completely white. For the isolation of the crushed samples, the commercial kit protocol was modified and the following steps were followed sequentially.

The quality and quantity analysis of DNA obtained after extraction, values between 1.65 and 1.9 nanograms/microliter were determined using nanodrop.

Polymeraze Chain Reaction

After the literature review, the most common primers were selected and synthesized (Table.2.2).

Table 2.2.Primary information of *Wolbachia*, *Rickettsia* and *Spiroplasma*

Wolbachia F; Tb: 58°C	5'-TGGTCCAATAAGTGAAGAAACTAGCTA-3'
Wolbachia R; Tb:59°C	5'-AAAAATTAAACGCTACTCCAGCTTCTGCAC-3'
Rickettsia F; Tb:51°C	5'-AGAGTTTGATCATGGCTCAG-3'
Rickettsia R; Tb: 52°C	5'-CATCCATCAGCGATAAATCTTTC-3'
Spiroplasma F; Tb:51°C	5'-GCGCAGACGGTTTAACAAG-3'
Spiroplasma R; Tb; 53°C	5'-TCCGCCACTGGTGTTCCTC-3'

The primers, which were sent as dried in HPLC purity, were dissolved using the specified amount (508-675µL) of nuclease-free water to become 100µM stock. The thawed primers were stored at -20°C until use. The materials and protocol of the commercial kit were used for PCR application (Table 2.3).

Table.2.3. Preparation of PCR samples

25µl Taq PCR Master Mix (2.5 units Taq DNA Polymerase, 1x PCR Buffer, 200µM of each dNTP, 1,5mM MgCI2)
5µl 10x Primer Mix (2µM of each primer) (2,5µl F- 2,5µl R)
15µl RNAse-free water
5µl DNA
Total volue; 50µl

Table.2.4. Instrument program for touchdown PCR analysis

Initial Denaturation 94 °C 3 dk
Denaturation 94°C 1 dk
Annealing 60°C 1 dk (11x:-1°C, 60°C-50°C)
Extention 72°C 1 dk
11x
Denaturation 94°C 1 dk
Annealing 55°C 1 dk
Extention 72°C 1 dk
25x
Final Extention 72°C 10 dk
+4 °C

Electrophoresis

The final volume of the samples from PCR is 50µl. 5 µl of Bromophenol Blue was added to each tube and the final volume was 55 µl. TBE buffer with 10x concentration was prepared. 1% agarose was used for each gel. 2 µl of the marker was loaded into the 2 wells at the right and left ends. 25µl of PCR product was loaded into each of the other wells. Electrophoresis programs suitable for each endosymbiont, 90 Volts for Wolbachia, 90 minutes at 150mA; 60 Volts for Rickettsia, 60 minutes at 100mA, and 60 Volts for Spiroplasma, 40 minutes at 100mA. For each endosymbiont, the running process was carried out separately in the gel electrophoresis device. After gel electrophoresis, populations were visualized using a UV cabinet.

Results and Discussion

According to the obtained gel images, the detection rates of *Wolbachia*, *Rickettsia* and *Spiroplasma* belonging to 48 scanned samples are given in the table below for each endosymbiont (Table3.1).

Table.3.1. Presence rate of endosymbionts in wheat weevil populations (%)

Populations	***Wolbachia***	***Rickettsia***	***Spiroplasma***
Diyarbakır (C3)	83	66.4	33.2
Isparta (G1)	83	83	66.4
Isparta (G2)	33.2	0	16.6
Konya (E3)	100	49.8	16.6
Konya (E16)	0	33.6	16.6
Elazığ (D2)	100	49.8	83
Ankara (B2)	66.4	16.6	0
Burdur (H2)	100	33.6	49.8
Average	**70.7**	**41.5**	**35.3**

Contamination rates for each endosymbiont averaged 68.75% for *Wolbachia*, 41.66% for *Rickettsia* and 37.5% for *Spiroplasma*. Tunçbilek et al. (2015) detected *Wolbachia* and *Arsenophonus* in Antalya *S. granarius* populations, but *Spiroplasma* was not detected. İpekdal and Kaya (2020) determined that *Wolbachia*, *Rickettsia* and *Spiroplasma* were 25%, 70% and 10%, respectively, in the *S. granarius* Kırşehir population. The endosymbiont composition of the same insect differs in different region and/or country populations (Su et al., 2013).

Several studies have reported that the infection frequencies of *Wolbachia* in natural insect populations are 15–30% (Werren et al., 1995, West et al., 1998, Werren and Windsor, 2000, Kikuchi and Fukatsu, 2003, Tagami and Miura, 2004). Based on these and other results, Hilgenboecker et al. (2008) statistically estimated that 66% of insect species are infected with *Wolbachia* with variable frequencies. Considering the high *Wolbachia* infection frequency (30%) among insects, the *Wolbachia* infection status or *Wolbachia* genotype can be useful as a source of additional information to add to insect genomic data such as DNA barcoding (Frézal and Leblois, 2008).

Carvalho et al. (2014) investigated *Sitophilus zeamais* primary endosymbiont (SZPE), *Sitophilus oryzae* primary endosymbiont (SOPE), *Wolbahia* (WSZ) from *Sitophilus zeamais* and *Wolbachia* (WSO) endosymbiont from *Sitophilus oryzae* in populations taken from different countries in his study with *Sitophilus* species. *S.zeamais* SZPE, WSZ, WSO triple infection was found in the Mexican population, and SZPE , WSZ dual infection was found in

the Brazilian, Mexico, Colombia, Panama, India, Thailand populations. SOPE and WSO endosymbionts have been found in *S. oryzae* populations of Mexico, Brazil, Greece, Peru, Australia, Iran and Ecuador.

The presence of endosymbionts *Wolbachia (W), Rickettsia (R),* and *Spiroplasma (S)* in each of the six individuals studied in each population for multiple infections is given in Table 3.2.

Table.3.2. Multiple infection states of endosymbionts in each individual in *Sitophilus granarius* populations

Populations	**Number of individual having double infection**			**Number of individual having triple infection**
	W+R	**W+S**	**S+R**	**W+R+S**
Diyarbakır (C3)	3	2	-	-
Isparta (G1)	1	-	-	3
Konya (E3)	3	1	-	-
Elazığ (D2)	1	3	-	2
Konya (E16)	-	-	-	-
Ankara (B2)	-	-	-	-
Isparta (G2)	-	1	-	-
Burdur (H2)	-	2	-	1
Total specimen number and Average presence ratio (%)	**8** **%16.6**	**9** **% 18.7**	**0** **0**	**4** **%8.3**

The rates of W+R, W+S and S+R dual infections were found to be 16.6%, 18.7% and 0%, respectively, while W+R+S triple infection was 8.3%. İpekdal and Kaya (2020) found the prevalence of W+R , S+R, W+S dual infections to be 20%, 5%, 0% and W+R+S triple infection as 5% in Kırşehir *S.granarius* populations. Kayegama et al. (2010) examined Sitophilus species, they found only NFRI infection of three (NFRI, Tsukuba, Kanagawa) *Wolbachia* strains for *S. zeamais*, but no infection was found in two (NFRI, Italy) strains for *S. oryzae* and from *S. granarius* (UK).

Infection with more than one genus or race of endosymbionts is common (Malloch et al., 2000; Jaenike et al., 2010). Benefits of hosting multiple symbionts simultaneously may include improved resistance to natural enemies (Guay et al., 2009). Co-infections with several different endosymbiont species in the same host are common in various insect groups (Goto et al., 2006).

There is also evidence of an antagonistic relationship between RPEs. For example, Goto et al. (2006) reported a negative interaction between *Spiroplasma* and *Wolbachia*. However, since S+R dual infection has never been found in populations, it may be correct to think that these two endosymbionts can have an antagonistic effect on each other. Again, triple infection is present in populations, in this case *Wolbachia, Rickettsia* and *Spiroplasma* can be present in an individual at the same time and do not have an antagonistic effect.

Chen et al. (2012), *Wolbachia* is required for oocyte production. Vigneron et al. (2012), on the other hand, showed that symbiotic organisms reduce the living standards of the insect while fighting against pathogens and that there are new perspectives on host immunity, and reported that the control methods are increasing due to the decrease in insect resistance owing to endosymbionts and pathogens.

At present, nothing is known about the effects of oral administration of *Wolbachia* endosymbionts on human health. However, some *Wolbachia* strains which are essential endosymbionts of the pathogenic nematodes *Brugia malayi* (Brug) causing lymphatic filariasis, or *Onchocerca volvulus* Leuckart causing river blindness, can induce severe inflammatory reactions in humans when they are released into the blood (Cross et al., 2001, Saint André et al., 2002). Therefore, further studies on the possible effects of various *Wolbachia* strains on human health are required. In this context, the present classification of *Wolbachia* by the *wsp* gene, which is known to induce an innate immune system response (Brattig et al.,2004), is valuable.

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Lectins and Lectin Histochemical Applications

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Abstract

Lectins are proteins of non-immune origin that can recognize and bind structural epitopes of specific carbohydrates. Carbohydrate biochemistry and carbohydrate biology, namely glycobiology, is a field that studies the structures, biosynthesis and biological functions of sugar chains commonly found in nature. Lectins, play their biological roles by binding to carbohydrate chains in glycoproteins or glycolipids localized in the tissues from at least two places. Many lectins are currently being used as important tools in the fields of biochemistry, cell biology and immunology, as well as for diagnostic and physiologic purposes in cancer research. They are important tools in cytochemistry, histochemistry and immunohistochemistry. Lectin histochemistry is one of the tools to identify differences between carbohydrates and glycoproteins. As a result of revealing the glycoconjugate character in healthy tissues by lectin histochemistry, the changes in pathological conditions will be determined and the diagnosis of diseases will be easier. In this review, it was tried to give brief information on lectins, their importance and importance of lectin histochemistry.

Keywords: Glycobiology, glycoconjugate, lectin, lectin histochemistry

Introduction

The molecules that precipitate glycoconjugates and agglutinate cells are lectins. Lectins contain at least two sugar binding sites (Goldstein et al., 1980). Lectins, known as phyto-agglutinins for many years due to the fact that some plant extracts agglutinate erythrocytes, play their biological roles by binding to carbohydrate chains in glycoproteins or glycolipids localized in the tissues from at least two places (Seyrek ve Bildik, 2001).

Glycoproteins act as biological labels whose carbohydrate moieties are read by lectins. The lectins found in all organisms are protein or glycoprotein substances that bind with high affinity and specificity to carbohydrates on the cell surface and organelles (Lehninger et al., 2005; Öztabak, 2005). Because lectins were originally derived from plants, they were thought of as plant-specific compounds. However, over time, lectins have been obtained from other

living things (Goldstein and Poretz, 1986). It has been determined that lectins are found in almost all living groups in nature (Sharon and Lis, 2007). In addition to their natural occurrence, they are also known to be produced synthetically by recombinant techniques. In studies, it was determined that lectins, which were thought to be found only in higher plants, were found in lower-class plants, vertebrates and invertebrates (Galanina et al., 1997). The presence of many types of lectins has been reported in viruses, bacteria, fungi, plants, animals and humans (Öztabak, 2005). Although it has been revealed that they take place in a wide range from mollusks to vertebrates, what kind of role they play in the organism is still controversial (Gabius, 1997). It has been reported that these proteins are separated from other molecules, do not have enzyme and antibody properties, and their synthesis in cells is controlled by genes, not as a result of stimulation by any antigen (Barondes, 1988).

Most of the lectins are glycoproteins, and unlike antibodies, they do not show structural similarity. They may consist of eighteen different polypeptide chains, as well as generally consisting of 2 to 4 units, and as a rule, each unit has the ability to bind a carbohydrate residue (Rini, 1995). The hydrogen bond partners in the carbohydrate-recognizing portions of each type of protein bind to specific carbohydrates, so lectins can be easily distinguished by the sugars to which they are attached (Lehninger et al., 2005).

Animal Lectins

Lectins obtained from vertebrates are named as S-type, C-type, P-type, singlectins, pentraxins according to their binding specificities (Gabius, 1997).

S-type lectins, which are the most common group of animal lectins, are also called galectins. In addition to 12 identified mammalian galectins, galectins have been reported to be isolated from lower vertebrates, worms, birds and other animal species. (Sharon and Lis, 2007). Galectins are a family of proteins that have a small molecular weight, do not require calcium for their functions, play a role in cell growth, activation, cell-cell and cell-extracellular matrix interactions, and can bind to carcinoembryonic antigen and laminin (Seyrek et al., 2004). Intracellular galectins are found in the cytosol and nucleus, and extracellular lectins are located on the cell surface and in the extracellular space (Kasai and Hirabayashi, 1996; Perillo and Marcus, 1998), and that all of these lectins have affinity for galactose (Perillo et al., 1998). It has been stated that galectins play an important role in events such as initiation of cell death, striated muscle differentiation and regeneration, and stem cell proliferation. Also it has been reported that galectins have functions such as eliminating pathogenic fungi, increasing and decreasing parasitic attachment in the

extracellular matrix and tumor angiogenesis (Kilpatrick, 2000). In addition to determining the carbohydrate composition in the cells, it has been determined that galectins have a role in the organism during oncological, fibrosis, infected and inflammatory diseases (Varki et al., 1999). Galectin-3 is a member of galectin family with 30-kD -galactoside-binding protein. Although the exact function of the galectin-3 in cancer development is unclear, galectin-3 expression is associated with neoplastic progression and metastatic potential (Seyrek et al., 2004).

C-type animal lectins need Ca^{+2} ions to bind to glycoconjugates. It has been reported that they are divided into three major classes: endocytic lectins, collectins, and selectins (Drickamer, 1988). The class called lecticans is also considered the C-type lectin group. Collectins, another large class of C-type animal lectins, got this name because of their collagen-like structure. Collectins are types of lectins that are soluble and not membrane bounded. The last major class of C-type animal lectins, selectins, have been reported to have three types: E, P, and L-selectins (Sharon and Lis, 2007).

Selectins are plasma membrane lectins that bind to carbohydrate moieties in the extracellular matrix or on the surfaces of other cells and thus mediate the flow of information between and between the cell matrix. The adhesion of bacterial and viral pathogens to target cells in other animals occurs through the binding of lectins from pathogens to the oligosaccharide in the target cell (Lehninger et al., 2005). It has been reported that E-selectins originate from the leukocyte membrane and are soluble lectins. It is known that their function is to participate in cell adhesion in general. P-selectins originate from platelets. It has been determined that P-selectins are involved in the transfer of leukocytes, wound healing and blood coagulation (Varki et al., 1999; Nilsson, 2007). It has been detected that L-selectins are found on the surface of active leukocytes and their amounts increase in the case of tumors. It has been reported that L-selectins can affect monocytes, neutrophils, natural killer cells, and T and B lymphocytes in the bone marrow (Varki et al., 1999).

P-type lectins are known to be a small group of animal lectins with only two members. It has been reported that both of these lectins are mannose-6-phosphate (Man6P) receptors and are found in many cell types (Sharon and Lis, 2007).

Selectins are called IgG-like lectins that bind to sialic acid. It has been reported that it is found in oligodendrocytes and Schwan cells in the nervous system (Gaudin et al., 1995).

Plant Lectins

It is known that lectin is obtained from higher plants (Goldstein and Poretz, 1986) and they are found in legumes such as soybeans, beans, lima beans, lentils, chickpeas and peanuts for

many years. It has been shown that over time, they are found in a large part of other plants and consumed as food (Sharon and Lis, 2007). It is known that lectins play a role in many events such as agglutination, mitogenic stimulation and death of cells, and they are generally resistant to temperature and proteolytic enzymes such as intestinal bacteria (Santos et al., 2014; Muramoto, 2017).

Legume lectins are the largest group of plant lectins. It has been reported that over a hundred lectins are obtained from legumes. It was stated that lectin isolation from legumes was obtained from seeds (Van Dame et al., 1998). In addition, lectin can be obtained from vegetative tissues of plants. It has been determined that lectins found in vegetative tissues constitute 30% of the total protein rate, but they can be isolated only at a rate of 0.01% (Peumans et al., 2000).

Legume lectins consist of two or four subunits. Each subunit weighs 25-30 kDa and has a single carbohydrate binding end. The subunits of many legume lectins consist of a single polypeptide chain of approximately 250 amino acids (Sharon and Lis, 2007). It has also been reported that the calcium and magnesium ions required for carbohydrate binding in the subunits are also tightly bound (Van Dame et al., 1998).

Since many lectins, such as legume lectins, are relatively stable against heat denaturation and proteolytic digestion, the digestive tract is constantly exposed to biologically active lectins contained in fresh and processed foods (Muramoto, 2017). The intestinal tract of humans and animals is constantly exposed to dietary lectins. After reaching this channel, most of the lectin binds to carbohydrates in epithelial cells (Pusztai and Bardocz, 1997). Binding in the small intestine is more pronounced, but attachment occurs throughout the digestive tract from the oral cavity to the distal colon. Because surface glycosylation is different in different parts of the system, binding is not uniform, and specific regional effects are seen with different lectins (Jordinson et al., 1999). Through a combination of these and other effects, lectins affect the use of diets, the growth and health of animals. Poorer-than-normal growth rates have been observed when animals are fed raw soybeans or soybean oil (oil extraction from protein-rich seeds) food (Sharon ve Lis, 2007).

It is now well established that many lectins are toxic, inflammatory, resistant to cooking and digestive enzymes and present in much of food. Lectins interact with the epithelial surface of the intestine and cause adverse effects, sometimes called food poisoning, in humans and animals (Hamid and Masood, 2009, Muramoto, 2017). Meanwhile, many interesting biological functions have been discovered in lectins originating from foods or foodstuffs, including immunomodulating effects, selective cytotoxicity against cancer cells,

antimicrobial and insecticidal activities, modulating effect on the intestinal transport system, and so on (Muramoto, 2017). Studies in laboratory animals have shown that ingested lectins have a wide range of effects that might be relevant to human diseases. These include changes in the differentiation as well as the proliferation of intestinal and colonic cells (Hamid and Masood, 2009).

Lectin Histochemical Applications

It is stated that carbohydrates, the importance of which has just begun to be understood due to their special functions in cells, are much more convenient to store information thanks to their wide variety of connections (1-3, 1-4, 1-6), anomeric structures (α or β) and modifications (sulphated, phosphated) compared to nucleotides or amino acids (Harmankaya et al., 2014; Habermann et al., 2021). Carbohydrate biochemistry and carbohydrate biology, namely glycobiology, is a field that studies the structures, biosynthesis and biological functions of sugar chains commonly found in nature. Glycoproteins forming glycoconjugates are bound with covalent bonds to oligosaccharide side chain rows, polypeptides and lipids in proteoglycans and glycolipids (Karaçalı, 2003). Glycoconjugates, which are formed as a result of the binding of carbohydrates to proteins and lipids, can be found in cell membranes, cytoplasm, organelles, and intercellular spaces and fluids. It has been stated that carbohydrates play an important role in the communication between cells and they use their own lectins as receptors while fulfilling these roles (Harmankaya et al., 2014).

Depending on their properties and distribution in tissues, lectins can play important physiological roles. They are important tools in cytochemistry, histochemistry and immunohistochemistry (Santos et al, 2014). Therefore, the binding specificity of lectins can be used to specifically elucidate the glycosylation pattern in various tissues (Keller et al. 2022).

Lectin histochemistry is one of the tools to identify differences between mucin glycoproteins (Brooks and Carter, 2001). Lectin histochemistry is used to describe cellular and subcellular features in normal and neuropathological events in humans and experimental animals (Zatta and Zambenedetti, 2000). The abbreviations, sugar binding specificities and specific groups of some lectins used in lectin histochemical studies are listed in Table 1.

Table 1. Binding specifities and abbreviations of some lectins (Keller et. al. 2022)

Lectins	**Abbreviations**	**Preferred sugar specificity**	**Specificity groups**
Concanavalin A	ConA	αMan, αGluc	Mannose
Dolichos biflorus agglutinin	DBA	αGalNAc	Gal/GalNAc
Datura stramonium lectin	DSL	$(GlcNAc)_{2–4}$	GlcNAc
Erythrina cristagalli lectin	ECL	Galβ4GlcNAc	Gal/GalNAc
Griffonia (*Bandeiraea*) *simplicifolia* lectin I	GSLI	αGal, αGalNAc	Gal/GalNAc
Griffonia (Bandeiraea) simplicifolia lectin II	GSLII	α or βGlcNAc	GlcNAc
Artocarpus integrifolia (Jackfruit) seeds	Jacalin	Galβ3GalNAc	Gal/GalNAc
Lycopersicon esculentum (Tomato) lectin	LEL	β-1,4 GlcNAc oligomers	GlcNAc
Lens culinaris agglutinin	LCA	αMan, αGlc	Mannose
Maackia amurensis lectin II	MAL II	Neu5Acα3Galβ3GalNAc	Oligosaccharide & *N*-acetylneuraminic acid
Phaseolus vulgaris Erythro agglutinin	PHA-E	Galβ4GlcNAcβ2Manα6 (GlcNAcβ4) (GlcNAcβ4Manα3), Manβ4	Oligosaccharide & *N*-acetylneuraminic acid
Phaseolus vulgaris Leuco agglutinin	PHA-L	Galβ4GlcNAcβ6, (GlcNAcβ2Manα3), Manα3	Oligosaccharide & *N*-acetylneuraminic acid
Arachis hypogaea (Peanut) agglutinin	PNA	Galβ3GalNAc	Gal/GalNAc
Pisum sativum agglutinin	PSA	αMan, αGlc	Mannose
Ricinus communis agglutinin	RCA_{120}	Gal	Gal/GalNAc
Glycine max (Soybean) lectin	SBA	α > β GalNAc	Gal/GalNAc
Sambucus nigra lectin	SNA	Neu5Acα6Gal/ GalNAc	Oligosaccharide & *N*-acetylneuraminic acid
Solanum tuberosum (Potato) lectin	STL	GlcNAc Oligomers, LacNAc	GlcNAc
Ulex europaeus agglutinin	UEAI	α-Fuc	Fucose
Vicia villosa agglutinin	VVL	GalNAc	Gal/GalNAc
Triticum vulgaris (wheat germ) agglutinin	WGA	GlcNAc	GlcNAc

Wheat germ agglutinin, succinylated	WGA-s	GlcNAc	GlcNAc

Fuc, fucose; Gal, galactose; GalNAc, N-acetylgalactosamine; Glc, glucose; GlcNAc, N-acetylglucosamine; Man, mannose; NeuAc, N-acetylneuraminic acid.

