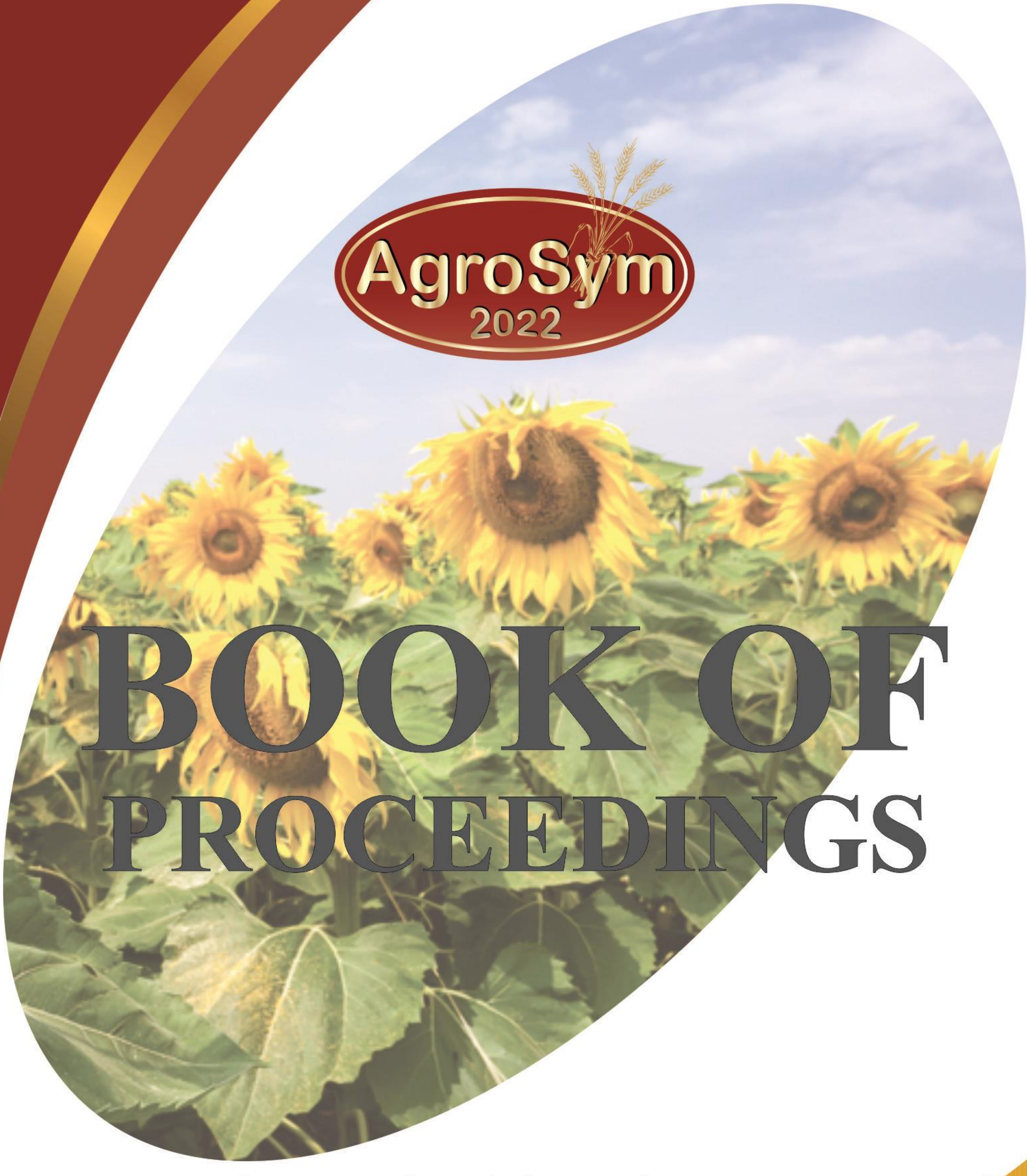

AgroSym 2022

BOOK OF PROCEEDINGS

XIII International Scientific Agriculture Symposium
"AGROSYM 2022"
October 6-9, 2022

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ORGANIZING COMMITTEE

PREFACE

Dear colleagues,

The Faculty of Agriculture of the University of East Sarajevo (Bosnia and Herzegovina), the Faculty of Agriculture of the University of Belgrade (Serbia), and CIHEAM - Mediterranean Agronomic Institute of Bari (CIHEAM Bari, Italy) organized from 6 to 9th October 2022 on Jahorina mountain (East Sarajevo, Bosnia and Herzegovina) the 13th International Scientific Agriculture Symposium "AGROSYM 2022". The symposium was organized for the third time in a hybrid format, with in-person participation (around 300 participants) and online participation (400 participants), because of the prescribed restrictions caused by the COVID-19 pandemic and the world's political situation.