Lectins have been widely employed in histochemical studies to map glycosylation in cells and tissues (Brooks, 2022).

Seyrek et al. (2004) examined the localization of galectin-3 in 16 cases with invasive ductal breast carcinoma. In their lectin immunohistochemical analysis, they reported that galectin-3 was predominant in connective tissue, infiltrative tumor cells in connective tissue and ductal epithelial cells, however this expression was different in ductal epithelial cells and staining was particularly evident in migrating ductal epithelial cells. They (Seyrek et al., 2004) were suggested that because of especially infiltrated tumoral cells and cells that fall into the duct lumen express galectin-3 abundantly, galectin-3 may have an important role in the development of breast carcinoma.

In the literature, there are several researches about glycoconjugate patterns of different tissue mucosa in some invertebrates (Zorlu et al, 2011; Çınar et al, 2014), fishes (Al-Banaw et al, 2010; Demirbağ et al, 2012a; Öztop et al, 2021a), birds (Çınar and Demirbağ, 2012a; Öztop et al, 2021b) and mammals (Pedini et al, 2008; Demirbağ et al, 2012b; Zorlu et al, 2013; Kuru et al, 2017). In these studies, researchers revealed the lectin histochemical structure, distribution of glycoconjugates and regional differences in healthy organisms.

There are different studies to reveal the normal lectin histochemical character of the respiratory tract of some invertebrates (Castells et al., 1990) and some poultry (Gheri et al., 2000; Van Poucke et al., 2010), mammals (Çınar and Demirbağ, 2012b; Demirbağ and Çınar, 2012; de Fátima Martins et al., 2019; Çınar, 2020) and human (Paulsen et al. 2001; Van Poucke et al., 2010). Lectin histochemical structure of respiratory tract has similarities in some mammalian species, but showed differences between the regions of the respiratory tract.

While lectin histochemistry is usually carried out manually on single slides, it was claimed that (Keller et al. 2022) a fully automated immunostaining system offers an easy, standardized, and high throughput system. The researchers (Keller et al. 2022) notified that their results showed that lectin staining profiles using the implemented protocol on the automated system were constant and suitable for high throughput morphological studies.

Conclusion

The functions of lectins in nature are extremely diverse, and in solution or in the cell these functions depend on their ability to recognize and bind the carbohydrate moieties of glycoconjugates. Because carbohydrates can be specific to species, tissue or cell (Fujita, 2002). Lectin histochemistry is a helpful diagnostic and prognostic method in diseases and can be used to better understand pathogenesis or to identify targets for possible therapy (Keller et al, 2022). As a result of revealing the glycoconjugate character in healthy tissues by lectin histochemistry, the changes in pathological conditions will be determined and the diagnosis of diseases will be easier. In conclusion, lectins and lectin histochemical methods seem to be important tools for researchers in different fields, thanks to their versatile use.

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Physical Activity and Hypertension

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Abstract

Hypertension is a very common disease with an extremely high incidence. It is estimated that approximately 30% of the adult population in the world will be diagnosed with hypertension by 2025. Hypertension is not only a disease that progresses with the increase in blood pressure values, but it is a serious health problem that is a very important cause of morbidity and mortality with the target organ damage it causes. It is responsible for 13% of all deaths worldwide. Physical activity reduces blood pressure and cardiovascular mortality risk in both sexes. Sedentary behavior has negative effect on body composition, blood pressure and cardiometabolic health in hypertensive patients. In contrast, physical activity significantly improves the patient's general cardiac parasympathetic system, vagal tone, which reduces resting heart rate and systolic blood pressure in adults, resulting in significant improvement in hypertensive patients. Physical activity and exercise practices in hypertensive patients should be individualized according to the clinical and functional status of the patient. Moderate-intensity aerobic, isometric and dynamic resistance exercises can be used alone or in combination to reduce blood pressure in hypertensive individuals. In this review, it is aimed to give information about the prevention and therapeutic efficacy of physical avtivity in hypertension.

Keywords: Physical Activity, Hypertension, Exercise.

Introduction

Hypertension (HT) is an important risk factor for the development of many cardiovascular conditions, including stroke and coronary artery disease. HT is defined as chronic systolic blood pressure (SBP) greater than 140 mm Hg and/or diastolic blood pressure (DBP) greater than 90 mm Hg and is classified as essential (primary) or secondary HT (Hall et al. 2012).

HT in which the trigger for blood pressure (BP) increase is not clear is called essential HT. Approximately 95% of all HT cases are categorized as essential HT, and the remaining 5% are categorized as secondary HT caused by various medical conditions (kidney disease, tumors, etc.) (Behrens and Leitzmann 2013). Essential HT is believed to be caused by a complex combination of genetic predisposition and lifestyle factors. Weight gain associated with physical inactivity, excessive alcohol use, smoking and malnutrition is known to play an important role in the development of essential HT. It is accepted that physical inactivity alone is responsible for 5-13% of the risk of developing HT (Geleijnse ve ark., 2004).

HT, which is becoming increasingly common among adults with the modern lifestyle and decreasing physical activity (PA), is expected to affect 30% of adults worldwide by 2025. It is foreseen that this situation will be a serious burden for the society. Because of this situation, effective treatment of HT is becoming increasingly urgent. In this sense, lifestyle changes in addition to pharmacological treatment will provide an advantage in controlling BP (Bauer et al. 2014).

Diagnosis of hypertension

HT is diagnosed when SBP is >140 mm Hg and/or DBP is 90 mm Hg in repeated BP measurements in a standardized sitting position. (Table 1) (Mancia et al. 2013). In addition, ambulatory BP measurements (24-hour BP measurement) are increasingly used for both diagnosis and BP monitoring in the home environment. A nighttime BP >120/75 mm Hg in ambulatory BP measurement is considered an abnormal BP level (Elley et al. 2006).

Table 1. Classification of BP in Adults Aged 18 Years and Over

BP Category	**Systolic BP (mm Hg)**		**Diastolic KB (mm Hg)**
Optimal	< 120	and	<80
Normal	120-129	and	80-84
Slightly high	130-139	or	85-89
1st degree HT	140-159	or	90-99
2st degree HT	160-179	or	100-109
3st degree HT	≥180	or	≥110

Pathophysiology of hypertension

The first pathophysiological sign of HT is an increase in cardiac output as a result of increased heart rate and stroke volume associated with increased sympathetic activity.

Secondary to the thickening and remodeling of the vessel wall in the progressive process, peripheral resistance increases and causes further changes in BP. Endothelial dysfunction and atherosclerosis of the great vessels can cause left ventricular cardiac hypertrophy and renal dysfunction secondary to prolonged hypertension. In addition, various cardiovascular complications (stroke, myocardial infarction) may occur in relation to increased SBP and DBP (Lacey et al. 2018).

Treatment approaches in hypertension

Evaluation of cardiovascular major risk factors and lifestyle and making necessary modifications in order to reach target BP in hypertensive patients is a very important part of the treatment of HT (Table 2) (Chobanian et al. 2003).

Table 2. Cardiovascular Major Risk Factors

-Age (Male ≥ 55, Female ≥ 65)	-Target organ damage (TOD)
-Hypertansion	- Diabetes mellitus (DM)
-Tabocco use (Smoking)	- Dyslipidemia
-Obesity (BMI ≥ 30 kg/m2)	- History of cardiovasculer disease
-Physical inactivity	- Microalbuminuria

The traditional treatment of HT consists of a combination of lifestyle changes and pharmacological treatment (Table 3) (Mancia et al. 2013). In hypertensive patients, even small BP reductions lead to a decrease in both morbidity and mortality (Sleight et al. 2002). It is recommended to begin the treatment with lifestyle changes and to switch to pharmacological treatment if blood pressure control is not achieved (Chobanian et al. 2003). Therefore, lifestyle changes including PA increase have an important role in the treatment of BP in hypertensive patients.

Table 3. Risk Groups and Treatment Methods (Pescatello et al., 2004)

BP (mm hg)	**Risk group A (No risk factors)**	**Risk group B (At Least 1 Risk Factor not including DM,TOD)**	**Risk group C (DM, TOD with/without other risk factors)**
130-139/85-89	Lifestyle change	Lifestyle change	Medication
140-159/90-99	Lifestyle change	Lifestyle change (6 ay)	Medication
≥160/≥100	Medication	Medication	Medication

Effect of physical activity on blood pressure

It is argued that physical activity and exercise are an integral part of lifestyle changes in the prevention, treatment and control of HT. Basic exercise programs that include endurance activities prevent both the development of HT and low BP in adults with normal BP. The BP-lowering effects of exercise are seen after exercise (acute) or following exercise training (chronic). The hypotension that occurs after endurance exercises continues for hours in hypertensive patients, and then BP becomes normalized. (Eicher et al. 2010).

Acute physiological response with exercise; during aerobic exercise, an increase in cardiac output and an increase in circulation are observed to ensure perfusion of active muscles. This response occurs by neurohormonal and hydrostatic mechanisms, initially with an increase in systolic volume and then with an increase in heart rate (Ghadieh and Saab 2015).

During resistance exercises, as a result of the stimulation of the cardiovascular center in the medulla by proprioceptors (mechanoreceptors and metaboreceptors) in active muscles, SBP and DBP increase due to the pressor reflex. In addition, arterial pressure rises to balance the decreased muscle perfusion due to high intramuscular pressure that interrupts arterial blood flow during resistance exercises (Ruivo and Alcântara, 2012).

Physiological response after exercise; a hypotensive response occurs up to 22 hours after exercise. This response results from decreased levels of norepinephrine and thus inhibition of sympathetic activity, due to circulating angiotensin II, adenosine, and reduction in receptors in the central nervous system. All these factors cause a decrease in peripheral vascular resistance and an increase in baroreflex sensitivity. In addition, post-exercise hypotension is triggered by the vasodilator effect of prostaglandins and nitric oxide. Various factors such as the duration of exercise, type, clinical condition of the individual, age, ethnicity and physical fitness affect the hypotensive response that occurs after exercise (Eicher et al., 2010).

Chronic physiological response to exercise; physical activity causes neuroendocrine, vascular, and immune changes. Vascular changes include increased vessel length, luminal diameter, precapillary sphincter number, and neoangiogenesis. Exercise exerts an antihypertensive effect by causing changes in baroreceptor sensitivity, norepinephrine levels and peripheral vascular resistance. It causes changes in the expression of vasodilator and vasoconstrictor factors by increasing insulin sensitivity. While the expression of prostaglandin and nitric oxide during exercise provides vasodilation, the use of calcium channel blockers also causes vasodilation. In addition, aerobic exercise reduces left ventricular mass and wall

thickness, increases central antioxidant concentrations, decreases pro-oxidant levels and arterial stiffness, and increases central nitric oxide synthase activity, thereby improving endothelial function (Ruivo and Alcântara, 2012).

Aerobic exercise directly lowers BP by exerting an anti-inflammatory effect through the sympathetic nervous system and hypothalamic-pituitary-adrenal axis. In addition, it has been shown that repeated isometric exercise resets the activation of baroreceptors, thereby increasing the effect of antihypertensive drugs by reducing blood pressure in the long term (Chrysant 2010). In contrast, the complex mechanisms of dynamic resistance exercises that provide a small reduction in BP have not been fully elucidated (Geleijnse et al. 2004).

Various forms of exercise have different effects on hypertension

Aerobic exercises; aerobic exercises that train broad muscle groups and contain rhythmic motions, such as walking, running, or swimming, are recommended for hypertensive individuals. In normotensive individuals, regular aerobic exercises cause a reduction of 3 to 5 mm Hg in SBP and 2 to 3 mm Hg in DBP. In hypertensive individuals, this effect is even more significant, and it has been reported to cause an average of 7 mm Hg decrease in SBP and an average of 5 mm Hg in DBP. (Mancia et al., 2007; Cornelissen and Fagard, 2005). In addition, aerobic exercises are an effective practice in reducing risks such as DM or obesity that may cause deterioration in cardiovascular health. (Church, 2011). The intensity of aerobic exercise should be above the threshold level in order to provide physiological benefits. It is recommended that aerobic exercise to be done in hypertensive individuals should be planned at an intensity equivalent to 40-60% of the maximum oxygen consumption, 3-5 days a week and each exercise session should be 30-60 minutes. Hypertensive individuals with low exercise capacity can perform intermittent aerobic exercises of low intensity and duration, which are applied several times a day (Pescatello et al., 2004).

Resistance training; Weight lifting, circular training or resistance training, including concentric and eccentric contractions using resistance devices, help BP control as much as aerobic exercises. It is recommended to perform resistance exercises as 3 sets of 8-10 repetitions 2-3 days a week, equivalent to 50-60% of 1 maximum repetition for the lower extremity and 30-40% of 1 maximum repetition for the upper extremity. The patient should not hold their breath during resistance training. If resistance exercises cause an increase in DBP of 20 mm Hg or more, or if DBP rises above 120 mm Hg, exercise intensity should be reconsidered. (Ghadieh and Saab, 2015; Ruivo and Alcântara, 2012).

Although there is no study in the literature that shows the effects of isometric resistance exercises, including static contractions, in patients with risk, unstable, and high blood pressure values (Ghadieh and Saab, 2015), there are studies that show the positive effects of isometric grip strength (Kelley and Kelley, 2010) and isometric leg exercises (Cornelissen and Smart, 2013) on blood pressure.

Streching exercise; Stretching exercises lead to improvements in blood flow, decrease in arterial stiffness and increase in parasympathetic activation, resulting in decreases in BP. (Hotta et al., 2013; Hotta et al., 2018; Shinno et al., 2017). During stretching exercises, tension occurs not only in soft tissues, but also in vascular structures. The tension occurring in the vascular structures causes both structural changes and the release of vasodilator metabolites. These modifications reduce arterial stiffness, resistance to blood flow, and blood pressure (Hotta et al., 2018; Jackson et al., 2002; Kuebler et al., 2003).

Conclusion

In addition to pharmacological therapy for BP control, hypertensive patients should be included in well-planned, supervised and individual exercise training programs appropriate to the patient's functional capacity and health status. The literature provides important evidence that moderate-intensity aerobic exercises contribute to the prevention of HT and to the treatment of stage 1 HT. In addition, there is sufficient evidence that dynamic resistance exercises reduce SBP and DBP when planned according to the patient. Studies on the subject have shown that moderate-intensity aerobic, isometric and dynamic resistance exercise training, applied alone or in combination, is equally effective in reducing both SBP and DBP in adults with normal BP, prehypertension and HT.

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Resistance studies to corn (sesamia nonagrioides l.) in corn plant

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Abstract

The aim of this study is to examine the advantages and disadvantages of the methods used in corn pink stem borer resistance studies (while developing new varieties by breeding). There are two important harmful insect species that reduce the yield of the corn plant, which has a strategically important place in the food sector in Turkey and in the world, the first of them is the corn pink stem borer and the second is the ostrinia nubilalis. The aforementioned pests can cause up to one hundred or fifty percent damage in first crop and second crop corn. Corn pink stem borer enters the inner parts of the corn plant during the egg laying period or pupa period, making it impossible to combat with chemical pesticides. It is important to know which control method to use and which method is more reliable in order to develop a corn variety resistant to this insect species. These methods do not always give accurate or reliable results. However, it is thought that it will be beneficial to determine which method is more reliable and to determine the most appropriate method to be used in determining resistance to corn *(pink stem borer)* resistance, in terms of developing new resistant and high yielding corn hybrid varieties. Therefore, in this study, the water-yield relationships of the aforementioned methods will also be examined.

Keywords: Corn, Corn *(pink stem borer),* Water-Yield

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Introduction

While the production of corn plant, which has an important share in our country and world agriculture, was made only in the Black Sea and Marmara regions about 40-50 years ago, it has been planted as a second product in the Mediterranean-Southeast Anatolian regions in recent years, after the wheat and barley harvest, and provides high contributions to the economy. Almost every part of maize is evaluated and used mainly in food, animal feed

preparation and industry. In our country, the cultivation area of corn is 594,000 hectares, its production is 6,000,000 tons and its average yield is 900 kg/da (TUIK, 2021).

In our country, Lepidoptera species are at the forefront of the factors that reduce yield and quality in maize, and among these species, the corn pink stem borer, (Sesamia nonagrioides) draws attention. their color is usually yellowish gray. Female individuals lay 200-350 eggs in clusters, provided that it is a few times. The larvae that emerge from the egg stay in groups for a few days, then they enter the cob and damage the grains in the milk stage by eating and opening galleries. In addition, the excrement of the larvae encourages bacterial growth and causes damage to the entire cob. The larvae become mature after 6-7 molts and pass into the pupa stage in the chambers they form in the stem or cob. Corn pink stem borer spends the winter mostly in the stem or cobs in the mature larval stage and can give 4-5 offspring per year in the Mediterranean Region. Corn pink stem borer is common in Aegean, Marmara, Mediterranean and Southeastern Anatolia Regions (Cekmez and Özpınar, 2014). Figure 1 shows the photo of the corn pink stem borer pest. Figure 2 shows the photograph with the number of internodes/hole and the count of live larvae.

Figure 1. Photograph of the larval stage of the corn sesamia

Figure 2. Corn pink stem borer larval census photograph

Product loss caused by larvae reaches 10% in the first crop, and from 70% to 100% in the second crop, especially in the second crop maize, in fields where the control function against the corn earworm pest is not carried out. In addition, since it feeds on stems and cobs, spraying is often not successful. Despite this, insecticides are used extensively every year. In the Mediterranean region, in the fields where local corn seeds are used as the second product, preventive spraying is applied on average 2-3 times in the fight against the corn earworm pest. If the pesticides are not carried out on time, the larvae enter the plant and therefore no results are obtained from the chemical control. In the periods when the insect population is intense, the number of chemical spraying reaches up to 4-5 and still there is a significant loss of product. Despite this, the chemical control method is preferred by manufacturers due to its easy applicability and immediate results. However, intensive and unconscious use of drugs causes environmental pollution, and the accumulation of chemicals in corn grains causes acute poisoning in humans and animals, and chronic diseases, especially carcinogens, mutagens, teratogens and allergens.

Experimental Studies

The larvae cause damage by feeding on the leaves, stems, cobs and tassels of the corn plant, starting from the seedling period. If contamination occurs during the spiral stages of the corn plant, the larvae feeding in the stem also damage the leaves that will emerge from the growth cone in the future. Symmetrical succumbed holes are seen in newly emerging leaves of corn plants.

The larvae that enter the stem from the leaf sheath cause damage by opening galleries here. They also throw out the excrement materials (such as sawdust) they have removed from the entrance holes.

The larvae emerging from the eggs laid on the inner surface of the sheaths of the leaves surrounding the cobs and the larvae in other organs complete their feeding and enter the cob. Here they feed by eating the grains in the milk maw. During this feeding, they open galleries just like the trunk. With the fecal matter they remove, they increase the bacterial activity and cause damage to all of the grains. Fungi entering the cob through the holes in the cob pose a danger to human and animal health due to the toxins they produce. It has been determined that this pest is found in corn planted areas in the Mediterranean, Aegean, Marmara and Southeastern Anatolia Regions of our country. There are methods other than chemical control in the fight against pests in corn agriculture. The most important and cheapest of these is to use resistant varieties. Considering the negative effects of chemical control, the most effective way to combat corn worm and corn pink stem borer is to develop hybrid maize varieties resistant to these pests. Different methods are used in the development of hybrid corn varieties resistant to the main pests.

Experimental Results

Different methods are used in the development of hybrid corn varieties resistant to the main pests.

As an example of these methods; Koc and Tusuz (1995), in their study to determine the plant growth period in which artificial inoculation will be made in developing new varieties resistant to corn pink stem borer (S. Nonagrioides) in Antalya conditions, they preferred plants that are up to 7 weeks old for laying eggs in their second crop planting, The plant growth period to be made artificial inoculation was determined as before the tassel removal and the flowering period.

Turkay et al. (2007), the criteria used in the evaluation of insect resistance in maize, the resistance mechanisms and the indirect evaluation technique on the plant according to their use in natural-artificial grafting conditions; The amount of damage to the plant, the size of the lesion and cavities, and the number of holes drilled by the larva for exit.

Turkay et al. (2011), Yücel (2012), evaluated resistance to O.nubilalis according to "number of holes / 100 internodes" and number of larvae, damage and index; Very durable: Less than 20 holes, Durable: 20-35 holes, Medium strength: 35-50 holes, Precision: 51-74 holes, Very sensitive: 75-100 holes, Extremely sensitive : Number of holes is rated as more than 100.

On the other hand, Turkay et al. (2011) compared the durability assessment methods used in the world and revealed the advantages and disadvantages of the methods when used in breeding. These methods are; Number of Larva+Pupa / Plant Method, Number of Surviving Plants Method. Number of Holes method is Tunnel Length Method

In the preparation of an effective control method against corn pests, the biology of parasitoids should be determined well, the host-parasitoid relationship in nature should be examined in detail, and finally, mass production possibilities should be investigated under laboratory conditions (Haspolat, 2012).

25 plants, counted as the number of holes, are split in the middle and the tunnels formed by the pest are determined by measuring with a ruler as under the ear and above the ear (Turkay et al. (2011).

Ucak et al. (2017) The effects of different irrigation levels (I100, I70, I35) on the wolf population (S.nonagrioides Lef.) and pest preferences in maize genotypes (31D24, ADASA16, P1429) in the Southeastern Anatolia region were determined by chemical analysis in 2015 and 2016. in their study in open field conditions in a plot design with divided blocks. The effect of irrigation issues on genotypes was found to be statistically significant ($P<0.01$) and significant differences were determined between genotypes. The average of the research years (2 years), the highest number of holes/100 internodes (units) was determined in the full irrigation subject x variety interaction (I100x31D24), while the lowest in the excessively restricted irrigation subject x variety interaction (I100xP1429). However, the highest yield (average) (2657.67 kg ha-1) was determined in the full irrigation x variety interaction (I100X31D24), which has low live larvae+pupae, tunnel length and high fat content (%), while the lowest yield (2597.63 kg ha-1) was determined. -1) high viable larva+pupae, tunnel length and low oil content (%) were determined in the x cultivar interaction (I35xP1429). As a result, they reported that using tunnel length and oil ratio as screening parameters rather than 100 internodes/hole number in endurance studies would give more accurate results.

Conclusion

In the corn plant; Corn pink stem borer (S. nonagrioides) is one of the two main pests. Corn worm (O. Nubilalis); Although it is common in many countries, including Europe, America and Turkey, the corn pink stem borer (S. Nonagrioides) is seen in countries with a coast to the Mediterranean. In order to prevent and/or reduce the said damage, corn producers apply preventative spraying 1-2 times in the main product and 3-4 times in the second product

during the production season, but the protection rate provided remains around 60%. On the other hand, when spraying is not done on time, chemical control becomes impossible because corn borer and corn cob borer larvae enter the plant and feed. Numerous sprayings cause both economic losses and environmental pollution. Therefore, it is thought that determining the most appropriate method to be used in determining the resistance to corn borer and corn cob borer will be beneficial for the development of resistant and high yielding new corn hybrid varieties. However, it can be said that using tunnel length and oil ratio as scanning parameters rather than 100 internodes/hole number in endurance studies will give more precise results. In other words, it was determined that the main pest preferred the most full irrigation (I100) and the least limited irrigation (I35). However, even in full irrigation, it was determined that he did not prefer every genotype at the same rate. It has been determined that the pest does not prefer genotypes with high oil content, and the high oil ratio has a repellent effect. On the other hand, it was determined that the genotypes with the highest number of holes gave the highest yield, while the genotypes with the longest tunnel length gave low yield.

As a result, it may be recommended to test genotypes in non-water stressed and extremely water-stressed conditions and to identify those with similar performance as resistant when studying wolf resistance in genotypes or lines. On the other hand, it has been determined that using tunnel length, live larvae and fat ratio as screening parameters rather than 100 internodes/hole numberx100 will allow more accurate results to be obtained.

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ABSTRACTS

The calculation algorithm of nitrous oxide emissions from soils integration into the conceptual hydrological model METQ

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Abstract

The mitigation of GHG emissions from anthropogenic ecosystems is one of challenge for following decades. The successful GHG emission mitigation scenarios can be developed if there is tools to predict GHG emission trends according to climate, soil conditions, farm management practices and other factors. One of most important GHG emission source is managed agricultural soils, and most important factors is soil conditions, soil moisture and temperature. The conceptual hydrological model METQ has been created under the leadership of scientists at Latvia University of Life Sciences and Technologies and validated for run-off modeling. The development of the conceptual hydrological model METQ by adding additional ecosystem modules is complex but conceptual approach and developed algorithms allow to use this model for ecosystem modelling. The aim of the study is to establish a conceptual framework of GHG emission calculation module integration in the conceptual hydrological model METQ, for the assessment and forecasting the impact of climate change, land use, farming systems and other factors on GHG emissions. The developed GHG emission calculation modules are developed in two groups. The first group is emissions from the soil where the GHG emission calculation modules is connected to the soil active layer calculation algorithm of the conceptual hydrological model METQ. The second GHG emission calculation modules is indirect N2O emissions from water bodies where the GHG emission calculation algorithm is connected to the conceptual hydrological model METQ calculation algorithms. Integration of the GHG emission calculation into the conceptual hydrological model METQ requires the rewritten code of the existing modeling platform and the creation of an open platform for adding new calculation modules.

Keywords: ecosystem modules , GHG emissions , GHG mitigation , GHG modelling , nitrous oxide

Water quality and quantity investigation of an meadow flower green roof

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Abstract

Green roof can shield solar radiation, decrease indoor temperature, lower air conditioner use, reduce air pollution, and slow rainwater runoff, while improving visually pleasing green scenery to the urban area. The vegetation in the green roof may also increase biodiversity of various animal inhabitants such as birds and various kinds of pollinators. Record of rainfall, runoff and water quality data from three different intensive green roof models with meadow flower has been analysed to establish the extent to which the drainage layer treatment affect hydrological performance. Phosphates were chosen as the water quality indicator based on their potential adverse impact on water quality in urban rainwater collectors. The field experiment was conducted at the Warsaw University of Life Sciences Water Center meteorological station from November 2019 to September 2021. The monitoring of quality and quantity of runoff was carried out on three models of green roofs covered by meadow flower with drainage layers of an 2, 4 cm polipropylene mat and 6 cm chalcedonit in an urbanized area under moderate climate conditions. The model with the 4 cm polipropylene mat drainage layer retained more rainwater as compared to the models with chalcedonit and 2 cm mat drainage layer. Presented results, should increase interest in less-noticeable sources of urban water pollution, like green roof runoff, and strive to create legislative conditions to promote use of low P emission materials in green roofs construction.

Keywords: drainage layer, green roof, meadow flower, phosphours, runoff retention

The influence of irrigation and fertigation on the activity of enzymes in soil in quince cultivation

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Abstract

The field experiment was carried out in the years 2019-2022 on the experimental field at the forest nursery in central of Poland. The experiment were designed as two-factorial trials. The first-row factor was drip irrigation: O – control plots (without irrigation), D – drip-irrigated plots. The seasonal irrigation doses used in the years of the research were closely related to the course of thermal and precipitation conditions in the research objects. The factor of the second order was drip fertigation in three variants: N1 -without fertilization (drip irrigation), N2 - fertilization with calcium nitrate, N3 - fertilization with magnesium sulphate, N4 - without fertilization and irrigation. The experiment was carried out in an area particularly characterized by significant water shortages - soil with limited retention capacity (very light soil) and very little rainfall during the growing season.The aim of the study was to investigate the effect of nitrogen fertilization, hydrolysis of fluorescein dioctate (FDAH), β-glucosidase, urease and nitroeductase in the light soil during quince vegetation.The dehydrogenase activity was within broad limits of 240.14 - 702.54 μg of TPF g-1.24h-1 and changed in the quince vegetation seasons. Glucosidase activity ranged from 0.697 - 1.070 μg pNP g-1.h-1, and the highest activity was found in the soil without fertigation and fertilization. The influence of irrigation and fertilization on the activity of urease was also demonstrated, the highest activity of which was found in soil with magnesium sulphate in each growing season. Its activity was in the range of 2.892-5.751 μg NH4+ g-1.h-1. The activity of nitroeductase ranged from 105.69 to 399.95 mg N-NO2 g-1.h-1, and the activity was low in fertigation. FDAH activity ranged from 22.28 to 30.53 μg F g-1.h-1.Soil enzymatic activity response in light soil depended on nitrogen fertilization and irrigation and differed in the time of quince development.

Keywords: enzymes, fertigation, fertilization, soil

Assessment of the water needs of the Common Birch (Betula Pendula Roth.) in Phytomelioration Plantations

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Abstract

The aim of this study was to evaluate the water needs - field water consumption - of the common birch in a row planting on very light soil under subsurface drip irrigation conditions. The water needs of birch were determined based on the climatic criterion (ETp). Moreover, birch water shortages were also estimated.The research was conducted on a strict field experiment on fallow land (very light soil, VI class, very weak rye agricultural suitability complex) in Kruszyn Krajeński near Bydgoszcz. Two-year-old seedlings of common birch (Betula pendula Roth) were used for planting. The selected tree species are recommended for wood planting due to their relatively fast growth and resistance to difficult soil conditions. Moreover, it is a species adapted to Poland's climate and soil conditions. Water needs identified in the field water consumption of common birch in phytomelioration plantings on very light soil under conditions of optimal soil moisture in the growing season were variable and depended on the variants of the experiment and the course of precipitation conditions in subsequent growing seasons.The application of modern subsurface drip irrigation technology increases the possibility of using very light soil by ensuring optimum soil moisture conditions, allowing undisturbed growth and developing the common birch in row phytomelioration plantings.

Keywords: water needs; common birch

Plant protection perspectives in the era of climate change and the European Green Deal Policy

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Abstract

Global warming is already a fact. Globally, we observe an increase in the average temperature by more than 1.2 degrees Celsius. This situation entails consequences that have an increasing impact on our lives. Weather and climate-related natural disasters are becoming more and more frequent. In recent decades, we have seen an increase in the number of extreme weather events. Particularly severe for agricultural production are: increase in average temperature and uneven distribution of rainfall leading to periods of drought and excessive rainfall. Scientists agree that in recent decades, Southern Europe has experienced increasingly frequent and severe droughts, and the Mediterranean region has been a hotspot, especially during the spring and summer periods. A clear increase was also visible in the Carpathian region. By contrast, Northern Europe tended to have wetter conditions. There is also a general consensus on the projected increase in the number of extreme events in Europe in the coming years (Spinoni et al. 2017). Therefore, identifying areas where droughts are predicted to be more frequent and severe will be a very important issue. Listed facts will have a big impact on global food security based on plant production. Production losses due to climate change can occur directly or indirectly, including through the distribution and impact of plant pathogens. Risk of infection and yields are likely to increase at high latitudes for most crops. Conversely, in the tropics, the risk of infection is likely to decrease and there will be little or no increase in productivity. In addition, Europe, the United States, and China may experience major changes in pathogen communities. Yield gains may therefore be diminished due to greater crop protection problems caused by increased disease and new pathogens (Chaloner et al. 2021).

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Keywords: plant protection, agricultural production, climate change, European Green Deal

Yielding of a three-cut meadow with a subirrigation system after silicon fertilisation treatment

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Abstract

Subirrigation is one of the systems enabling the regulation of water relations in the meadow. Using valves on the ditches makes it possible to control the water level in the ditches and the groundwater level of the adjacent areas. In this study, two plots were separated in a three-cut meadow in Poland. In the first of these, a high groundwater level (HWL) is maintained thanks to a closed ditch valve, while in the second plot, the water level is lower (LWL). Each plot had a separate area where fertiliser with silicon (Si) was applied and a control area without application (C). Thus, four measurement combinations were obtained (HWL, LWL, HWL+Si, LWL+ Si). The experiment's main objective was to evaluate the effect of silicon fertiliser and different groundwater levels on the yield of a three-cut meadow. Silicon fertiliser was applied at the beginning of the 2021 growing season and ten days after each of the three cuts. In order to assess grass yields, samples were collected from each combination, which were dried and then weighed to obtain the dry matter volume. Meteorological conditions, groundwater levels, ditch water levels, and soil moisture were monitored throughout the experiment. In addition, soil surveys and an assessment of the area's biodiversity were also carried out. The yield results obtained were statistically analysed using R Studio.The study showed that the application of silicon resulted in a slight reduction in yield compared to the control, but this was not statistically significant. Regardless of the combination when analysing all three swaths, the lowest yield values were obtained in the third last swath. Furthermore, it was found that in the meadow area, it is important to maintain an optimum groundwater level that is neither too high nor too low for proper vegetation development.

Keywords: meadow, irrigation, yield, silicon fertilisation

Mineral additives in Lithuania: a review of practices and soil moisture retention

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Abstract

In Lithuania artificial drainage and irrigation systems is a common practice for double sided soil moisture regulation system. At over moist periods country used drainage systems, which covered over 86 % of agricultural lands and for summer periods irrigation systems, which covered less than 4 % of agricultural lands helps manage water stress. Lithuania is already facing changes in rainfall and intensification of droughts. To lower droughts influence, farmers can install irrigation systems or use mineral additives in the field, such as agroperlite and agrovermiculite. These can both absorb large amounts of water, as much as hundreds of times their own mass. The use of biological environmentally friendly additives to the cultivation of agricultural products, particularly germination and rooting periods, can ensure the required moisture content of the soil. Therefore, a review is presented of the results from various investigations and research studies conducted in Lithuania with have reported the environmental end water management effect. Positive effect of mineral additives for green houses and laboratory conditions was fixed and small effect at open field structures. In order to demonstrate all the benefits of mineral additives, are needed a longer observation period and greater coverage of farms.

Keywords: climate, mineral additives, precipitation, soil water content

Fusarium Head Blight on Winter Wheat Cultivars cultivated in monoculture, organically, integrated and conventional growing systems

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Abstract

In 2014-2016, the occurrence of Fusarium Head Blight (FHB) and the colonization of grain with Fusarium spp. in the experimental fields in Osiny near Puławy (Poland) were determined. The experiment involved two factors; the first was the growing system: organically, integrated, conventional and monoculture, the second factor was the winter wheat cultivars: 'Arkadia', 'Bamberka', 'Jantarka' and 'Sailor'. Field observations on the occurrence of FHB were carried out at the milk-wax maturity stage. The percentage of plants with FHB symptoms and the degree of head infection were determined, and then the disease index was calculated. In order to determine the fungi Fusarium genus inhabiting wheat grain, mycological analysis was performed. Some differentiation in the severity of FHB depending on the cultivar cultivated was observed. The synthesis of three-year research results showed that in the organically system, the percentage of heads with FHB symptoms was significantly lower than grown in the conventional system and monoculture. Analyzing the severity of disease symptoms, it was found that in the organically and integrated cultivation system it was significantly lower than in monoculture. Significant differences in the occurrence of disease symptoms in individual cultivars were also observed. The most frequently isolated species from organically system was F. poae, while from conventional - F. culmorum. The analysis of the three-year results showed significant differences in the colonization of winter wheat grain with Fusarium spp., depending on the growing system and cultivar. It was shown that grain from organically wheat (13.1%) was used to isolate significantly fewer Fusarium fungi than from monoculture (26.6%), integrated (19.1%) and conventional (33.8%) growing system. The studies did not show any correlation in the occurrence of FHB between the growing system and the cultivars in it.

Keywords: Fusarium Head Blight (FHB), growing systems, wheat

The impact of the first and second waves of the Covid-19 Pandemic on vascular surgery practice in the leading regional vascular surgery center

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Abstract

INTRODUCTION: In March 2020 a state of pandemic of the coronavirus disease-2019 (COVID-19) was declared. There has been a reorganization of the health service and a shift of efforts and resources from planned procedures towards the fight against the pandemic. We conduct the analysis of vascular surgery regional center reorganization in response to the first and the second wave of the COVID-19 pandemic. MATERIAL END METHODS: The study included 632 patients admitted to our department in three periods: March to May 2020, October to December 2020 and October to December 2019 as a control period. The registry data were collected using MS Office Excel® and TIBICO Statistica 13.3.0(Copyright © 2021 TIBCO Software Inc.) and analyzed using descriptive statistics. RESULTS: The analysis showed that in the pandemic period the number of admitted patients decreased appropriately in the first and the second wave 23% and 18% in relation to the control period. There was a reduction of performed procedures especially – scheduled carotid arteries revascularization. We observed an increase in the ratio of less invasive procedures in the total number of surgeries. There was a significant reduction in hospitalization time in relation to the control period. DISCUSSION AND CONCLUSIONS: The rearrangement, reduction of scheduled admissions and the volume of procedures affected vascular centers all over the world. An increased number of vascular patients should be expected in the future, which will result from the failure to perform the necessary elective procedures during a pandemic.

Keywords: angiology, COVID-19, pandemic, public health, surgery, vascular surgery

Investigation of *Aedes* Mosquito Population, Vector of Zika Virus, in Adana and Mersin and Production of Predictive Risk Maps Using GIS Technology

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Abstract

Zika virus disease, which belongs to the Flaviviridae family and is caused by an RNA virus, is most commonly transmitted by Aedes mosquitoes. Infection with Zika virus does not usually cause any symptoms. Although rare, symptoms are characterized by acute onset fever, maculopapular charges, arthralgia, or nonpurulent conjunctivitis. Zika virus disease causes fetal anomalies; In adults, although it is rare, it causes pictures. Although no cases have been reported from Turkey, Aedes mosquitoes responsible for the spread of the virus are also found in Turkey. In order to control the Zika virus, the most effective public health measures are insecticide applications supported by geographic information systems and possible risk maps. In our study, summer information of 2021 and 2022, mosquito larvae in 64 jit fields were collected in 10 selected neighborhoods of Yumurtalık Karataş and Tarsus districts of Adana and Mersin provinces. The collected larvae were stored in 70% alcohol and brought to the laboratory and species were identified. Type inspection result; Cx. pipiens (50.32%), Cx. territans (21.12%), Ae. vexans (10.79%), An. maculipennis (7.98%), Cx. quinquefasciatus (5.16%) and Ae. aegypti (4.22%), Cu. morsitans (0.46%) rates were determined. However, together with the bioclimatic principles of the breeding areas contents, it is in the direction of risk maps. As a result, as stated by the World Health Organization, the Zika virus is among the countries where there are vector types in our country, but there are no cases yet, and possible transmission is likely. According to predictions, the provinces of Adana and Mersin, which they have built, may be among the areas where new cases can be seen. We would like to thank Çukurova University Scientific Research Projects Unit, who used our study with the "FBA-2020-12496" supervisory project.

Keywords: Adana, Mersin, Aedes, GIS, MaxENT, Zika.

Effect of endomycorrhizal fungi on resistance of grass plants to pathogens

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Abstract

Grasses have huge economic importance, used for pasture, lawns for recreational facilities, in the energy industry and also have a decorative character. One of the most important grass species is perennial ryegrass (*Lollium perenne* L.), which is the main component of lawn mixtures. Symbiotic relationships of perennial ryegrass with endophytes have a beneficial effect on the stimulation of plant growth. Additionally, attention should also be paid to arbuscular mycorrhizal fungi (AMF). They belong to soil microorganisms forming symbiotic relations with almost 80-90% of plants on Earth. They provide the plant nutrients necessary to grow, increase its tolerance to drought stress and heavy metal contamination of the soil, protect against mechanical damage and stimulate specific immune mechanisms of plant (induced systemic resistance - ISR). The aim of the research conducted under controlled conditions was to determine the effect of endomycorrhizal fungi of the genus *Rhizophagus* on the induction of mechanisms of higher resistance of perennial ryegrass infected by *Fusarium poae* and *Drechslera teres*. Perennial ryegrass plants colonized with *Rhizophagus* spp. (AMF+) and uninoculated (AMF-) were used in the experiment. Plants were inoculated with a suspension of mycelium and spores of *F. poae* and *D. teres*. 2, 4 and 6 days after inoculation the percentage of plants infested with a given pathogen and showing external disease symptoms was calculated. The plant material was analyzed for the presence of phenolic compounds and for the content and activity of enzymes. The obtained results were subjected to statistical analysis. There was observed effect of endomycorrhizal fungi of the genus *Rhizophagus* on the degree of infestation of perennial ryegrass by *F. poae* and *D. teres*. Less symptoms of infection were noted on plants settled by studied fungi as compared to combinations without symbiont. A slight effect of *Rhizophagus* on the increase of total protein content was found in the following days after inoculation of plants. There was an effect of *Rhizophagus* spp. presence on total activity of glucanases in the following days after inoculation of plants with pathogenic fungi. There was noted an effect of *Rhizophagus* spp. on increase of total activity of chitinases as compared with plants not settled by the symbiont in the following days after inoculation. The presence of endomycorrhizal fungus did not affect the total content of phenolic compounds in perennial ryegrass. The results suggest that phenolic compounds may not play an important role in the defence mechanisms of plants settled by *Rhizophagus* spp.

Keywords: arbuscular mycorrhizal fungi (AMF), *Rhizophagus*, grass,

Plant factories with artificial lighting: strengths and challenges

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Abstract

A rapidly increasing population, urbanization and the shrinkage of agricultural lands, and growing environmental problems and pollution pose a threat to agricultural production. In addition to these challenges, the fact that the current agricultural production areas will experience regional changes in the future due to global warming and the related climate change may compromise our ability to meet the nutritional needs of populations. Thanks to the development of technology, agricultural production can be carried out in a fully controlled indoor environment to minimize the effects of future threats, including global warming, environmental pollution, the reduction of agricultural lands, and food insecurity. In this way, the negative environmental effects encountered in existing agricultural systems and the excessive consumption of environmental resources can be prevented. The development of technological tools and the ease of access to information has accelerated studies on plant cultivation in indoor environments, and even large-scale commercial enterprises with artificial lighting, called plant factories, have begun to spread rapidly around the world. This study aims to provide a starting point and references for researchers in this field. For this purpose, studies on controlled environment agriculture and plant factories, which are a new agricultural system, were examined.