AGROSYM 2022 made an important contribution to agriculture science and practice in different topics: plant production, plant protection, animal husbandry, environmental protection, organic farming, agroforestry, agroeconomy, and rural development. The Symposium topics cover all branches of agriculture as well as forestry and agroforestry. The scientific committee received around 700 papers and after review, it accepted 668 papers, 159 for oral presentations and 509 for poster presentations, which represents over 1500 authors from more than 80 countries worldwide.

During AGROSYM 2022, we had the opportunity to share the results of the current research at the international level and new information relating, inter alia, to biotechnology, world markets and agricultural knowledge and innovation systems in the European Union, especially in plenary papers. Based on many investigations, we can see that practices based on the concept of sustainable agriculture are gaining more and more attention. The goal for sustainable agriculture must be to meet society's needs, not only the production of goods such as food and fiber but also the maintenance or restoration of ecosystem services such as watershed protection, healthy soil and the biodiversity on which humanity depends.

Big thanks to all members of the scientific committee and the staff from the symposium secretariat for their continued efforts and hard work that made this symposium possible and successful. I should like to thank my colleagues from the organizing committee, particularly the Dean of the Faculty of Agriculture of the University of East Sarajevo, professor Vesna Milic, as a host and chairperson. Special thanks to His Excellence, Prof. Sinisa Berjan, for all he has done to bring this event together; it has been a considerable logistical exercise.

Finally, I would like to thank all the authors, reviewers, session moderators and colleagues for their help in preparing and editing these e-Proceedings. Special thanks go to the organizers, partners and sponsors for their unselfish collaboration and comprehensive support.

Editor in Chief

East Sarajevo, 25 October 2022

Dušan Kovačević

Academician Dusan Kovacevic,
Academy of Engineering Sciences of Serbia

CHITOSAN AND OTHER ANTITRANSPIRANTS – THEIR INFLUENCE ON ASPECTS OF ORGANIC AND CONVENTIONAL PLANT PRODUCTION

Bogdan NIKOLIĆ[1]*, Hadi WAISI[2,3], Vesna DRAGIČEVIĆ[4], Sanja ĐUROVIĆ[1], Violeta ORO[1], Vladan JOVANOVIĆ[5], Miloš DUGALIĆ[6]

[1]Institute for Plant Protection and Environment, Teodora Drajzera 9, Belgrade, Serbia
[2]Faculty for Ecology and Environmental Protection, University UNION-Nikola Tesla, Cara Dušana 62-64, Belgrade, Serbia
[3]Institute for General and Physical Chemistry, Studentski trg 12-15, Belgrade, Serbia
[4]Maize Research Institute, Slobodana Bajića 1, Zemun Polje, Belgrade, Serbia
[5]Institut for Pesticides and Environmental Protection, Banatska 31b, Belgrade-Zemun, Serbia
[6]Faculty of Technology and Metallurgy, Karnegijeva 4, Belgrade, Serbia
*Corresponding author: bogdannik@mail2world.com

Abstract

The work presents main findings from investigations of our and other different researcher carried out on different cultivars using chitosan, its derivatives, nanoparticles and other antritranspirant compounds (like Di-1-p-menthene). The work demonstrates that this chitosan (and other antitranspirants) is highly effective against the most dangerous diseases and pathogens in different cultures. Also, natural origin of chitosan (and also, other antitranspirants) makes it suitable for use in organic agriculture. Furthermore, it also contributes to improving yield and different plant physiological and growth parameters. Additionally, it induces excellent resistance to some abiotic stresses (drought, salt, and low temperature) and reduces their negative impact on different cultivars.

Key words: *antritranspirants, phytopathology, organic agriculture, yield, yield components, quality of crop yield.*

Introduction

This article presents the some findings from investigations carried out on different cultivars using chitosan, as antritranspirant compounds. Research into the use of that substances in agriculture is growing in popularity. Since 2000, more than 200 original scientific articles indexed in different databases have been published on this topic. Many researcher of the topic focused mainly on main cereals, but application in other cultures is not neglected. Also, natural origin of chitosan makes it suitable for use in organic agriculture. Chitosan is a derivative of chitin and is considered the second most common polymer in the world after cellulose and it is classified as polysaccharides containing randomly distributed β-(1-4)-linked D-glucosamine and N-acetylglucosamine units. Chitosan is mainly obtained from different sea invertebrates obtained from seafood processing. Furthermore, the potential to receive it from waste fungal mycelium is also indicated. In agriculture, chitosan is used through foliar application to plants, seed treatment, or as a direct soil fertilizer. The work demonstrates that this chitosan is highly effective against the some vicious diseases and pathogens in a crops. Furthermore, it also contributes to improving yield, yield components, as well as some chemical and biochemical parameters, as indicators of crop yield quality. Additionally, it induces excellent resistance to some abiotic stresses (drought, salt, and low temperature) and reduces their negative impact on different cultivars. However, further studies are needed to demonstrate the full field efficacy of chitosan (and also, other antitranspirants, such as Di-1-p-menthene).