Keywords: Artificial lighting, Controlled-Environment agriculture, Plant factory, Urban agriculture, Vertical farming

The occurrence of microorganisms and enzymatic activity at different depths of the soil profile in arable soil

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Abstract

In agriculturally used soils, studies on microbial diversity and enzymatic activity are usually conducted in the upper layer of the soil profile. In contrast, microbial properties in the deeper genetic horizons of the soil profile are understudied. The enzymatic and microbiological characteristics of the soil in the deeper layers of the profile depend, e.g., on the soil type and the size and distribution of the plant root system. The study aimed to compare microbiological properties of Luvisol soil under winter wheat and alfalfa and to evaluate the effect of two soil types (Luvisol and Phaeozem) under the same crop (alfalfa) on the examined properties. The soil profiles were excavated at different sites located in two mesoregions of the South Baltic Lake District in North Poland. Essential physicochemical properties, the activity of selected enzymes of C, N, and P metabolism, and selected microbial groups (total bacteria, copiotrophs, oligotrophs, actinomycetes, and filamentous fungi) were tested in five genetic horizons of 3 soil profiles. The enzymatic activity of most studied enzymes (dehydrogenases, catalase, phenoloxidase, peroxidase) and microorganism groups was highest in the surface horizon (Ap) and significantly decreased with the depth of the soil profile. However, the activity of some enzymes was similar in all genetic horizons (e.g., α-glucosidase) or the subsurface and deeper horizon (e.g., acid phosphatase). A significantly higher abundance of microorganisms and activity of enzymes were found in Phaeozem than in Luvisol. The most significant differences in soil microbiome composition were observed between Bt and G1 and C and G2 horizons. On the other hand, a distinct correlation between the activity of the studied enzymes and the cultivated plant's root system size was observed exclusively at the surface level of the studied profiles.This research was funded by the National Science Center, Poland (project no 2018/29/B/NZ9/00982)

Keywords: Arable crops, Enzymatic activity, Genetic horizons, Soil microorganisms, Soil profiles

Producers perspective on youth farmers' projects in the Aegean Region

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Abstract

In addition to the low income of agriculture in rural areas, the inadequacy of education, health, transportation services and the lack of social opportunities, which are among the problems experienced since the past, push young people to leave the countryside and agriculture. The Aegean Region leg of the project, which was carried out in 9 different regions between 2018-2021, was carried out in our institution. This project, named "Impact Analysis of the Grant Program for Supporting Young Farmers Projects within the Scope of Rural Development Supports", was prepared and carried out as "nationally guided" under the guidance of the General Directorate of Agricultural Reform. The aim of this project is to measure the impact of the grants distributed within the scope of the "Program for Supporting Young Farmers Projects within the Scope of Rural Development Supports". The other aims of the project are to determine the differences between the farmers who benefit from the support and those who do not, to determine the effects of the distributed grants by regions, and to determine whether the effect of the grant given in terms of project subjects is different. The provinces to represent in terms of their differences were selected purposefully and sample selection was made. In the survey study conducted in the provinces of the Aegean region, a survey was conducted with 234 young farmers, including all project subjects, 164 enterprises that received support, 52 cattle enterprises that did not receive support, 18 small cattle enterprises that did not receive support and 52 enterprises that did not receive support in other subjects. Independent t-test was applied to make comparisons between groups that received and did not receive support. In the impact analysis study, it can be said that especially the "Geographically Indicated Crop Cultivation", "Greenhouse Crop Cultivation", "Bee and Bee Products Production", "Grape Fruits" and "Mushroom Production" projects are the most successful projects in terms of producers' satisfaction. These project issues have a great impact on the increase in the amount of production and the use of labor. It is seen that the most important problems they experience are in the supply of inputs (4.46) and the continuation of production activities (4.05). It is thought that considering the principles of physical sustainability as well as financial sustainability in the selection of the projects to be supported will directly affect the success.

Keywords: Young farmer, impact analysis, rural development, support

Factors related to over-prescribing of antibiotics in primary care

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Abstract

Antibiotics are frequently overused by primary care physicians for respiratory tract infection treatment. Recommendations and their application in daily practice allow to reduce mistakes in the form of improperly prescribed antibiotic therapy.The aim of study was to analyze the compliance of family doctors with the recommendations for the treatment of community-acquired respiratory infections. This retrospective study analyzed all medical services provided in the case of respiratory tract infections in 2017 which resulted in antibiotic prescription for the population of 93 thousand patients . 75 doctors participated in the study, the majority of whom constituted female (73.3%). The vast majority of medical advice concerned upper respiratory tract infections (84.6%), however, antibiotics were more often prescribed in the case of lower respiratory tract infections (71.7%). The most frequent prescription of antibiotics was acute tonsillitis (94%), and the least common cold (6.7%). Treatment in accordance with the recommendations turned out to be most compliant in the group of resident physicians, who applied first-line antibiotics most often (45.4%), in contrast with doctors without specialization (15.6%). The application of first-line antibiotic therapy decreased with doctor's age . Female doctors chose first-line antibiotics more often than male doctors. Doctors employed in bigger centres, more often chose first-line antibiotics. First-line antibiotics were more often applied in lower respiratory tract infections than in the upper ones. Patient's age turned out to be a significant factor, it was shown that the younger the patient, the treatment is more often compliant with the recommendations.The compliance of antibiotic therapy application with recommendations depended on: ICD-10 classification; the stage of specialization education; doctor's age; doctor's gender; patient's age; location of doctor's office.

Keywords: antibiotics, primary care, recomendations

An overview of crop production in hungary in the last century (1921-2019)

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Abstract

The agricultural sector is one of the important sectors in Hungary, where it contributes to the national GDP by 4% and provides work for more than 200.000 people. Hungary has a total area of 9.3 million hectares, of which 5.3 million hectares are agricultural land, of which 4.3 million hectares are arable land, which means that arable land makes up 46% of the country. Since the last century, the Hungarian crop production model was evolved; where precession agriculture penetrated and was adopted on most the Hungarian farms. The main goal of this research is to provide a close look to the changes of the main crop production in Hungary, and to point out the most important crop in the country. Data for the main crops were collected from the Hungarian Central Statistical Office, which include the wheat, maize, barley, rye, oats, potatoes, soyabeans, sunflower seeds, rapeseeds, poppyseed, tobacco, sugar beet, and fodder crops (1921-2019). For capturing changes within the time series, the Mann-Kendall Trend Test and Sen's Slope were used. Results showed that the highest increased was recorded in maize production (72738.1 ton/year, $p<0.05$), followed by wheat (40738.4 ton/year, $p<0.05$), and sugar beet (26252.0 ton/year, $p<0.05$). On the other hand, the production of rye, oats, and potatoes were decreased significantly by -7608.1 ton/year ($p<0.05$), -2164.7 ton/year ($p<0.05$), and -18184.0 ton/year ($p<0.05$), respectively. Production in most product groups in the crop sector has decreased due to extreme weather and shrinkage of the harvested arable land, except for wheat, barley, sunflowers, apples and pears The output of this research drops the attention to the direct impact of adopting new technologies (i.e., precision farming) and national policy for increasing crop production in Hungary.

Keywords: agriculture, change, crop, Hungary

GIS procedures for hydropower potential identification - Hyposo Map

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Abstract

Hydropower, and in particular small hydropower plants, has for many years been very important in the electrification of regions and an indispensable part of the energy system around the world. Evaluation of small hydropower (SHP) development represents a relatively large part of the total project costs. In order to determine the most suitable SHP locations as accurately as possible, a high level of experience and expertise is required. Very often, the most suitable locations for SHP are in remote areas where engineering teams are limited in their ability to work. The primary purpose of this study is to provide a complete and comprehensive assessment of hydropower potential in the target countries (Cameroon and Uganda, Bolivia, Colombia and Ecuador).GIS modelling technologies were used to determine hydropower resources based on geospatial, hydrology and hydropower databases.The Hyposo map – a web-based platform, is an open-source GeoServer software. The map consists of 28 layers and a particular focus is on the series of new hydropower sites with a piece of concise information for potential investors. More than 2,400 such locations are planned to be exhibited. It is expected that developed hydropower maps significantly improve the database for hydropower development in these countries and provide valuable information for small and medium projects.

Keywords: GeoFigureic information system, Hydropower potential, Web-based map platform

The occurrence and enzymatic activity of aerobic sporulating bacteria in different arable soils

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Abstract

Bacterial enzymes, especially amylases and proteases, are widely used in the production and preservation of food, production of starch-based syrups, detergents, bioinsecticides and vitamins. In order to the high resistance to environmental stress factors, spore-forming soil bacteria are considered a valuable source of microbial enzymes for biotechnological industry. The aim of the study was the isolation of aerobic spore forming bacteria from different horizons of 6 various arable soils profiles. The enzymatic activity of isolated microorganisms was also determined. The isolation procedure included "heat-shock" stage (80°C, 15 min.), during which the elimination of vegetative forms of bacteria occurred. The results of the microbiological analyses showed the presence of aerobic spore-formers in soil even at the depth exceeding 100 cm. The total number of the aerobic sporulating bacteria was the highest in the upper horizon of all the soil profiles investigated (106 cfu·ml-1). The count of spore-formers decreased with the depth of the soil levels, reaching the value of 103-104 cfu·ml-1. Similar trend was observed in the concentration of amylo- and proteolytic aerobic spore-forming bacteria, however their number was approximately 1 - 2 log units lower, compared to total number of spore-formers. The highest abundance of amylo- and proteolytic spore-forming bacteria was found in leached black soil. It can be concluded, that the enzymes produced by aerobic spore-forming bacteria inhabiting the lowest levels of soil profiles and revealing their activity under oxygen-limited conditions can be effectively used in biotechnological processes occurring under oxygen-deficient conditions.Research funded by the NCN, research project No. UMO-2018/29 / B / NZ9 / 00982.

Keywords: aerobic sporulating bacteria, enzymes, soil

Effect of the precision dripping irrigation for the sweet maize ndvi values and leaf area index under field trial in Hungary

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Abstract

Nowadays, the cultivation of sweet corn demand difficulties by the increasing climate change. This research was carried out under irrigated and non-irrigated conditions at Faculty of Agricultural and Food Sciences and Environmental Management of the University of Debrecen. The examined sweet corn hybrid was SF1379. Precision devices were used to monitor the the development of sweet corn. LAI and NDVI were used for measurement at two phenological phases. The results of the experiment showed that LAI and NDVI increased significantly with irrigation. The applied irrigation was carried out against the background of professional and high-quality knowledge. Significant relationship was measured between LAI x irrigation, NDVI x irrigation, and yield x irrigation. For sweet corn growers, we can offer practical guidance to draw attention to the use of professional irrigation. Cultivation sweet corn requires optimal technological implement in compliance with these rules, the cultivation of the crop is economically efficient and profitable.

Keywords: irrigation, LAI, NDVI , sweet maize

Ecosystem connectivity of key factors in ecological integrity

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Abstract

Ecological connectivity is the interdependence resulting from hydrological factors described as ecohydrology. Determining the magnitude of linkages provides measurable indicators under: human pressures; natural processes; stresses; ecological health. In order to track these relationships, reference areas should be established, which could be coastal lakes. Their hydrological connection to the sea makes it possible to carry out research on ecology, ecological health and the idea of forecasting potential changes. Measures implementing the principles of EcoHealth provide a catalogue of indicators indicating the level of elimination of individual obstacles to healthy ecosystems once they have been implemented. The principles of this scientific approach can be seen as seeking to provide innovative, practical solutions to reduce or reverse the negative health effects of changes in ecosystems, such as aquatic ecosystems, and to use the salutary effects of functional ecosystems to improve public health. Much broader is the idea of foresight, i.e. the need and desire to anticipate the direction of events (developments in new technologies, services, consumer trends) when they are at a sufficiently early stage of development and the time to react is sufficiently long. In the case of ecological integration research, all these aspects are important and form a synergistic whole that allows for the creation of neothetic predictive models. They are largely used when determining the potential of individual ecosystem services, which are particularly important in areas with high development potential.

Keywords: Coastal lakes, neotic model, foresight, integrative research, environmental management

Androdiploid lines in the creation of original genetic variability of Capsicum Spp.

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Abstract

The purpose of this research was to evaluate hybrid progeny obtained as a result of androgenic hybridization of soft-flesh lines and sweet hard-flesh cultivars of Capsicum spp. Soft-flesh forms of bell pepper are characterized by soft pericarp flesh. During the production process, it can be separated from other parts of the fruit by mechanical separation without the use of high temperatures. This allows to preserve the taste and dietary-anticancerogenic properties of the obtained nutraceutical products. Nine bell pepper genotypes were used as research material in the experiment: maternal line '9', which resulted from interspecific hybridization of Capsicum frutescens × C. annuum, thanks to which it gained the soft-flesh trait and high capsaicinoid content, pollinators: 'Sono', 'Mino', 'Luba', 'R' and their hybrid progeny. Biometric evaluation of fruits of all genotypes was performed. Technological efficiency in production of puree was determined for hybrids and the obtained yield was calculated. Dry matter content and capsaicinoid content were determined in the obtained material using the HPLC method according to the procedure described by Collins et al. Dried material from different parts of the fruit was flooded with acetonitrile and then extracted in a water bath at 80ºC for 4h. The obtained supernatant was filtered through 0.45µm filters. The fruits of the hybrids were found to have soft-flesh characteristics and significantly higher capsaicinoid content compared to the pollinator plants. Their weight ranged between 29-52g, which significantly exceeded the fruit weight of the maternal line. The obtained mixtures of F1 generation will be the starting material for induction of androgenic regenerants in in vitro anther cultures.

Keywords: Androgenesis, biometric evaluation, Capsicum, hybridization, PCR

Flow Cytometry In Plant Genome Studies

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Abstract

Flow cytometry (FCM) is a simple, rapid and accurate method for analyzing cells an cellular organelles. This method is applied to plant sciences by botanists, genetics, biotechnologists, plant breeders, and seeds producers. In plant studies the flow cytometry is used mostly for the determination of genome size, ploidy, cell cycle and endoreduplication analysis in different plant organs. Estimation of plant nuclear DNA content is usually performed using young and fresh leaves, with most of the cells arrested in the G0/G1 phase of the cell cycle. Nevertheless, any plant material containing living nuclei, e.g. seedling parts, roots, flowers, pollen grains as well as seeds can be used for FCM analysis. The cytometric analysis is usually performed in nuclear suspension, therefore before measurement plant material is chopped in a Petri dish with a razor blade in the presence of nuclei isolation buffer and fluorescent dye. The results of the analysis are usually displayed in the form of a histogram of fluorescence intensity among the particles in the sample. Ploidy determination is very important in plant breeding programs for the control of ploidy stability (including in vitro cultures), screening for haploid plants or interspecific hybrids, the detection of mixoploidy and aneuploidy as well as for seed lots quality control during seed production. FCM is frequently applied to genome size estimation, in which the genome of sample plant is compared to this of a standard plant with known genome size. Knowledge of DNA content can be useful in creating a genomic library of species, in mapping, evolution studies as well as in the identification of species or verification of their taxonomic position.

Keywords: cell cycle, endoreduplication, nuclear DNA content, plants, ploidy

DNA synthesis during Capsicum Annum L. fruit development and its association with biometrical fruit features

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Abstract

There are two cellular mechanisms that enable plant growth: mitotic division and endoreduplication. Due to the mitotic divisions, the number of cells increases while endoreduplication causes the increase in their size. Endoreduplication is a modified cell cycle during which the nuclei undergo repeated rounds of DNA synthesis without mitosis. This process is widespread in plants however, its role remains to be elucidated. It has been suggested that endoreduplication may be important in increasing the yield and improving the quality characteristics of cultivated species important for human nutrition. One of the products that is gaining importance in the human diet is pepper fruit. The aim of the study was to determine the relationship between endoreduplication intensity in the pericarp and placenta of Capsicum annum L. fruits different in biometrical features. In the experiment, the fruit pericarp and placenta of nine genotypes were analyzed during development. Biometrical analysis of fruits included fresh mass, fruit length and width, as well as pericarp wall thickness. Endoreduplication intensity was measured by flow cytometry and the percentage of nuclei with different DNA content, the number of endocycles, and mean C-value were determined. In fruits nuclei with DNA content from 2C to 128C were detected in the pericarp, and 2C to 64C in the placenta however, endoreduplication patterns differed between genotypes. It was observed that the intensity of endoreduplication increased during development. Moreover, a positive correlation between endoreduplication intensity and fruit characteristics was confirmed.

Keywords: cell cycle, endoreduplication, flow cytometry, fruit, nuclear DNA content, red pepper

Reactions of soil enzyme activity to supplemental irrigation and differential nitrogen fertilization in malting barley

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Abstract

The aim of the study was to determine the effect of using different doses of nitrogen fertilizer and supplemental sprinkler irrigation on the activity of dehydrogenase (DH), catalase (CAT) and peroxidase (PER) as well as urease (UR) and nitroreductase (NR) in light soil under long-term spring barley cultivation.Soil samples were collected from a multi-year experiment carried out at University Research Center (53°13' N, 17°51' E). Supplementary irrigation ensured optimal conditions in terms of the amount of water readily available to plants in the root zone of barley in its period of high water needs.The dehydrogenase activity was within the broad limits of 13.55–57.89 μg TPF.g-1.h-1, it was dependent on irrigation and fertilization. The peroxidase activity also changed during the barley growing season and ranged from 3.84 to 9.34 mg of purpurogallin g-1.h-1. The influence of irrigation and fertilization on the activity of catalase was also demonstrated, the highest activity of which was found at the beginning of the growing season. Its activity was in the range of 1.90-4.80 mg of decomposed H2O2 g-1.h-1. The nitroreductase activity was within the broad limits of 2.84 mg N-NO2 g – 1. h-1 at the beginning of the growing season to 4.73 mg N-NO2 g-1.h-1before harvest. Higher urease activity was found in soil samples collected from objects not fertilized with nitrogen. Its activity ranged from 3.20 to 9.76 μg NH4+ g-1.h-1.The reaction of soil enzyme activity in light soil depended on nitrogen fertilization and irrigation and differed during the generative stages of barley development. The highest activity of DH, PER T and UR was found in soil samples taken from objects not fertilized with nitrogen. The activity of nitrogen circulation enzymes indicates changes in nitrogen compounds in the environment and might be used as an indicator of nitrogen availability for plants.

Keywords: nitrogen availability indicator, nitrogen circulation, nitrogen fertigation, soil enzymes, sprinkler irrigation

Development and application of smart forest utilization platform using digital serious games

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Abstract

With the recent start of the Fourth Industrial Revolution, many changes have begun in the forest industry. Traditionally, the forest industry has three pillars: forest management, forest protection, and forest utilization, forest utilization can be defined as an industry that provides various opportunities for modern people living in cities to access the forest environment and provides services that improve people's quality of life and health. Forest utilization began with forest recreation and has recently been developed into forest education and forest healing. In this study, the purpose of this study was to investigate the effect of serious games produced as a method to increase adolescents' interest in forests and nature. Students' interest in nature after participating in serious games for a month increased significantly compared to before participation. These serious games are expected to effectively increase interest in nature for modern adolescents with low interest in the forest environment. Due to recent urbanization, teenagers' interest in nature is decreasing. In this situation, the produced digital serious games are expected to be a gateway that connects youth's lives and nature in the future.

Keywords: Forest Based Intervention, Forest Education, Forest Welfare, Therapeutic effects of forest environments on Human Body and Mind

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To study the effect of abrasion cycle and twist level on cotton knitted fabric made by Eli-Twist and Tfo Yarn

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Abstract

Abrasion resistance of textile materials is a very complex phenomenon and is affected by many factors, mainly classified as fibre, yarn, fabric properties and finishing processes. Some of these parameters affect fabric surface, whereas some of them influence the internal structure of the fabrics [1]. Yarn structure, count, twists, and hairiness are the main properties that affect the abrasion of textile fabrics. In recent advancements, the Eli-Twist yarn has been developed by Sussen. The Eli-Twist yarn with a novel structure combining all benefits of condensing and doubling in a single operation. The yarn surface and appearance of the Eli-twist are comparable to a single compact yarn [2].An attempt has been made to compare the effect of spinning systems (Eli twist vs ring-spun TFO yarn), number of abrasion cycles, and twist level on abrasion properties and air permeability of cotton knitted fabrics. Yarn samples were produced on the Ring spinning system and Elite compact spinning system with three twist multipliers (i.e. 3.5, 3.9, 4.3). From these samples, knitted fabrics were produced. The fabric sample was tested at two levels (10000 & 20000 cycles) on an abrasion tester for measurement of abrasion in terms of fabric weight loss % and thickness loss. Air permeability and Rate of drying for studied fabric were also investigated. Eli-Twist knitted fabrics show less weight loss & thickness loss than TFO knitted fabrics. Eli-Twist knitted fabric is observed to have a high drying rate performance as compared to TFO knitted fabric.

Keywords: Abrasion, Air permeability, Cotton, Drying Rate, Eli-Twist yarn, Knitted Fabric

Projection of agricultural machinery usage and agricultural mechanization level in Alanya District

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Abstract

In this study, it was aimed to define the usage projection of some agricultural machinery and agricultural mechanization indicators in Alanya district. The changing ratios and projection coefficients of tillage, sowing, fertilization, spraying and harvest machinery for the 2012-2021 periods and computations were done for the 2022-2031 period and the years 2012-2021 and the agricultural mechanization indicators was computed. Turkish Statistical Institute data and other studies on the subject were used as references for the study. Mouldboard type tractor plough, disc harrow, rotary tiller, cultivator, tractor-drawn seed drill, atomizer, pto-driven sprayer, motorised sprayer, knapsack sprayer, hay rake, motor scythe, threshing machine and fruit harvester were included in computations. The projection coefficients were computed for these machines as %-0.02, %1.27, %33.06, %0.96, %0, %1.13, %1.70, %0.14, %0.66, %-2.12, %46.67, %-1.64, %0, respectively. The total number of tractors was 515 in 2012 and it increased to 765 in 2021. In tractors, there was a significant increase in the number of tractors in the 5+ HP power group. The data for 2012 and 2021, average tractor power was 22.67 kW and 18.26 kW, the tractor power per cultivated area was 0.49 kW ha-1 and 0.59 kW ha-1, the number of tractors per 1000 ha was 21.59 and 32.41 and the cultivated area per one tractor was computed as 46.30 ha and 30.85 ha, respectively.

Keywords: Agricultural mechanization, Average tractor power, Projection coefficient

An artificial neural network as a tool for predicting environmental indicators: a case study of chemical rainfall characteristics in Central Europe

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Abstract

An artificial neural network (ANN) is one of the deep learning algorithms that could be used for predicting ecosystem variables. This study evaluated the performance of multilayer perceptron (ANN-ML) and radial basis function (ANN-RB) algorithms in predicting selected chemical rainfall characteristics. Available chemical rainfall characteristics data were collected from the website of Hungarian Central Statistical Office for four stations across Hungary between 1985 and 2020. Then the rainfall indicators (Sodium Adsorption Ratio (SAR), Sodium Percentage (Na%), Magnesium Ratio (Mg%), and Kelly's Ratio (kr)) were calculated. In the next step, the ANN was implemented within three models as an input. The inputs for the first model (M1) were pH, EC (µS/cm), Cl- (mg/l), Na+ (mg/l), K+ (mg/l), Mg+ 2 (mg/l), and Ca+ 2 (mg/l). The M2 inputs were Na+, K+, Mg+ 2, and Ca+ 2, while only Na+ was the input for the third model (M3). In the last step, each model performance was evaluated using statistical indices. The average SAR in the four studied stations was 1.6±0.8 (excellent), Na% was 45.8% ±16.4 (acceptable), Mg% was 21.0±11.1 (good), and kr was 1.3±0.8 (safe). This indicates that the chemical rainfall characteristics are good and acceptable across Hungary. The implementation of ANN reveals that the ANN-ML and ANN-RB could predict the chemical properties of rainfall. M2 and M1 had the better performance for ANN-ML (NSE- SAR(ANN-ML-M1) = 0.99, NSE- kr (ANN-ML-M2) = 0.96). For ANN-RB, the M1,and M2 was better than M3, but less accurate than ANN-ML (NSE- SAR(ANN-RB-M2) = 0.85, NSE- Mg%(ANN-RB-M3) = 0.018). However, the ANN-ML was more accurate in prediction than ANN-RB. Among suggested models, this research recommended using a variety set of inputs to reach high accuracy for ANN. The output of this research reveal that the ANN-ML can be predicting some indices of rainfall in central Europe.

Keywords: ANN, Hungary, Hydrometeorology, water

The sustainable and creative approach of hand block prints fabrics of Rajasthan, India

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Abstract

Design for sustainability requires inventing solutions that all equally favorable to human mankind and its ecological environment. The role of design in this context prolonged over time. The global focus shift from designing aspects to remedial and preventing sustainable action of the product during manufacturing and its life cycle. The design prospects not only demand the holistic life cycle approach of the products but also an emphasis on the design sustainability of the products in term of raw material, manufacturing process, uses and waste management. The Creative design with sustainability has enlarged its scope and field action over time. The life cycle, eco-design products, and designing for social consistency and equity with low environmental aspects in the selection of the raw materials are key parameters for the creative design approach of the products. From the last 2-3 decades' design researchers also started to look at nature as a source of inspiration to address the sustainability.

India is endowed with natural resources and their use is well imitated in most traditional art and crafts. Especially two states like Rajasthan and Gujarat are the booming trade centres for hand block printing. Each region has its specific style, motifs and method of printing which is an identity of that state. This research paper focus on the creative design functional approach of Dabu Mud resist printing on fabrics with sustainable approaches, in the field of raw materials, manufacturing process, design motifs and its life cycle. These sustainable practices are supportive to the humanity and environment by their uniqueness and mannerism.

Keywords: Hand Block prints, Eco-design, Sustainability, Dabu Printing, Design Motifs

Mapping evidence of the role of foliar fertilizers in mitigating abiotic stress effects on maize: A review

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Abstract

Maize production is threatened by a variety of abiotic stresses globally. By location, the climatic and environmental conditions of countries differ implying that research efforts to mitigate adverse effect of these stresses on maize differ. This review therefore was conducted to reveal overview of types of abiotic stresses affecting maize, ascertain the nature of foliar fertilisers used in different countries all over the world, and their overall effect in mitigating abiotic effect on growth and yield of maize. Literature search was conducted in Web of Science using keywords ((“Foliar fertilizer*” OR “foliar fertiliser*” OR “foliar application”) AND (“nutrient*” OR “element*”) AND (“abiotic stress” OR “heat stress” OR “drought” OR “moisture stress” OR “water stress” OR “low temperature” OR “high temperature” OR “salinity”) AND (“sweet corn” OR “maize" or "Zea mays”) AND (“growth” OR “yield” OR “production”)). Results show that the distribution of the literature was Pakistan (47.37%), Turkey (26.32%), Egypt (10.53%), Hungary, Poland, and Iran each had 5.26%. The dominant abiotic stresses evaluated were salinity stress (52.63%) and drought stress (26.32%). Other stress factors were nutrient stress, water stress, temperature stress, light stress (shaded environment). About 56% and 100% of the studies in Pakistan and Turkey respectively assessed salinity stress effect on maize. The composition of dominant foliar fertilizer used was potassium, calcium, sulphur (21.05%), zinc, iron boron, copper (26.32%) and Kinetin, indoleacetic acid, gibberellic acid (15.79%). Other foliar treatments had amino acids, cyanobacteria, and humus extract. The mitigating effect of foliar treatment on abiotic stresses depended on maize variety, nature of abiotic stress and other agronomic factors. Foliar fertilizers circumvented negative effect of abiotic stresses on maize resulting in improvement of growth parameters such as leaf area index, plant height and number of leaves; physiological parameters like chlorophyll a and b and physiologically rate and consequently yield.

Keywords: abiotic stress, foliar fertilizer, growth, maize, yield

Effect of drip fertigation with Nitrogen application on the yielding of potato cultivar 'Vineta' on the sandy soil in Central Poland

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Abstract

Field experiment with the use of drip irrigation and nitrogen (N) fertilization of the potato cultivar 'Vineta' was carried out in central Poland in 2014–2016 on very light soil. The experiments were designed as two-factorial trials with four replications. The first-row factor was drip irrigation: O – control plots (without irrigation), D – drip-irrigated plots. The second-row factor was the way of nitrogen (N) fertilizer application: P – N-broadcasted application plots, F – N-fertigated plots. Nitrogen fertilization was 120 kg N ha−1 on each plot. Drip irrigation, on average for the research period, significantly increased the commercial yield of potato tubers from the level of 23.68 to 41.74 t ha-1 (by 76%). Drip fertigation significantly increased the commercial yield of potato tubers from the level of 31.16 to 34.26 t ha-1 (by 10%). Potato yields were the highest on the plots where drip irrigation with fertigation was applied and was an average of 43.62 t · ha-1 for the three years of the study. Drip irrigation, on average in the research years, significantly increased the weight of a single potato tuber from 86.1 to 98.7 g (by 15%). Drip fertigation, increased the potato yield from 89.0 to 95.9 g (by 8%). The weight of a single potato tuber was the highest on the plots where drip irrigation with fertigation was used, and amounted to an average of 103.4 g for the three years of the study. Drip irrigation had a significant positive effect on the content of dry matter, starch, vitamin C, monosaccharides, sucrose, total sugars, total polyphenols, chlorogenic acid and antioxidant capacity. Compared to broadcasting fertilization, fertigation significantly increased the content of vitamin C, total polyphenols and chlorogenic acid, as well as the antioxidant activity of potato tubers.

Keywords: commercial yield, drip irrigation, nitrogen fertigation, Solanum tuberosum L. , vitamin C

{Fusarium Langsethiae} and Mycotoxins contamination in oat grains from farmers' fields in Poland

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Abstract

The objective of our study was to Fusarium langsethiae and mycotoxin quantify the contamination in oat grains from farmers' fields in Poland, and study the associations between Fusarium and mycotoxins prevalent in grain. The F. langsethiae DNA and mycotoxins contamination levels were measured in harvested grain. In a 4-year period from 2013-2016, 116 grain samples of oats were collected from farmers' fields in various regions of Poland. All of the oat samples were analyzed by quantitative PCR (qPCR) to determine the DNA content of F. langsethiae. qPCR was performed in LightCycler 480II using LightCycler 480 SYBR Green I Master Mix. Based on the qPCR analyzes carried out on the colonization by F. langsethiae obtained from farmers' fields, the highest concentration of DNA of this fungus for average values was found in oat grain harvested in 2014, then 2013, 2016 and 2015. Different levels of fungal contamination were found depending on the origin of the samples. However, F. langsethiae DNA was not detected in all samples. The following mycotoxins were included in the analysis: HT-2 toxin, T-2 toxin, deoxynivalenol (DON), nivalenol (NIV) and zearalanone (ZAN). The grains were analyzed for different Fusarium-mycotoxins by liquid chromatoFigurey – mass spectrometry. Most of the oat grain samples from the farmers' fields were contaminated with mycotoxins. Generally, the average mycotoxin levels were low. High levels were occasionally observed in Poland oat grains lots. T-2 and HT-2 toxins were found in all the tested samples of oat grain from 2013, 2014 and 2016, while in the grain from 2015 these toxins were found in 10 out of 11 samples. A significant relationship was found between the content of F. langsethiae DNA in the oat grains and its contamination with T-2 toxin.This research was supported by the Polish Ministry of Agriculture and Rural Development.

Keywords: Fusarium langsethiae, mycotoxins, oats, qPCR

Measures against drought from the point of farmers view via Choice Experiment Approach

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Abstract

The drought that is uncertain where and when it will occur and whose effect increases day by day as a result of human actions, causes large losses in agriculture every year. Among all-natural disasters, drought is alone responsible for 30% of damage and loss in agriculture. In this case, the use of methods to minimize this damage and loss is of great economic and ecological importance. This study aimed to determine the most suitable methods, from the point of farmers' view, to minimize damage and loss that may occur due to drought and to calculate the willingness to pay for these methods. For this purpose, the Choice Experiment Approach was used. The data obtained were interpreted by the Conditional Logit Model. According to the Conditional Logit Model results used in the Choice Experiment, it was determined that farmers were willing to pay a one-off $18.18 for drought-resistant crop varieties, and $16.34 for pressurized irrigation methods. Although the practices related to soil protection were not significant in the model, willingness to pay was calculated as a one-off $3.95.

Keywords: agriculture, choice experiment, conditional logit model, drought, willingness to pay

Data analysis of the grain harvester Remote Monitoring System towards the sustainable development of agriculture

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Abstract

Remote monitoring systems are becoming an integral and very important part of modern precision agriculture. With the development of telemetry systems, we are confronted with the abundance of accumulated data and their analysis. This constitutes additional issues of proper use of data in improving agricultural technologies and in pursuit of the implementation of the European Union's Green course. Therefore, the possibilities of new smart technologies can contribute to the aspirations of modern, innovative and sustainable agriculture. In order to achieve these goals, the data collected in the telemetry system of grain harvesters were analyzed using mathematical statistics methods. Harvesting data of the same type of Lexion 770 combines were collected and saved on the Telemetric platform for research purposes. The performed data analysis showed that the work efficiency of the harvester and the reduction of energy consumption depend on the execution of a properly organized technological process. In order to analyze the performance of the harvesters, data were collected when the harvesters were controlled by automatic steering systems and when they were controlled manually. It has been established that 35 to 57% of the total working time of grain harvesters is devoted to technological process execution. Analyzing the fuel consumption data, it was found that the global warming emission can be reduced by 2.45% when using the automatic driving mode of the grain harvester compared to the manual driving mode. In summary, it can be said that the rational use of innovative technologies in agriculture can significantly increase productivity, shorten the time of operations, ensure better quality of work, save energy resources, and as a result, we would achieve sustainable development of agriculture.

Keywords: harvesting data, remote monitoring, telemetry

Investigation of the occupational health and safety status of greenhouse labourers in Alanya Town

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Abstract

Greenhouses are structures where cultivated plants, seeds and seedlings are produced at any time of the year by adjusting the air conditioning. In today's technology, the temperature, humidity and water that every plant needs are provided in greenhouses. Greenhouses are preferred by agricultural labourers as they provide permanent employment opportunities. However, if labourers are to be counted according to Turkish Labour Law No. 4857, the number of agricultural labourers working in each greenhouse must be at least fifty-one or more. Agricultural Labourers Social Insurance Law No. 2925 and their dependents have the right to benefit from health services and other rights provided by the provisions of general health insurance." Except for the public ones. Within the scope of Article 5 of the Annex of the Law, those who work temporarily in agriculture or forestry with a service contract and those who work in agriculture independently on their own behalf and account; Those who are engaged in agricultural activities and those who document that the monthly average of the amount remaining after deducting the expenses related to this activity from their annual agricultural activity income is less than thirty times the lower limit of the daily earnings subject to the determined premium, and those who have reached the age of 65 with this Law, are not considered to be insured. This study was planned as a field study. Data were collected through face-to-face interviews with producers, producer associations and public institutions. General information about the region has been tried to be reached. Although it is a high-risk job in terms of occupational health and safety, it has been observed that employees are hired for low wages and there is unregistered employment where labourers have difficulty in obtaining basic rights and services such as food, shelter, clothing, health, transportation and education.

Keywords: agricultural labour, Alanya, greenhouses, occupational health and safety laws

Determination of the vertical distribution pattern of indoor climate parameters in the greenhouse heated in the winter period

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Abstract

The study was carried out in a venlo type glass greenhouse with a floor area of 8x27 m2. The long axis direction of the greenhouse is North-South, the height of the gutter is 6.00 m, the ridge height is 0.50 m. Heating was done by heating pipes located on the side wall and floor. The system is made with an automation system that automatically activates when the temperature inside the greenhouse falls below 15 ° C. Temperature, relative humidity, dew point and vapor pressure deficit values in the greenhouse were made with values taken from 8 different measurement points. Measurement points were made horizontally and vertically at 2, 4 and 6 meters. Sensor placements are grouped vertically as 2 meters (G1: S1, S2 S3), 4 meters (G2: 4, 5, 6) and 6 meters (G3: S7, S8).The measurements taken were divided into 3 parts on average as daily, day and night. According to the results obtained from the research, it was determined that the indoor climate parameters changed during the average daily, day and night hours in the greenhouse. Accordingly, it has been determined that hourly climate values should be used instead of average values in the greenhouse and the changes that occur as the greenhouse rises from the base to the ridge should be followed.

Keywords: air conditioning, environmental control, greenhouse

Determination of the effect of the thermal screens used in greenhouses on energy conservation

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Abstract

Conservation of energy in heated greenhouses is as important as heating in greenhouses. One of the energy conservation methods applied in order to reduce the heat energy need for heating in greenhouses is the use of thermal screens. However, the impermeability and effectiveness of the thermal screens are extremely important in terms of energy saving. In the study carried out for this purpose, the impermeability and effectiveness of the heat curtain used in the venlo type glass greenhouse under continental climate conditions were determined. At the same time, the indoor temperature values were recorded hourly in the greenhouse with and without thermal screen, and the differences were revealed. In the greenhouse, which has an automation system and a floor area of 216 m2, heating is done with heating pipes located on the side wall and floor. The greenhouse indoor temperature is set at 15°C. The heat curtains were opened in the evening due to the decreasing radiation effect and were collected in the morning hours in order for the light required for Figuresynthesis to reach the greenhouse. As a result of the study, it is shown that the heat curtains create a resistance against heat loss and reduce heat losses due to their impermeability. For this reason, it has been determined that in the use of thermal curtains, attention should be paid to their impermeability and effectiveness.

Keywords: energy saving, greenhouse, thermal screens

Prioritization of drip-irrigation pump alternatives in agricultural applications: An Integrated Fuzzy MCDM Model

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Abstract

Water, which is one of the basic needs for the continuity of life, is also one of the renewable energy sources. It is known that this energy source is not unlimited and its use should be managed effectively in terms of sustainable development. The selection of irrigation methods is of great importance because of the necessity of saving water consumption in agricultural production. The fact that different criteria are taken into account during the selection of the pump to be used in irrigation shows that the selection problem in question can be considered as a multi-criteria decision-making problem. The uncertainty of decision-making problems encountered in different fields can make it difficult to solve the problems. This has led researchers to focus on the complexity of the problems to provide more reliable solutions. Fuzzy extensions of multi criteria decision making (MCDM) methods aim to solve more complex and detailed problems in accordance with classical MCDM methods. In order to ensure productivity and minimization of water consumption in agricultural areas we focus on the drip-irrigation pump selection problem as the aim of the study. Picture fuzzy CODAS (PF-CODAS) method is implemented to handle drip-irrigation pump selection under vagueness by using expert opinions. When compared with other methods, the suggested method combines multi criteria decision analysis with picture fuzzy hesitancy and negative ideal solution supported by Euclidean and Taxicab distances. The content presented by the study and the results obtained will contribute to sustainable agricultural production with the efficient use of irrigation resources.

Keywords: Drip Irrigation, Multi Criteria Decision Making, Picture Fuzzy CODAS , Picture Fuzzy Sets, Sustainability

Maize irrigation scheduling in Central Poland on the basis of multi-annual field research

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Abstract

The importance of maize grown for grain in Poland is large. According to data from Polish Statistical Office, the cultivation area increased from 2004 to 2020 by approx. 33 thousand ha/year and grain yields increased by 670 kg/ha. 42% of the area of maize cultivation is located in the areas with the greatest water deficits due to the lowest rainfalls in the country, as well as occurring frequently (30%) agricultural droughts. The cultivation of maize is therefore at risk of reducing yields due to water scarcity – yield losses in dry years (2006, 2015, and 2019) amounted to 22–28%. Irrigation is an effective way to prevent those losses, but the development of irrigation of agricultural crops in Poland needs to be preceded by a continuous, multi-annual, and large-area program, to assess its effectiveness. The research was carried out in the years 2005–2020 on light soil with the compacted sub-soil at the University Research Center (φ=53°13', λ=17°51', h = 98.5 m above sea level). The innovative drip line technology of maize irrigation was used. Numerous years of research have shown that the yields of non-irrigated maize significantly depended on rainfall indicators and were characterized by very high variability in time. Irrigation contributed to the significant, on average 54% increase and stabilization in yields over the years. As a result of irrigation, the coefficient of yield variation decreased from 51 to 17%. The production effects of drip irrigation significantly depended on rainfall indicators in the period of high water needs for maize, covering June and July. In seasons abundant in the rain, increases in grain yield under the influence of irrigation were insignificant and about four times lower than the average increases, however, in seasons poor in precipitation the increases were by over half higher.

Keywords: agricultural drought, atmospheric precipitation, drip irrigation, irrigation planning , maize yield , water needs

What information about the performance of wetland roof can be obtained from conductivity measurement?

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Abstract

Wetland roof located at Marki (52.33398367443746, 21.12563478465449) is a type of surface flow wetland, where plants were introduced in the form of the coconut fiber helophyte mate underlined with a 10 cm of mineral substrate. The main function of the wetland roof is to retain rainwater, what is possible by connection of the 3400 m2 of roof with underground tanks. Conductivity and temperature of water in wetland are continually measured with a HOBO U24-002-C recorder. The aim of this study was to assess, how useful can be continuous electrical conductivity (EC) monitoring for the assessment of the performance of wetland roof. For the analysis, monitoring data from 2021 and 2022 were used and compared with other measured parameters or noted events. Observed daily fluctuations in EC were connected with solar radiation. Rainfall events were also reflected in EC, in most cases lowering its value, but in general each rainfall event appears to be individual, in some cases there was a decrease in EC associated with the occurrence of rainfall, in others an increase, and in others no change was observed. Filling the wetland with the water stored in underground tanks was also reflected by the increase of EC. Values of EC observed in monitoring period were in most cases higher than reported for rainwater. Base on so far monitoring it can be stated that EC, which shows changes in water salinity, can be a useful parameter supporting wetland roof water quality monitoring, however interpreting the data without supporting parameters is difficult or even impossible.

Keywords: electrical conductivity, rainwater quality, wetland roof

Researching the historical tourism potential of Antalya/Gazipaşa District within the scope of Physical Therapy/Physiot herapy and Rehabilitation, Spa and Health Center

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Abstract

Health tourism is one of the fastest developing and growing sectors and is discussed in different dimensions in international platforms. Health tourism, which has boceme an important income sector in European countries, creates a new field in our country. It is foreseen that increasing the studies on this subject, introducing both the natural beauties and historical structures of our country to the outside World and offering new job opportunities to the people of the surrounding area willgreatly benefit the country economy. In this period, where geriatric tourism is gaining more and more importance, Turkey is an important tourism destination for customers.