Material and methods

The conditions for growing crops are stated in the works Waisi et al. (2014) and Dragičević et al. (2016). A micro-trial (plot size $1m^2$) was set up in spring barley, on degraded chernozem (Zemun Polje location, Serbia), where the first treatment was carried out at the end of the vegetative phase of this crop's development. The experiment for apples was set up in an orchard in Padinska Skela (Serbia) on alluvial soil. The elementary plot consisted of 5 apple trees, and the first treatment was carried out at the beginning of flowering. The conditions of standard chemical (ICP-OAS), biochemical (different methods) and microbiological analyzes are stated in the papers Waisi et al. (2014), Dragičević et al. (2016) and Živković et al. (2018).

Results and disscusions

In Table 1 we see that chitosan-treated barley plants give the highest average yield over two years (2013 and 2014), despite unfavorable agrometeorological conditions. However, this is not due to the increase in the mass of 1000 grains of barley (Table 1). In Table 2, we show the availability of different nutrients (inorganic P, β-carotene, Mg, Ca, Fe, Zn and Mn) in barley seed, expressing them relative to the phytate, unavailable form of phosphorus, so that the lower the values of this ratio, the increased availability of these nutrients, both for germination of barley seeds and in the diet of domestic animals and humans. Chitosan has a particularly beneficial effect on the availability of inorganic phosphorus, beta carotene, while moderately increasing the availability of trace elements (Table 2). Chitosan is known to have a beneficial effect on the resistance of crops and other plants to abiotic stresses (Ludwig et al., 2010; Iriti et al., 2010; Safaei et al., 2014; Hidangmayum et al., 2019; Kocięcka and Liberacki, 2021), but from the attached we can conclude that it also increases their nutritional value (Table 2; Dragičević et al., 2016).

Table 1. Grain yield and 1,000 grains weight of barley (cv. Apolon) influenced by the different foliar fertilizers (according: Dragičević et al., 2016).

Treatment	Grain yield (kg ha^{-1})			1000 grain weight(g)		
	2013	2014	Average	2013	2014	Average
Control	3231.7	922.3	2077.0	37.80	29.09	33.44
Epin extra	3113.0	1043.1	2078.0	39.30	36.64	37.97
Zircon	3752.0	623.7	2187.9	38.69	32.84	35.77
Chitosan	3856.3	1098.8	2477.6	39.14	31.55	35.34
Benzyladenine	3244.3	1107.5	2175.9	40.01	30.49	35.25
Siliplant	3194.3	933.3	2063.8	39.40	32.63	36.01
Propikonazole	3328.7	653.1	1990.9	40.67	33.78	37.23
Average	3388.6	911.7		39.29	32.43	
LSD 0.05*	Treatment	Year	T X Y	Treatment	Year	T X Y
	1462.0	532.5	569.4	4.03	1.95	1.05

*Least significant difference, P = 0.05 (n = 4)

Table 2. The effect of different foliar fertilizers on relations between phytic and inorganic P, phytate, *β*-carotene, Mg, Ca, Fe, Zn and Mn in barley (cv. Apolon) grain (according: Dragičević et al., 2016).

Treatment	Pphy/Pi	Phy/β-carot.	Phy/Mg	Phy/Ca	Phy/Fe	Phy/Zn	Phy/Mn
Control	5.10	5356.60	2.15	2.86	107.34	40.22	74.1
Epin extra	4.58	5242.48	2.11	2.68	100.90	27.52	60.0
Zircon	4.62	5411.22	2.14	3.11	103.15	37.21	71.0
Chitosan	4.60	5088.97	2.14	4.21	72.38	34.10	70.1
Benzyladenine	4.60	5349.25	2.03	2.36	62.91	31.81	69.1
Siliplant	4.47	5610.72	2.05	2.96	51.13	28.70	76.1
Propikonazole	4.74	5828.46	2.16	2.96	55.46	35.80	80.3
LSD 0.05*	0.8	2397.6	0.11	0.58	262.7	15.66	104.3

*Least significant difference, P = 0.05 (n = 4)

Chitosan also has a beneficial effect on the yield and yield components of apples (Tables 3 and 4). Since chitosan has so far been mainly tested on cereals, with rarer examples of its beneficial effects on vegetables and herbs, (Ludwig et al., 2010; Iriti et al., 2010; Safaei et al., 2014), this preliminary finding seems encouraging (Table 3 and 4), particularly because the season (2014) in which we tested influence of chitosan on apple yield and quality of yield was very humid.