According to the Ministry of Environment Measurement Reports, the air cleanliness of Antalya/Gazipaşa District is considered as "good". The district has clean air and water, untouched nature and beauties, and rich and fertile soil structure where many different tropical fruits can be produced. It is one of the places preferred by foreign tourists with its historical places and the Mediterranean. In addition to the clean and oxygen-rich air of the Taurus Mountains in the district, the fact that the land is covered with trees and greenery and the untouched coves of the Mediterranean increase the value of the district one more time. The rich and fertile soil structure and the ability to grow all kinds of tropical fruits are among the important and sought after features of the district. Gazipaşa District has the potential to be transformed into an important health center where the "old age" and the "disabled" will regain their health, improve their mood with psychological treatments, and relieve their body pain.

In the research, the historical texture and health tourism potential of Gazipaşa District will be investigated. This small town with the traces of Hittite civilization, Roman Empire, Seljuk and Ottoman Empire takes its name from the title of "Gazipaşa" of Mustafa Kemal Atatürk, the founder of the Republic of Turkey. In order to explain the definition of health tourism and what it covers, primary and secondary sources related to the subject will be scanned and used in the research. In addition, all kinds of documents-documents related to the subject will be collected by going to Gazipaşa Municipality, District Governorship, District Agriculture Directorate, and necessary documents will be procured from the Turkish Statistical Institute and used in the research by content analysis method.

Keywords: History, health, tourism, Gazipaşa

Occurrence of Fusarium Head Blight and Fungi Fusarium Genus on Winter Wheat Grown in the ecological system in various regions of Poland

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Abstract

2014-2016 observations of the occurrence of Fusarium Head Blight (FHB) and the colonization of grain with fungi Fusarium genus were made on 12 cultivars of winter wheat grown in experimental fields in various regions of Poland: in Osiny near Puławy, Chwałowice near Radom and in Chomentów near Łomża. Field observations on the occurrence of FHB were carried out at the milk-wax maturity stage. The percentage of plants with FHB symptoms and the degree of head infection were determined, and then the disease index (DI) was calculated. In order to determine the species of fungi of the genus Fusarium inhabiting wheat grain, mycological analysis was performed in the laboratory. The severity of FHB on winter wheat varied depending on the year of the study and the locality, and ranged from 0 to 19.5% of infected heads. Significant differences in the occurrence of disease symptoms in individual cultivars were also observed. There was a large variation in the severity of FHB on winter wheat depending on the year of the study. The greatest number of disease symptoms in all locations of the experiment was observed in 2014, and the least in 2015. The species composition of Fusarium spp. inhabiting grain from winter wheat cultivation in different localities was similar. In all experimental locations, F. poae was the most numerous species isolated. It constituted over 66% of the total number of isolated Fusarium spp. The dominant presence of F. poae explains the large differences between the severity of FHB and the colonization of grain with Fusarium spp. Other species: F. avenaceum, F. culmorum, F. equiseti, F. graminearum, F. langsethiae, F. reticulatum, F. sporotrichioides and F. tricinctum were less or sporadically isolated.

Keywords: Fusarium Head Blight, Fusarium poae, grain, winter wheat

The study of the effectiveness of 'Algaliv' in limiting the growth of Fungal Pathogens

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Abstract

Seaweed extracts are increasingly used by modern agriculture and horticulture. The use of marine algae extracts in spraying plants can affect many factors improving, among others, quality and quantity of crops, as well as reduction of abiotic and biotic stresses. The biotic stress group includes plant damage caused by pathogens. Marine algae have antifungal activity. The purpose of the Petri dishes experiment was to study the effect of Ascophyllum nodosum 'Algaliv' extract and its mixtures with selected fungicides to limit the growth of mycelia of pathogens: Alternaria alternata, A. brassicicola, A. solani and Botrytis cinerea causing damage to potato, winter oilseed rape and other crops agricultural and horticultural plants. Obtaining satisfactory results in laboratory experiments gave rise to another experiment, this time it was a field experiment with 4 cultivars of winter oilseed rape, in which the effect of technology using 'Algaliv' on yield and biometric parameters of rape was tested. The idea of sustainable development, the more frequent occurrence of abiotic and biotic stresses, the increase of resistance of pathogens to the active ingredients of fungicides and the need to produce food in the world will naturally stimulate further research of substances of vegetable origin that are readily biodegradable and, above all, effective in combating pathogens. The source of such substances can be successfully selected species of marine algae.

Keywords: Ascophyllum nodosum, Marine algae, seaweed extracts

Possibilities of using precision irrigation in Lithuania

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Abstract

As the number of people in the world increases, and the dynamic phenomena of climate change are recorded, the need for fresh water grows. The term "precision irrigation" is often understood to mean drip irrigation, but it must cover the whole range of measures such as all tools that make the system efficient: these are meteorological stations linked to soil types and moisture measurement, together with time zone controllers, fertilizer injectors, drippers of different diameters and many other tools that have one goal, to reduce water use, increasing production volumes. Basically, precision irrigation is about optimizing the irrigation process throughout the growing season. In drip irrigation all plants are irrigated equally and with the same amount of water. Using capillary irrigation in agriculture increases the yield several times, and water is saved up to 250%. This is one of the best ways of watering plants, because the water goes directly to the roots of the plants, almost does not evaporate, a film does not form on the surface of the earth, so the moisture stays in the soil longer. Watering is done only at the plants growing area, so irrigation is covering from 40 to 60 percent of the whole plot. Impermeable soil, i.e. it does not get wet, so plant roots receive oxygen throughout the vegetation. When fertilizing with watering is combined, the fertilizer goes directly to the root system together with water, which means that it is the most efficient method of fertilization. The advantages of this type of watering are revealed during harvesting, because the interlayers are dry, and in the case of plots with slopes, soil erosion phenomena are not dangerous. New technologies are associated with new materials, which are abundant in agriculture, and it is important to choose them properly.

Keywords: climate change, evapotranspiration, irrigation, plants, precision irrigation, water resources

Relationship between the Anorexia Readiness Syndrome and the familism of physically active girls with regards to the quality of the body image

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Abstract

Introduction: Anorexic Readiness Syndrome (ARS) is a construct of prophylactic importance, useful in the selection of people showing a tendency to use restrictive diets and increased concentration on the body. The aim of the research was to verify the significance of the type of physical activity, body perception and familism for the development of ARS. Material and method: The research was carried out in the first half of 2021on a sample of 163 girls. It consisted of: 1) physically inactive girls, 3) physically active girls in disciplines other than aesthetic, 2) girls engaged in aesthetic physical activity. The study used: Anorexic Readiness Syndrome Questionnaire (ARS-12), Familism Scale (FS) and Body Image Avoidance Questionnaire (BIAQ). Results and Discussion: The highest average ARS score was recorded in the group of girls engaged in aesthetic activity. The severity of ARS rises as the difference between real and ideal body weight increases. People active in aesthetic disciplines who obtained a high score on the Respect scale have a lower ARS score than those physically active in other disciplines who obtained low scores on the Respect scale. The higher the score on the Material success and achievement scale, the greater the ARS intensity in all subgroups. What is much more important in shaping ARS is the perception of your body. The focus on eating and body weight and Clothing and appearance are relevant to the ARS and moderate the relationship between Material success and anorexic readiness.Conclusions: People engaging in aesthetic physical activity are more likely to suffer from ARS. The family can certainly prevent a child from developing anorexic readiness by shaping a sense of community and family identity. The prevention of ARS and eating disorders should also focus on strengthening the realistic assessment of body parameters and their acceptance.

Keywords: Anorexic Readiness Syndrome, body image, body weight, familism, physical activity

The effects of land consolidation projects on pressurized irrigation system performance and the cost: a case study from Turkey

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Abstract

Land consolidation projects (LCP) has been applied in various countries to decrease land fragmentation, to give field road and to create more appropriate parcel shapes besides many benefits to farmers. Moreover, LCP help to decrease the cost of irrigation system establishment. Turkey aims to modernize open irrigation systems into pressurized systems with LCPs to save water due to climate change and global warming. In this study, Eymir Village LCP in Turkey was chosen as the material to investigate how can LCP affect the cost of the establishment of a pressurized irrigation system. In this context, two irrigation systems are designed with help of geoFigureic information systems (GIS) and are analyzed by COPAM (Combined Optimization and Performance Analysis Model) to optimize the hydraulic performance. Results show that land consolidation proved to be an effective tool to solve spatial problems related to improving the irrigation systems, technical problems related to the performance of the networks, and the equity of services (guaranteeing that 98% satisfactory of users). And, LCP has the most important effect on the economic feasibility of pressurized irrigation network establishment whose cost can be decreased by 13.6% by LCP.

Keywords: Cost-effective strategies, Irrigation systems design, Land consolidation, land policy

Educational innovations and the need to support activities towards a circular economy CE

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Abstract

Educational innovations and the need to support activities towards a circular economy CE. The consumption patterns of the inhabitants of economically developed countries are hardly sustainable. The experience of Western European countries shows that the level of consumption increases sharply with the increasing wealth of the society. This trend is also noticeable in Poland. As the European Commission emphasizes in the communication: Closing the loop - an EU action plan for the circular economy, choices made by consumers may support the development of the circular economy or hinder it. Sustainable consumption is about meeting basic human needs while minimizing the consumption of natural resources and reducing waste and emissions. Increasing consumer awareness is an extremely important issue. Environmental education is crucial for the successful transformation towards circular economy. However, research on sustainable consumption shows at the same time that the level of consumer knowledge is still low. The belief in the real impact of consumers on the environment in which they live, and as a result on the quality of life of the present and future generations is also weak. In this context, it is important to direct education to change consumer behavior by raising their awareness in the field of environmental protection and developing their knowledge about the rights related to access to information about the product and the producer.In the era of **"**lifelong learning**"** educational activities should be diverse and targeted at all social and age groups.The research was conducted in Poland from 8 to 19 March 2021 and was quantitative research with the help of telephone interviews (CATI) and computer software. All interviews were carried out on the basis of a questionnaire containing 25 substantive questions of a closed, open and semi-open nature, as well as 12 personal identification questions concerning the socio-demographic characteristics of the respondents. Awareness about circular economy among the surveyed respondents is at an average level. Many of them can explain what are the characteristics of circular economy, some have even had contact with awareness-raising on this topic, however, not all of their daily consumer choices and behavior fully reflect this idea.

Keywords: Educational innovations, Circular economy, Sustainable consumption, consumer behaviours

Minimizing carbon tax for sustainable transportation in cross-docking supply chains

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Abstract

One of the transportation strategies that facilitates the distribution of goods without need for stocking is cross-docking. However, as experienced during the Covid-19 period, breakdowns in supply chains due to external events may require temporary storage. This study aims to plan a sustainable transport system for supply chains that include multiple suppliers, retailers, product types, and cross-dock facilities. Cross-docks in the study can handle short-term inventory with limited storage. There exist two ways to supply products: (1) direct shipments from suppliers to retailers, (2) indirect shipments via cross-docks. In addition to the total cost of transporting, handling, and storing freight, carbon tax is also taken into consideration during the transportation of goods in order to reflect the environmental concerns. The carbon tax rate is incorporated in the model based on the load-distance travelled by trucks. Hence, one major goal of the study is to minimize distribution-related carbon emissions in the supply chain. The problem is modeled as a dynamic mix-integer linear program. A heuristic algorithm is also suggested to solve the model. Several computational experiments are performed to test the performance of solution methods in terms of solution quality and effectiveness. The effects of parameters used in computational experiments are discussed in various sensitivity analyses. It is observed from the sensitivity analysis that carbon tax has a significant role to reduce the total-distance traveled, i.e., total carbon emission. Moreover, increasing the carbon tax rate enforces direct shipments from suppliers to retailers. Results also show that the average system-wide total cost and the carbon tax rate have almost a linear relationship.

Keywords: carbon tax , cross-docking, supply chain, sustainability, transportation

Sharing economy in transport – analysis of selected issues in terms of sustainable development

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Abstract

Sharing economy is a part of the consumption in the circular economy and means that customers choose not to own a product themselves, but instead share it with other users. It is referred to as the fastest-growing business trend in the history of economics. The dynamically developing market of sharing services in transport is perceived as one of the possibilities for solving problems related to critical traffic congestion, transport inefficiency, and poor air quality. The model of shared mobility is becoming a separate, fully-fledged category of transport - complementing public transport, individual transport as well as taxi services and others solutions. One of the forms is micromobility, which is based on the use of small and light means of transport for short distances. The micromobility market is developing very dynamically around the world and it is estimated that by 2030 its value will amount to from 300 to 500 billion dollars. In turn, the development of shared mobility, depends on technological innovation, changes in lifestyle or changes in the residents' communication habits. It is indicated that micromobility is popular among young people. Hence, the paper is devoted to the analysis of the factors determining the use of shared mobility by young people. The source material consists of the results of the CAWI research conducted in 2022 on a group of 100 students in a selected city in Poland.

Keywords: sustainable transport, sharing economy, micromobility

Biocontrol *Bacillus* an alternative to supress grapevine fungal pathogens

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Abstract

Esca disease of grapevine is a vineyard-destructive complex of plant pathogens, caused by different unrelated fungi. Not only that is causing grapevine premature dieback but it triggers many other grape decaying molds. Within bio-control strategies, *Bacillus* sp. are commonly known antifungal bacteria protecting grapevine from certain plant diseases. The aim of this paper is to underline the bio-control potential of some plant associated *Bacillus* strains in suppressing grapevine fungal pathogens. These *Bacillus* strains were identified at specie level by 16S rDNA sequencing. The *in vitro* antagonism of *Bacillus* strains was evaluated on mycelial growth by dual culture method. The inhibitory activity was evaluated against several fungal pathogens responsible for Esca disease, and against *Fusarium* spp. associated to trunk diseases, *Botrytis cinerea* gray mold, *Penicillium* spp. blue mold and *Aspergillus* spp. black mold. Due to their high and broad antifungal activity, the bio-control endophytic bacteria were studied through molecular techniques to reveal their functional genes involved in antifungal compounds synthesis. Genes encoding for iturin C and D, fengicin, macrolactin, difficidin, and mycosubtilin were found in these bio-control strains. Lytic enzymes, such as chitinase, cellulase and proteases were also revealed to be produced by these bacterial strains. Therefore, we could consider such beneficial *Bacillus* spp. endophytes as promising candidates for plant protection.

This research was funded by the University of Agronomic Sciences and Veterinary Medicine of Bucharest, project number 2021-0005/13.07.2021 - Developing a microbial bio-fertilizer technology [Dezvoltarea unei tehnologii de obținere de biofertilizanți de origine microbiană].

Keywords: antagonism, Bacillus, functional genes, grapevine fungal pathogens

In vitro micropropagation of established and hybrid Capsicum Spp. Genotypes

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Abstract

The aim of the study is to develop the methodology of in vitro microproduction of hybrid genotypes of the F1 generation and the Capsicum Double Haploids line. Creating a new, original genetic variation mainly consists in creating hybrid forms. Interesting genotypes appear in hybrid offspring, often with higher efficiency (also qualitative traits) than in F1 hybrids (transgression phenomenon). Due to the heterozygous nature of such plants, their offspring are not genetically stable. Maintaining interesting genetic variation is possible only through in vitro vegetative reproduction.The research material consists of nine pepper genotypes. Maternal form - the '9' line was created as a result of interspecies crossing Capsicum frutescens × Capsicum annuum, in the experiment, sweet pepper varieties were used as pollinators: 'Sono', 'Mino', 'Luba' and the androgenic line 'R'. Hybrid offspring of the F1 generation were also analyzed. The in vitro research on paprika to date has been limited to working on very young material. The study attempts to sterilize the material consisting of mature, fruiting plants. Before taking samples to establish an in vitro culture, the plants were topped by removing the growth tips of some shoots, and then the refreshed material was the basis for further work.Ultimately, the research results are to be useful in industry, in the rapid clonal multiplication of qualitatively and quantitatively valuable varieties.

Keywords: capcisum, double haploid , in vitro, micropropagation

Examination of the effects of climatic factors and location-specific N Fertilization on relative Chlorophyll content and yield of maize

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Abstract

The effect of climatic factors of the growing season on the chlorophyll content of maize was analysed in three years (2018, 2019 and 2020). The studies were carried out at the Látókép Experimental Station of the University of Debrecen in Hungary. The measurements were carried out under irrigated and non-irrigated conditions with the maize hybrid Sushi (FAO 340). Doses of 60 and 120 kg N ha^{-1} applied as spring basal fertilizer were followed by two top-dressings at V6 and V12 phenophases at rates of +30 and +30 kg N ha^{-1}. The largest increase in SPAD value up to the R1 phenophase was measured in the A_{120} treatment (15.0). The largest crop year modification effect was observed in the $V6_{90}$; treatment (6.9). The treatment with 120 kg N/ha had the highest SPAD value increase (7.2). A strong correlation between fertilizer and SPAD value was demonstrated at the R1 growth stage in both irrigated and non-irrigated treatments in 2018 (r=0.913***; r=0.928***) where fertilizer influenced SPAD values in 83% and 85%, respectively. The negative impact of the environmental factor was most pronounced in 2020 in the non-fertilised and basal treatments. Overall, in two years (2019,2020), the A_{120} treatment had a significant yield improving effect for the Sushi hybrid. With the exception of treatments $V6_{150}$ and $V12_{120}$, irrigation increased yield, with the highest increase of 1.58 t/ha^{-1} in treatment $V6_{90}$. A reliable difference between the two variants was found in the $V12_{120}$ treatment ($p < 0.05$), with a reduction of 1.13 t/ha^{-1}. In the non-irrigated variant, the correlation was strong in the R1 growth stage in 2018 (r=0.818***) and 2020 (r=0.863***), where SPAD affected yield development in 67% and 74%, respectively. In the irrigated version, a strong correlation (r=0.865***) between SPAD value and yield was confirmed in 2018, during the silking period.

Keywords: maize, N-fertilizer, relative chlorophyll content

Eradication of wild *Epichloë* enophytes from perennial ryegrass in the production of symbiotically modified grasses

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Abstract

Grasses are used mainly for fodder purposes and on recreational areas. They are often inhabited by symbiotic microorganisms. The most important are endomycorrhizal fungi *Rhizophagus* spp. and *Glomus* spp. as well as endophytes of the genus *Epichloë*. The first two penetrate the roots and develop together with the plant. In soil, they can survive thanks to special spores. On the other hand, *Epichloë* spp. are specialized endosymbionts that grow exclusively inside the living plant, in its above-ground parts. They are transmitted vertically with grass seeds or horizontally by vegetative reproduction. The presence of these endophytes determines the plant's higher resistance to numerous stress factors, both biotic and abiotic. The associations of grasses with endophytes are usually more persistent in the environment and are more resistant to drought and soil nutrient deficiencies. They are also less susceptible to infection by pathogens and pest preying. However, grasses inhabited by endophytes can pose a threat to livestock due to the production of harmful toxins. "Safe" associations are those inhabited by selected endophytes, the so-called novel endophytes. They are used in the process of creating symbiotically modified grasses. However, the introduction of such endophytes to the plant requires prior removal of harmful, "wild" endosymbionts naturally occurring in the cultivar. The eradication process is very difficult and time-consuming. It is usually carried out with the use of fungicides or high temperature. Therefore, it is purposeful to search for new, more effective and environment friendly methods. So, research was started on the development of a new technology for eradication of grass endophytes using low-temperature plasma. Currently, work is underway to optimize the operating parameters of the plasma generator, i.e. power and exposure time. The research is conducted on perennial ryegrass of the Bajka cultivar, which consists of 13 breeding lines. Plasma treated seeds are placed on Petri dishes with PDA (Potato Dextrose Agar) medium and also are sowed in pots filled with peat substrate. The seed and plant material are subjected to microscopic and molecular analyzes to determine the effectiveness of the method used. Preliminary results indicate the possibility of using cold plasma to eradicate the perennial ryegrass endophyte. The conducted research is a part of the project: „Doktorat Wdrożeniowy" funded by the Ministry of Education and Science in Poland.

Keywords: grass, endomycorrhizal fungi, novel endophytes

Reflections of nature on Gourd Embroideries in Alanya District of Antalya Province

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Abstract

Dating back to ancient times, gourd was always part of everyday life in Anatolia. Sometimes it was in the kitchen as a salt shaker, sometimes in the fields as a water-pot, and sometimes bowl to wash clothes. Not forgetting the mothers with infants, gourd was also dried along with its seeds to turn into a rattle, becoming the most natural toy for babies. Being previously used as a tool to help in basic daily tasks, the advances in technology during the past 50 years made gourds more into decorative ornaments. This way, Anatolian population turned gourd into a work of art by reflecting their aesthetic approach, interest and views on nature. This study is making an assessment of gourd's production, drying, internal and external cleaning, outer design and pattern-drawing and decoration techniques. In modern times, decorated gourds are turned into works of art such as lamp-shades, pendants, candle sticks, bird nests, vases, toys, ornaments and monuments. In Turkey, gourd embroidery is mostly conducted in Alanya district of Antalya province. This form of art draws various natural patterns on gourds and paints them and it has not only become part of everyday life but it has also become the symbol of Alanya. This gourd-based art must be preserved and passed down to future generations. It is highly significant in terms of our cultural values, tourism and future, and it must be promoted and improved both in domestic and international sense.

Keywords: Antalya, Gourd, Nature

Water requirements of {Robinia Pseudoacacia} L. in the reclamation plantation in Poland (Central Europe)

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Abstract

Black locust (Robinia pseudoacacia L.), as a species resistant to drought and unfavorable habitat conditions, is often used for biological reclamation of degraded areas. Nevertheless, in the juvenile stage, these trees need optimal soil moisture for proper development. The aim of this study was to estimate the water requirements of young black locust plants at the period of over three years after reclamation. The water needs were assessed for five agro-climatic regions of Poland for the period from 1 June to 31 August in 1981–2010. Water requirements, considered as the crop evapotranspiration, were determined as the product of reference evapotranspiration and plant coefficient. The reference evapotranspiration was calculated using the Blaney-Criddle's formula. The plant coefficient was adopted to the Żakowicz's method. On average, in Poland, the water needs of black locust calculated for the period June–August was 370 mm. The rainfall deficit was found throughout Poland, but the highest in the central regions of Poland. Moreover, in all studied regions, a clear upward trend in water needs of this species was noted. The results of the research will be helpful in planning and programming the irrigation of young black locust trees grown in reclamation plantings in Poland.

Keywords: black locust, evapotranspiration, irrigation, precipitation, rainfall deficit

Water needs of sunflower in Central Poland: toward water saved cultivation and optimized use of crop

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Abstract

Due to climate change, agricultural crops require water-saving irrigation, which is related to the development of research on the water requirements of plants. The aim of the research was to estimate the water needs of sunflower cultivated in four provinces (Kuyavian–Pomeranian, Masovian, Greater Poland, Lodz) located in central Poland. A measure of water needs was a potential evapotranspiration. The growing season of the sunflower (from 11 April to 10 September) in 1981–2020 was analyzed. Rainfall deficit in the normal, medium dry and very dry years was determined using Ostromęcki method. On average in provinces of central Poland, during the growing season, the highest daily water needs was in July (3.7 mm). The water needs during the vegetation season was 366 mm. The highest water needs was found in the Kuyavian–Pomeranian and Masovian provinces. In the studied forty years, an upward trend of water needs was observed in all provinces. The water needs increased the most in the Greater Poland province (each decade by 9.1 mm). The highest rainfall deficit occurred in the Kuyavian–Pomeranian province. The results of the study may contribute to increase the efficiency of using limited water resources available for irrigation in central Poland.

Keywords: climate change, crop productivity, evapotranspiration, Helianthus annuus L., rainfall deficit, water-saving irrigation

The influence of the weight and thickness of filter fabrics on the performance of the drainage system

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Abstract

Drainage is currently one of the most effective methods of groundwater level regulation both in Lithuania and around the world. It is used not only for land on the farm, but also in urbanized areas, forestry, road construction, in environmental protection, etc. The average age of drainage systems in Lithuania is about 60 years. One of the factors that determine the optimal regime of groundwater levels in drained areas is properly selected filtering materials that protect drains from silting. The purpose of this research work is to investigate whether filter materials are used for agricultural drainage in Lithuania according to a unified methodology. The subject of this research work is filter fabrics used in agricultural drainage systems. As the results of statistical data processing, it was found that material properties such as thickness in tension r = 0.52, resistance to static puncture r = 0.40 and water conductivity to a perpendicular plane r = 0.21 are weakly or not at all correlated with the amount of water that has flowed out. It can be said that the properties of filtration material do not have a significant impact on the functioning of the drainage system, these properties are more important for the transport of the material or other unexamined properties. The very strong correlations r = 0.806 were obtained between the weight of the material and water conductivity and very strong correlations between the thickness of the material and water conductivity r = 0.843. Thus, the thickness and weight of the material are two factors that ensure optimal conditions for the flow of water into the drains.

Keywords: drainage , filter materials, thickness of the material, water conductivity

Examination of the effect of basal fertilization and top-dressing on the vegetation index values and yield of maize hybrids of different genotypes

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Abstract

Three maize hybrids of different genotypes (Merida; Armagnac; Fornad) were involved to study the effects of basal fertilization, top-dressing and irrigation on the values of different vegetation indexes (NDVI and UAV NDVI) and yield in 2021. The studies were conducted at the Látókép Experimental Station of the University of Debrecen in Hungary. The experiment is two-replicate, one and a half hectare, two-plot, set up in 2011. In the field trial, nitrogen (N) fertilizer rates were applied as basal fertilization and top-dressing in addition to the non-fertilizer (control, A_0) treatment. The 60 and 120 kg N ha^{-1} applied as spring basal fertilizer was followed by two top-dressings at V6 and V12 phenophases at rates of +30 and +30 kg N ha^{-1}. When examining the effect of fertilizer treatments, averaged over irrigation and hybrids, the lowest NDVI value was measured in the A_0 treatment (0.685±0.148), while the highest NDVI value was obtained in the A_{120} treatment (0.734±0.133). Averaged over irrigation and fertilizer treatments, the highest NDVI value among hybrids was obtained for the Fornad hybrid (0.718±0.145), which was statistically confirmed. A significantly lower NDVI value was measured for the hybrid Merida (0.703±0.149). The NDVI value of the hybrid Armagnac was not statistically different from the other two hybrids. Irrigation had a statistically significant effect on NDVI (+0.014). Linear regression analysis of treatments and irrigation showed that irrigation increased NDVI values in all cases except in treatments $V12_{120}$ and $V12_{180}$. Based on the tests, the correlation between NDVI and UAV NDVI values was moderately strong (r=0.72; R^2=0.517) for the average of -fertilizer treatments and hybrids. The highest yield (12.03±1.09 t ha^{-1}) was statistically provided by the A_{120} treatment in the average of hybrids and irrigation. It can be concluded that the NDVI values give a reliable overview of yield trends.

Keywords: fertilization, hybrid, irrigation, maize, vegetation index, yield

Effect of water regime on microbial and enzymatic properties across the soil profiles under various land uses

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Abstract

Different water regime across the soil profiles affects changes in soil microbial and enzymatic properties, which play a major role in decomposition of soil organic matter (SOM) and nutrient cycling. The rate of SOM decomposition in the surface, oxidative horizons of soil profiles is often much higher than in the deeper, saturated and anaerobic soils layers with reducing conditions. In such gleyic horizons, the microbial and enzymatic properties can be directly associated with water saturation, which leads to a depletion of soil oxygen and changes in the soil features. To assess the effect of the water regime, we compared the soil properties in the gleyic horizons, which are expected to have reducing conditions, to the oxidative layers, occurring at the same/similar depth. Six soil profiles were excavated under various land uses (cereals, orchard, hop plantation) located in central Poland. In each genetic horizon, we assessed the oxidoreductase and hydrolase activities, the number of microbial groups and associated physico-chemical properties. As expected, nitrate-reductase activity and nitrate content was significantly higher in the gleyic layers than in the oxidative horizons, while the opposite trend was found for laccase and N-acetyl-glucosaminidase activities as well as fungi number. Unexpectedly, dehydrogenases did not have the highest activity in the gleyic horizons compared to the other horizons. Furthermore, no significant relationship was found between the dehydrogenases and facultative anaerobic bacteria number. The contribution of facultative anaerobic bacteria in total bacteria was higher in the gleyic horizons than in the compared oxidative horizons. No significant effect of water regime on C and P-related enzyme activities was found. The variation in the frequency and extent of the reducing conditions in soils accompanying weather changes may be insufficient to affect the short-term dynamics of these enzymes. The research was financially supported by the National Science Centre, Poland (project 2018/29/B/NZ9/00982)

Keywords: gleyic conditions, number of microbial groups, oxidative/reducing conditions, soil enzymes, soil profile, water regime

Competitiveness as theory and practice. Regulatory framework of competitiveness, specificity of manifestation thereof in the agrifood sector

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Abstract

The competitive practice most often differs from the theory, hence, there is a need for regulation at the political level, as pertaining to the way of regulation. Competitiveness games in the agrifood market are governed by the regulatory enactments that differ from one country to another too. However, in general, all of them result in a loyal competitiveness rule for those actors, who have economic interests in the market. Competitiveness is a gesture of manifestation in all key sectors of the domestic and international economy. The essential role belongs to the competitiveness in the agrifood sector, which is a milestone of economic development. This thesis highlights the regulation of the domestic regulatory enactments and the correlation thereof with the European area in the field of competitiveness. Aiming to achieve this objective, there was carried on a study of the regulatory enactments in the food sector. There were studied the works in the field of competitiveness regulation and the reports of the Competitiveness Council. The findings of the study show that the agrifood industry and the sale of foodstuffs are the key sectors, where sometimes anti-competitiveness impediments must be remedied, as a priority, via updated regulatory enactments at each stage of market development. Harmonization of the domestic regulatory enactments with those ones from the European area and application thereof in practice would remedy certain legislative gaps in the regulation of the competitiveness in the agrifood market.The study, which was carried on, is a preliminary one and its goal is to analyse the regulatory enactments that supervise the competitiveness in the agrifood market. This topic is to be developed within the Ph.D. curriculum.

Keywords: agrifood, competitiveness, harmonization, impediments

Impact of post-harvest drip irrigation on the yields of selected European Asparagus Cultivars grown for green spear production in sandy soil in Central Poland

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Abstract

The objective of this study was to verify the response of 10 European asparagus cultivars grown for green spear production using post-harvest drip irrigation. Irrigation, used to compensate for periodic deficiencies in precipitation, allows for high and good quality crops for many species, and also keeps soil in good condition. The field experiment was carried out in 2006–2008 on a very light sandy soil in central Poland. Irrigation treatments were applied using the tensiometer indications. Water needs of asparagus were calculated on the base of reference evapotranspiration and crop coefficients. The following evaluations were made: height, diameter and number of summer stalks, as well marketable yield, weight and number of consumption green spears. Drip irrigation applied for two years (2006–2007) in the post-harvest period, had a positive effect on all studied traits, both summer stalks and green spears in 2007–2008. A significant increase in the height, number and diameter of summer stalks, as well an increase in the marketable yield, weight and number of green spears was observed for most of the cultivars. In general, post-harvest drip irrigation of asparagus cultivated in very light sandy soil significantly contributes to the increase in productivity of this species.

Keywords: Asparagus officinalis L., cultivar, spears yield, light soil, water needs, water use efficiency

Effect of microbiologically enriched mineral fertilizers on the growth and development of Thuja Occidentalis

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Abstract

Conifers such as Thuja occidentalis cv. Brabant are commonly grown in gardens as evergreen hedges. This shrubs is characterized by relatively rapid growth, with annual increments of up to approx. 30–40 cm. Thuja cv.'Brabant' grows best in sunny or partial shade, on fertile, slightly acidic soils. Plant growth, branching and leaf color can be affected by nutrient availability in the soil. Lack of minerals such are nitrogen, potassium and magnesium, can negatively affect plant growth and resulted in leaf yellowing. Nutrient availability can be significantly improved by the adequate irrigation and presence of specific biological compounds (bacteria or fungi) active in soil. The aim of the studies, conducted during 3 years (2019-2021) were to determine the effect of microbiologically enriched fertilizers and two irrigation levels (stressed plants and fully irrigated) on the growth and development of Thuja occidentalis cv. Brabant. The tested fertilizers were enriched with fungi: Aspergillus niger and Purpureocillium lilacinum (UREA) or with bacteria Bacillus sp.:, Bacillus amyloliquefaciens and Paenibacillus polymyxa (POLIFOSKA 6 and SUPER FOS DAR 40). Control plants were cultivated without any fertilizers: control "0", or with "standard fertilization". Half of the plants were fully irrigated according to water requirement and second half were "stressed" the keep soil moisture at 12-15% .The fertilizers were applied at full dose -100% or reduced to 60%. The results showed that diversification of fertilization and irrigation influenced the growth of Thuja. On average, the stressed plants had diameters lower by about 6% than the optimally irrigated ones. Fertilization significantly influenced this parameter. The least developed plants with the lowest diameter were those not fertilized. The plants fertilized with urea and enriched Polyphoska reached about 80 cm in diameter and had well colored leaves.

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Keywords: biofertilizers, nursery plants, ornamental shrubs, water stress

Assessment of soil quality parameters after 4 years of compost application in organic farm

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Abstract

The soil organic matter, pH value, and amount of plant nutrients are significant soil quality parameters. Three soil plots (four reps), from 1.2 to 3.0 ha, were amended yearly for 4 years, respectively, with 5, 10 and 20 Mg ha−1 yr−1 of mature compost obtained from cattle manure and post-harvest residues collected from organic (biodynamic) farm. The 2000-hectare farm in Juchowo (northern Poland) is focused exclusively on cattle feed production (700 heads of cattle) and grassland grazing. The biodynamic farm promotes practices with plant biodiversity in the field, conservative tillage system, and crop plant rotation with Fabaceae family. Organic farming management relies on the purposeful maintenance and replenishment of soil fertility. The amended soils, and a control soil plot after 4 years (2017-2021) for the content of total organic carbon (TOC), total organic nitrogen (TON), dissolved organic carbon (DOC), dissolved organic nitrogen (DON), total exchangeable base cations (TEB) values, pH, and enzymatic activity were analyzed. The experimental data of this work indicate that the compost application may significantly affect the soil quality, fertility, and that the approach used in this work allows one to trace the fate of organic matter in the soil of organic farm. Conservation tillage, crop rotation, and compost application resulted in a statistically insignificant increase in average organic carbon content. The most efficient dose of compost to enhance the pH appeared to be 5 Mg ha−1 yr−1. Application of compost resulted in an increase of TEB, but not statistically significant. Soil samples from all analyzed plots in 2021 exhibited significantly lower average DOC content. After 4 years compost application, a significant increase in enzymatic activity of dehydrogenases, catalase, and alkaline phosphatase has been achieved.

Keywords: compost, enzymatic activity, organic farming, soil organic matter

Effect of beneficial microorganisms on the vegetative growth, yield and nutritional status of apple trees

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Abstract

In the past years, very intensive fruit-growing systems have been developed in many fruit-growing centres. Such a method of farming requires application of excessive amounts of chemical fertilizers. Because of concerns for food and environmental safety, the use of agrochemicals must be reduced. The proposed solution is to increase fertilization efficiency by enriching the soil with beneficial microorganisms. The aim of the study was to evaluate the effects of using bacterial and fungal inocula on the growth, yielding, and nutritional status of apple trees. The experiment was established in the spring of 2018 in the Experimental Orchard of the National Institute of Horticultural Research in Dąbrowice (Poland) on apple trees ('Šampion'/M.9) and was run for three years. The experiment included following combinations: (i) unfertilized soil, (ii) no fertilization + soil application of fungi, (iii) no fertilization + soil application of bacteria. The mixture of beneficial fungi contained: Aspergillus niger, Purpureocillium lilacinum. The mixture of beneficial bacteria contained: Bacillus sp., Bacillus amyloliquefaciens, Paenibacillus polymyxa. The application of beneficial microorganisms (especially bacterial strains) to the soil (without additional fertilization) enhanced the growth of the apple trees. In the third year of the study (2020), the trees grown in the plots inoculated with bacteria bloomed the most intensively. Plant nutritional status (expressed as concentrations of elements in leaves) was not affected by the application of the microorganisms. The stronger growth of trees in the plots where the bacteria were used was likely related not so much to the nutritional status of the trees, but to the mitigation of the influence of the negative factors that cause the replant disease (despite crop rotation, our earlier study showed occurrence of replant problems in the orchard).

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Keywords: beneficial bacteria, beneficial fungi, fertilization, mineral content

Product selection and profitability optimization for sustainable agriculture in Alanya Region

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Abstract

Today, increasing population, pandemic conditions, and international conflicts have made agricultural production more important worldwide. On the other hand, factors such as increasing costs, decreasing water resources and global climate change reduce agricultural production. While one of the important components of sustainable agriculture is the economic return of agricultural production, another important one is the efficient and effective use of water resources. The continuity of agricultural production can be associated with the economic income of farmers. This can be achieved by producing the right product variety in the right amount and in the right place, taking into account the supply and demand balance as much as the constraints allow. The aim of this study is to determine the most suitable product variety for farmers engaged in agricultural production in Alanya, Turkey. For this purpose, the product types that can be grown in Alanya, arable land, land sizes and agricultural irrigation opportunities have been determined. Then, product assignments were made to the lands in order to increase profitability in the short and long term. To do this, a mixed integer optimization model was created and solved. Among the inputs of the model are the size of the land where the agricultural activities will be carried out, the climate zone of the region where the land is located, the water capacity required for agricultural irrigation, the capital required for investment, the yield, the product sales price and the transformation period of the product into economic input. Results of the study will help to determine the most suitable products in the short and long term according to the constraints such as the amount of land owned by the farmers and irrigation water, to ensure sustainability in agriculture and to contribute to the economy of the district by increasing agricultural profitability.

Keywords: Irrigation efficiency, Optimization, Product selection, Profitability, Sustainable agriculture

Preliminary studies on molecular identification and variability of Polish *Epichloë* isolates originated from perennial ryegrass

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Abstract

Perennial ryegrass (*Lolium perenne* L.) is a species of one of the most durable low tuft grasses characterized by high forage value. Like other plants, it is exposed to unfavorable factors. Systemically developing endophytes of the *Epichloë* genus, thanks to bioactive alkaloids and other metabolites, can protect grass from biotic and abiotic stresses, including drought or pathogens. In the above-ground grass tissues representatives of *Epichloë* develop systematically and persist there throughout the whole host's life [1-3].

The aim of research based on the PCR technique was to analyze selected *Epichloë* isolates obtained from perennial ryegrass growing in Poland. For molecular analyses mycelium was grown on PDB (Potato Dextrose Broth, Difco) medium. DNA was isolated using the Bead-Beat Micro AX Gravity kit (A&A Biotechnology).

Analyses of sequences of ITS (internal transcribed spacers) regions and fragments of genes encoding Tef1-α (translation elongation factor 1-alpha), CHS (chitinase A) and NRPS-1 (nonribosomal peptide synthetase) confirmed that the isolates studied, initially identified on the basis of morphology under the microscope, belong to the *Epichloë festucae*.

Sequence analysis of the regions mentioned also allowed to study the genetic diversity of isolates. The comparison of differentiation between our *E. festucae* isolates and those deposited at GenBank NCBI, as well as the sequences of this species with other members of the genus *Epichloë* / *Neotyphodium* that can colonize grasses was carried out.

Genetic differentiation was found between the tested *E. festucae* isolates and some isolates of the same species from other regions of the world, from which our isolates differed at the level of 1-2%. Our isolates showed a similar difference compared to representatives of other species, such as *E. tembladerae* or *E. australiensis*.

The analyzed sequences of our *E. festucae* isolates named NovaPol1 and NovaPol2 were deposited at GenBank NCBI.

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Keywords: Perennial ryegrass, *Epichloë*, PCR technique

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Sustainable development in human environment – Poland Case

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Abstract

Sustainable development occupies a key place among the development priorities of global societies and economies. In today's world, sustainable development becomes a kind of compromise between environmental, economic, social and health goals that determine the survival and well-being of the present and future generations. This means securing resources in the form of natural, man-made material, intellectual and social capital. The social aspect, which is usually equated with education and gaining the ability to solve social and health problems, is a particularly important challenge for present and future generations. The challenges faced by humans in the context of the ongoing COVID-19 pandemic and after it seem to be extremely important. The evolutionary but visible nature of changes in the human environment is a natural process, caused by the need to adapt to the changing reality as well as the economic and social environment in every country. Therefore, it is important that this mostly literature study allows to design and propose a model of sustainable development of human environments, as well as to meet the current and future challenges in the functioning of health care, especially in the aspect of the COVID-19 pandemic and the production of healthy food in harmony with the natural environment in Poland.

Keywords: human environment, sustainable development

Effect of different levels of yeast biomass on growth performance, feed conversion and meat composition in Carp (Cyprinus Carpio) in a recirculating aquaculture system

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Abstract

In aquaculture, the use of yeasts as alternative sources of protein in fish feed represents a solution that leads to improved economic profitability and ensures environmental sustainability, through reduced carbon emissions. In the present study, there have been tested on Cyprinus carpio carps the effects of two experimental diets supplemented with yeast biomass (YBV3% and YBV5%) compared to a control diet (YBV0%) on growth performance, feed utilization and chemical composition. Fish were fed 2.5% of their body weight twice daily. Water parameters (temperature, oxygen, pH, conductivity, ammonia, nitrite, nitrate and phosphate), body weight and length of fish were measured weekly. Growth performance increased significantly ($P<0.001$) with increasing levels of yeast biomass, while feed conversion ratio and condition factor were not affected. Between the levels supplemented with yeast biomass and the protein efficiency ratio, there is a linear correlation. In conclusion, compared to the commercial diet, yeast diets are more effective and represent suitable protein sources in carp nutrition. In terms of preserving the environment and aquatic biodiversity, yeasts represent alternative and relatively cheap sources of protein compared to fish meal used in fish feed.

Keywords: aquaculture, carp, feed conversion ratio (FCR), protein, yeast biomass

Water needs and rainfall deficits of Asparagus plants under conditions of drip irrigation in Central Poland

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Abstract

The aim of the research was to estimate the water needs of asparagus plants cultivated in four provinces (Kuyavian–Pomeranian, Masovian, Greater Poland, Lodz) located in central Poland. A measure of water needs was a potential evapotranspiration. The irrigation season of the asparagus plants (from 21 June to 31August) in 1981–2020 was analyzed. Rainfall deficit in the normal, medium dry and very dry years was determined using Ostromęcki method. On average in provinces of central Poland, during the irrigation season, the daily water needs amounted 1.6 mm, 3.4 mm and 3.7 mm in 21-30 June, July and August, respectively. The water needs during the irrigation season was 238 mm. The highest water needs was found in the Kuyavian–Pomeranian and Masovian provinces; the lowest water needs was found in the Lodz province. In the studied forty years, an upward trend an upward tendency of asparagus plants water needs was observed in all provinces. The water needs increased the most in the Greater Poland province (each decade by 6.2 mm) and the least – in the Kuyavian–Pomeranian province (each decade by 3.1 mm). The highest rainfall deficit occurred in the Kuyavian–Pomeranian province. The lowest rainfall deficit occurred in the Lodz province. The results of the study may contribute to increase the efficiency of using limited water resources available for water-saving systems of irrigation for asparagus plantations located in central Poland.

Keywords: asparagus, central Poland , drip irrigation, ETc, water needs

Challenges of garlic cultivation in water-scarce areas

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Abstract

Vegetables grown in Poland are highly valued in both the local and foreign markets because their production usually does not involve the use of banned pesticides. An example of such a vegetable, for which demand is constantly increasing, is garlic. On the market, the plant is valued by consumers for its exceptional antibacterial and antibiotic properties.Garlic has very high water requirements related to this plant's shallow root system, reaching only about 30cm deep into the soil profile. Unfortunately, climate change contributes to longer periods of no precipitation, which leads to significant water shortages. Due to this fact, irrigation has become one of the indispensable agrotechnical operations required to cultivate this vegetable. One of the modern and efficient cultivation technologies is drip irrigation. The advantage of this system is the precise dosage of water directly to the root system of the plants. This leads to a reduction in water consumption, which is important for the environment and for the grower because it reduces operating costs. The aim of this study was to evaluate the effect of drip irrigation on the yield of garlic of the cultivar Harnaś. Garlic yielding was analyzed in 2020 and 2021 on two different plots (with and without irrigation) located at a farm in Poland. In the study, meteorological conditions were characterized and the water requirements of the plants were calculated and then the irrigation rate was selected.The study showed that irrigation of garlic contributed to a yield of 10 tons per hectare, while the yield obtained from the field without irrigation was 20-30% lower. Irrigation also had a positive effect on garlic size. On the irrigated plot, the diameter of garlic bulbs was much larger than on the non-irrigated one and was on average 5 cm, which significantly translates into higher profits from sales.

Keywords: garlic; drip irrigation; water requirements

Water needs of Cup Plant (Silphium Perfoliatum L.) in Bydgoszcz Region under drip irrigation conditions

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Abstract

Field experiment with the use cup plant (Silphium perfoliatum L.) was carried out in 2015-2018 in the experimental field at the forest nursery of the Bydgoszcz Forest District in Białe Błota (53°06'45.9"N 17°56'29.8"E). The experiment was conducted on the area particularly characterized by distinct water deficits (very light soil) and very low amount of rainfall during the vegetation period. Two water variants K1 (-40 kPa) and K2 (-20 kPa) were the first order factor. The second order factor were magnesium sulfate doses: N0 (without fertilization), N1 (300 kg.ha-1), N2 (600 kg.ha-1). The goals of the research were: the estimation of water needs - field water consumption (S) of the cup plant; the determination of crop coefficients (kc) for formulas of Hargreaves (in modification of Droogers and Allen) and the estimation of the water needs for the cup plant on the base of climate criterion (ETp); the determination of water deficits and irrigation needs for the cup plant. Field water consumption in the conditions of drip irrigation in – on average – amounted 421 mm and 462 mm, for K1 and K2 sites respectively. In each year of experiment, plants growing on K2 variants were characterized by higher values of daily water consumption. Potential evapotranspiration of cup plant crop under drip irrigation calculated on the base of Hargreaves' formula (in modification of Droogers and Allen) (ETpKHDA) amounted to 354 mm and 409 mm for variants K1 and K2, respectively. The largest water needs and the need for irrigating of cup plant in relation to field water consumption (S) in the 3rd year of the experiment (2018) in all months of the growing season were 217 mm and 239.93 mm for the variant K1 and K2, respectively.

Keywords: cup plant, drip fertigation, magnesium, sulphur, water needs

Perennial ryegrass cultivar inhabited by novel *Epichloë* endophyte – an innovative protection of grasses from stress factors

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Abstract

The perspective of limiting the use of plant protection products by 2030, resulting from the principles of the European Green Deal, imposes certain restrictions on agricultural producers. In this situation, an opportunity for agriculture is to use the achievements of science and support the broadly understood cooperation between Science and Business for the fastest possible implementation of new, innovative solutions that support sustainable, environmentally safe agricultural production. Dedicated financial resources are launched for this type of activity.

An example of such project is "Introduction to the market of an innovative variety of perennial ryegrass inhabited by symbiotic endophytic fungi". The project is carried out by the EPI consortium under the name NOVA GRASS. The consortium consists of: Bydgoszcz University of Science and Technology (Leader), The Plant Breeding Company Grunwald Ltd., Group IHAR based in Mielno, Plant Breeding and Acclimatization Institute - National Research Institute in Radzików, Kuyavian–Pomeranian Agricultural Advisory Centre in Minikowo and an individual agricultural producer. The result of the implementation of the above-mentioned project will be product, technological and marketing innovation for sustainable agriculture. The main objective of the operation is to create an innovative variety of perennial ryegrass inhabited by novel, symbiotic endophytic fungi of the *Epichloë* genus. Due to the presence of selected endophytes in plants, the inhabited grasses will be characterized by higher durability and better growth, higher resistance to water shortages and tolerance to soil salinity, better use of nutrients, higher resistance to infection by pathogenic microorganisms, as well as lower susceptibility to damage caused by insects and nematodes. This will allow producers to be more flexible and comfortable in production in the absence of optimal conditions for plant growth, especially in conditions of uneven distribution of rainfall and water shortages.

The conducted research is a part of the project: Launching innovative cultivar of perennial ryegrass colonised by symbiotic endophytic fungi" implemented by the NOVA TRAWA consortium, under Action M16 "Cooperation" managed by the Agency for Restructuring and Modernisation of Agriculture (Rural Development Program for 2014-2020).

Keywords: perennial ryegrass, innovative solutions, Epichloë

Impact of Climate Change on agriculture and the environment

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Abstract

The ozone layer, which brings the average temperature of the earth to livable levels by keeping some of the sun's rays coming to the world, has lost the natural rate of gases in its structure due to the rapid increase in the population in recent years and the developments in the technological and industrial sector. Apart from natural causes, greenhouse gases emitted by humans and the ozone layer, which deteriorates the rate of gases in its structure, cause the average temperature of the world to increase every year. Increasing greenhouse gas emissions with the developing industrial systems and excessive consumption in the last century have caused the world to reach many times more pollution than it has been able to reach for millions of years. The world is in such a balance that a mass of gas released into the environment disrupts the natural structure of ozone layer, and this causes floods, hurricanes, drought, excessive precipitation, unusually heavy hail, famine, hunger, diseases, etc. cause results. In addition, climate change can directly or indirectly affect agricultural activities as a result of air temperature, precipitation, wind changes and natural disasters. This study was conducted to examine the effects of climate change on the environment and agriculture. Measures that can be taken against global climate change and its consequences were discussed.

Keywords: Climate, global warming, agriculture, environment, greenhouse effect.

Protection of the old autochhonus variety of Pepper “Somborka” from pemanent loss in our area

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Abstract

Pepper (Capsicum annuum L.) is one of the most important vegetable crops in the world and in our country. There are a large number of varieties of peppers that differ primarily in color, shape, size, aroma, degree of spiciness, etc. The biggest producers are China, Indonesia, Mexico, Spain and Serbia. Old varieties of vegetables are disappearing at a high rate, every year 1-2% of the percentage is lost. In the last century alone, as many as 75% of old varieties have disappeared in the world. Older varieties of vegetables have a much higher nutritional value. Nowadays, when natural varieties are neglected and suppressed a lot, their renewal and reproduction are very important. During several previous years, in the experimental field of Agricultre Extension Service “Sombor”, biological properties and production characteristics were evaluated from collected samples of old autochtonus variety Somborka It belongs to the group of semi-stemmed, semi-determinant growth, strong, compact, the tree branches. The yield is a semi-bubble with a pointed top, slightly spicy, weighing 60-90 g, light yellow in technological maturity and intensely red in biological maturity. Somborka is a mid-early variety. It is used for various methods of processing, the yield is about 40 t/ha under conditions of full agricultural technology, it is tolerant to the most common causes of pepper diseases. Also, have big difference in taste between hybrids and domestic varieties. With the onset of hybrids from the fifties, the old varieties were suppressed, and the biggest reason is better yield and shape. However, with good cultivation, irrigation and fertilization, old varieties can give excellent yields. Old varieties are suitable for organic producers, because they generally have stronger resistance than hybrids. The old varieties have grown on that land for centuries and thus have best adapted to the conditions, soil and climate.

Keywords: autochtonas, old variety, pepper, pilot project, Somborka, vegetable

A multi-year (2004-2022) study on the occurrence of Sharp Eyespot ({Rhizoctonia Cerealis}) in wheat

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Abstract

Fungi Rhizoctonia genus are considered to be among the most harmful soil-borne pathogens in crop plants around the world. These fungi can occur at any time during the growing season on all cereals in different climatic zones. They can cause pre- and postemergence damping off and shoot death in seedlings. In wheat they cause sharp eyespot, seedling blight and Rhizoctonia root rot. Occurrence of sharp eyespot were performed over the time period of 2004–2022, on production fields of wheat, localized in different regions of Poland. At the milk stage of grain (BBCH 75–77) random samples were taken. Percent of infected stems, and the disease index (DI) were evaluated. Analysis of Rhizoctonia culture on PDA medium and PCR assay confirmed that R. cerealis was the main cause of sharp eyespot. There was a positive correlation between amount of R. cerealis DNA in wheat stem bases and DI, and the percentage of stems with symptoms of sharp eyespot. On the cereal stems with sharp eyespot symptoms, R. cerealis was most frequent. Rhizoctonia solani were less frequent. Rhizoctonia solani was more often isolated from roots and stems with true eyespot and Fusarium foot rot symptoms. We noted that occurred wide variation in disease incidence. On most fields sharp eyespot appeared in lower intensity. In some fields the disease was not reported at all. The intensity of the disease varied across the fields (locations), years, cultivar and soil. Most infected stems were noted in 2007. Greater intensity of the sharp eyespot was observed on lighter soils. Under production conditions, there was found no significant effect of the preceding crop, dose of nitrogen fertilization and the fungicide protection applied on the occurrence of sharp eyespot in winter wheat. Sharp eyespot affected wheat yield, and grain quality.

Keywords: Rhizoctonia cerealis, sharp eyespot, wheat

Role of endosymbionts in Phosphine resistance of two Sitophilus Species (Coleoptera: Curculionidae)

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Abstract

Sitophilus species (Coleoptera: Curculionidae) are important pests on stored grains in the world. The Phosphine gas was applied to control the pests. But, the pests can develop resistance against phosphine. There are some studies about the role of endosymbiont bacteria in developing resistance to pesticides. This study was conducted to determine the presence of endosymbiont bacteria Wolbachia, Rickettsia, and Spiroplasma in phosphine-resistant and susceptible Turkish populations of two stored-product insects, granary weevil *Sitophilus granarius* and rice weevil *S. oryzae*. The infection rates in susceptible and resistant S. granarius populations were determined respectively for *Wolbachia* 49.7% and 87.2%, *Rickettsia* 45.6% and 37.5% and, *Spiroplasma* 27.8% ve 28.50%, and for *S. oryzae* 16.6% and 27.8 %, *Rickettsia* 33.3% and 77.8% and, *Spiroplasma* 11.2% and 5.6%. It can be said that endosymbionts have no effect on phosphine resistance.

Keywords: *Sitophilus granarius*, S. oryzae, *Wolbachia, Rickettsia, Spiroplasma*, phosphine

Effect of olive fly [(bactrocera oleae gmel. (diptera:tephritidae)] damage on olive oil. Quality and sensory properties

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Abstract

Turkey is among the important producer countries in olive oil production. Supporting the positive effects of olive oil on human nutrition and health with scientific studies has given a new impetus to olive growing in our country as well as all over the world. With the increase in consumption in recent years, it is observed that quality awareness has also emerged. In the evaluation of olive oil quality, sensory testing besides chemical analysis has gained importance. For this reason, the number of Olive Oil Sensory Analysis Panels and trained panelists is increasing day by day in Turkey.

There are many factors that affect the quality of olive oil. Olive fly [(Bactrocera oleae Gmel. (Diptera:Tephritidae)] is one of the important factors affecting the quality of olive oil negatively.

There are many studies showing that olive oil yield decreases, olive oil quality parameters and chemical composition of olive oil are adversely affected as a result of olive fly damage. In this study, the effect of olive fly damage on olive fruit on olive oil quality and sensory properties was compiled.

Keywords: Olive, Olive fly, olive oil, quality

Determination of Hydrological Drought in Karst Basin: Example of Dim River

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Abstract

Drought is defined as a natural disaster that occurs when the precipitation measured in the region or in the basin is less than the average precipitation, and it affects the entire hydrological cycle system and disrupts the hydrological balance. In addition, drought is an extreme type of natural disaster that interacts with many factors and has devastating effects on events such as water resources, agricultural, social, economic, political and natural ecosystems.

With the effects of climate change, drought causes the average climate intensity and frequency of the region or basin to change more rapidly. Therefore, the definition and assessment of drought is much more difficult than other natural disasters. In recent years, global warming and extreme drought events have increased significantly. For this reason, the Karstic Dim stream-Alanya sub-basin within the borders of the Antalya basin, located in the western part of the Mediterranean region, was chosen in the study. In the Dim stream sub-basin, the monthly average flow values between the 1961-2017 water years of the 2 flow measurement stations where flow measurements were made by DSI were used. Using these data, monthly and annual standardized Flow Drought Index and hydrological drought analyzes were performed. As a result, i (Tr=1, 2.33, 5, 10, 25, 50, 100 years) values of hydrological droughts at certain recurrences were determined by using the monthly and annual Standardized Flow Drought Index values calculated for the Dim stream basin. It was determined that the Dim stream was under the influence of moderate drought after 2000. It will be effective in the planning and projecting of hydraulic facilities that are thought to be built on karst streams.

Keywords: Drought, Dim Stream, Basin, Alanya

Planning the Landscape Values of the Bartın-Güzelcehisar Region as a whole along the Coastal, Urban and Rural

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Abstract

Today, people combine resting and enjoying activities that are their free time activities with wishing of learning and trying of new cultures. For this purpose, escaping from urban environments directs people to coastal areas and rural areas. In this context, areas with rich landscape values revealed by geographical beauties become a center of attraction with many opportunities. The study area is an area of 86.44 km^2, covering the coastal areas of Güzelcehisar, Mugada, İnkumu and the rural settlements of Güzelcehisar, Karasu, Arıönü, Saraylı, Gürgenpınarı, Konuca and Kocareis, located in the west and northwest of Bartın province. The research area is an important region with its coastal, urban and rural areas, its natural and cultural potential, geological richness, military and commercial port advantages. Based on the idea that the region chosen as the study area that its potential is not used correctly and adequately; it is aimed to ensure economic and local development by stimulating agricultural and rural resource, to keep the labor in the region by using coastal and water resource effectively and to prevent out-migration. And also it is aimed to increase regional cooperation and most importantly to create a living space with rich physical and cultural feature with an ecological approach. In the study, at the stage of creating the 'future vision' of the field, on-site observation and field studies were carried out and SWOT analysis and a questionnaire was applied. In this context; the strategies and spatial projections covering the planning decisions and mechanisms and their implementation phases have discussed in the whole of coastal, urban and rural areas. The potentials of the area were examined on the basis of ecological approach and sustainable development, and planning scenarios were created in four different concepts. In this context; field-specific concrete and applicable targets, strategies and project packages have been developed. ArcGIS 10.2 and Photoshop CS6 software were used in the preparation and presentation of planning projects, in the stages of field analysis and preparation of layouts.

Keywords: Landscape planning, landscape management, rural planning, coastal planning, sustainable development, Bartin

Development of the phenology, heat and water use efficiency and grain yield of maize hybrids in a moderately hot, dry production zone

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Abstract

Knowledge of maize hybrid phenology, hybrid selection and N management are key in terms of adapting to climate change and improving production efficiency.

The present study examined the effect of Growing Degree Days (GDD) on the phenology of three maize hybrids (Merida FAO 380, Fornad FAO 420, Armagnac FAO 490). and also how the amount of nitrogen applied and its application time affected stomatal conductance (Gs), heat and water use efficiency (HUE,WUE) and productivity of the maize hybrids.
Besides the non-fertilizer treatment, the 60 and 120 kg N ha-1 applied as basal fertilizer were followed by two instances of top-dressings at V6 and V12 phenophases with amounts of +30 and +30 kg N ha-1, respectively. Gs measurements took place during the V6,V12,VT,R1 and R6 phenological phases.
Due to the unfavourable environmental factors, hybrids accumulated only 40-50% of the amount of GDD required for germination (34-53oC). GDD accumulation was higher in the reproductive stage than in the vegetative stage, which showed differences by hybrid. No verified differences were observed in GDD of early and medium-maturity hybrids.
The water deficit between phenophases V6-R1 was not accompanied with high temperature, thus transpiration was not reduced and stomata of hybrids were not closed. After silking, Gs was greatly reduced for the R6 stage in all three hybrids ($p<0.05$).
The most favourable fertilization strategy was A_{60} for the early hybrids and A_{120} for the medium-maturity hybrids. This is achieved when the average G_s value is around 390 mmol m^{-2} s^{-1} and is highest during the R1 phenophase.
It was confirmed that optimal nutrient supply contributes to the increase in HUE and WUE values. The early hybrid was utilized heat more efficiently than medium-maturity hybrids. It increased its biological activity, as confirmed by higher yields at all nutrient levels, but no reliable difference was detected compared to medium-maturity hybrids.

Keywords: growing degree days, heat use efficiency, nitrogen fertilizer, maize, stomatal conductance, water use efficiency

Comparing of the effects of two irrigation systems on cotton root anatomy

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Abstract

In the study it was aimed to examine the anatomical changes of cotton (*Gossypium hirsitum* L. cv. Stoneville 468) root under different conditions created by applying different irrigation water levels and using two different irrigation systems, and to compare the effects of two irrigation systems on cotton root anatomy.

In irrigation period of 2015, the irrigation issues 100 % (v/v), 75 % (v/v), 50 % (v/v), and 25% (v/v) were determined according to the amount of evaporation obtained from Class A Pan and irrigation was applied by using Drip Irrigation System and Subsurface Drip Irrigation System. For anatomical studies, cross sections were taken from the samples of the roots belonging to all irrigation issues by microtome and were examined by light microscopy. According to the biometric measurements performed in some tissues in all issues, the anatomical changes were observed.

It was observed that the periderm significantly thickened and the diameter of xylem vessel significantly widened in the cotton root cultivated under full irrigation condition by applying Subsurface Drip Irrigation System ($p<0,05$; $p<0,05$). It was understood that two irrigation systems did not statistically formed an anatomical effect on the root in the tissues examined in the other studied issues (25, 50 and 75% limited irrigation issues) ($p>0,05$).

Keywords: Abiotic factor, Cultivation, Economical plant, Plant tissue, Pressurized irrigation

Maize (*Zea Mays L.)* productivity response to foliar fertilisation under different environmental conditions

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Abstract

To this day, we can still witness and feel the crucial impacts of various increasing environmental stresses hampering agricultural productivity, and subsequently jeopardising lives and livelihoods. Maize is one of the most produced crops globally. Increasing and sustaining its yield over the upcoming generation is becoming a challenging target. Under existing scenarios, foliar fertilisation has proved to be an ideal method for crop yield enhancement while reducing environmental concerns. The main objectives of this study were to evaluate the influence of foliar fertiliser on crop growth traits, in addition to its potential in regard to the changes in climatic conditions. A three-year field experiment (2019-2021) was performed at the Látókép Experimental Site of the University of Debrecen, Hungary. DKC 5092 (FAO 400) and Fornad (FAO 420) were the test crops that, at the 8-leaf stage of crop development, were sprayed with foliar fertiliser. Maize growth parameters, particularly the plant and ear heights and LAI were recorded at the silking stage. The grain yield and thousand-grain weight were also recorded. According to the obtained results, changes in weather conditions over the examined years significantly influenced the performance of both hybrids in terms of LAI, ear and plant heights. Overall, foliar nutrition improved their yield under different environmental conditions. The yield variation featured the difference in both hybrid's capacities to utilise their resources. Therefore, DKC 5092 had better water use under favorable weather conditions in 2020, by producing 37.7 kg of grain yield per unit of the water supply while it was only 26.71 kg for Fornad. Moreover, the thousand-grain weight improved as a result of the performed treatment and due to the exposure to favorable weather conditions. Thereby, our study reveals the evident impacts of climate changes on maize performance and productivity, yet the use of the best stress-tolerant hybrids along with foliar nutrition may mitigate the drastic yield decline.

Keywords: maize hybrids, climatic conditions, foliar fertiliser, yield, growth parameters

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