Table 3. The effect of different foliar fertilizers on average and relative apple yield and different parameters of quantity of apple fruits (according: Waisi et al., 2014).

Type of fertilizer	Average (kg/ t) and relative (%) apple yield per trunk and per elementary area (1 ha)				different quantity (g/ %) parameters of apple fruit	
	Average yield per trunk (kg)	Relative yield per trunk (%)	Assesed yield per ha (t/ha)	Relative yield per ha (%)	Averaged weight of fruit (g)	Relative weight of fruit (%)
Control	15.984±5.78	100	20.779	100	217.44±31.338	100
Vegard (plant extract)	27.789±9.476	173.86	33.959	163.43	222.61±39.46	102.38
Eko-Fus (plant extract)	37.568±4.854	235.04	48.839	235.04	228.96±26.05	105.30
Calbit-C (plant extract)	20.222±2.235	128.93	26.289	126.52	220.24±42.82	101.29
Chitosan (plant& schell extract)	56.465±13.161	353.26	73.405	353.27	211.81±32.93	97.41
Cirkon (plant extract)	34.833±6.363	217.92	45.391	218.45	202.81±42.37	93.27
Cropmax (aminoacid fertilizer)	30.527±9.813	190.98	39.685	190.99	217.91±37.98	100.22

Table 4. The effect of different foliar fertilizers on average and relative apple yield and different parameters of quantity and quality of apple fruits (according: Waisi et al., 2014).

Type of fertilizer	different quantity (g/ %) parameters of apple fruit		different parameters of quality of apple fruit (corrected (at 25^{0}C) values of refraction coefficients (% Brix) extracts of apple fruit picking in different days of 2014 season)			
	Numbers (n) of apple fruits per trunk	Relative (%) numbers of apple fruits per trunk	19.05.	03.06.	02.07.	09.09.
Control	15.984±5.78	100	5.01	4.75	4.42	6.94
Vegard (plant extract)	27.789±9.476	173.86	-	5.07	5.02	5.34
Eko-Fus (plant extract)	37.568±4.854	235.04	-	4.88	5.02	7.94
Calbit-C (plant extract)	20.222±2.235	128.93	-	5.07	5.02	6.54
Chitosan (plant& schell extract)	56.465±13.161	353.26	-	5.00	4.55	5.34
Cirkon (plant extract)	34.833±6.363	217.92	-	5.07	4.35	6.74
Cropmax (aminoacid fertilizer)	30.527±9.813	190.98		4.87	4.55	6.54

It should be mentioned that chitosan induces increased resistance of crops (Iriti et al., 2010; Sanchez-Vallet et al., 2014; Trouvelot et al., 2014; Ghule et al. 2021) to biotic factors (fungi, bacteria, etc.), while the mechanisms of action of chitosan on these processes are still being investigated. These conclusions we proved by our preliminary work (Živković et al., 2018).

Table 5. Effects of chitosan on *A. alternata* and *C. gloeosporioides* decay on apple fruits (according: Živković et al., 2018).

Treatment	*A. alternata* lesion diameter (mm)	*C. gloeosporioides* lesion diameter (mm)
Control +	26.33 ± 0.57 a	33.50 ± 1.32 a
Chitosan 1 mg/ml	21.50 ± 0.50 b	26.00 ± 1.00 b
Chitosan 2 mg/ml	17.50 ± 1.32 c	17.67 ± 1.55 c
Chitosan 3 mg/ml	8.33 ± 1.15 d	11.00 ± 1.00 d
Control -	0.00 ± 0.00 e	0.00 ± 0.00 e

Conclusion

In this brief review, we have shown that chitosan affects the yield and yield components of arable (Tables 1-2) and fruit (Tables 3-4) crops, and also the resistance of stored fruit (Table 5) to some of the important diseases that can reduce the quality of fruit yield. Further directions of research will concern different formulations of chitosan and other antitranspirants, whereby the emphasis will be on monitoring a number of quality indicators of crop yields.

References

Dragičević V., Nikolić B., Radosavljević M. Đurić N., Dodig D., Stojiljković M. and N. Kravić (2016) Barley grain enrichement with essential elements by agronomic biofortification. Apteff, 47: 1-9;

Hidangmayum A., Dwivedi P., Katiyar D. and A. Hemantaranjan (2019) Application of chitosan on plant responses with special reference to abiotic stress. Physiol. Mol. Biol. Plants, 25(2): 313–326 (https://doi.org/10.1007/s12298-018-0633-1);

Iriti M., Castorina G., Vitalini S,, Mignani I., Soave C., Fico G. and F. Faoro (2010) Chitosan-induced ethylene-independent resistance does not reduce crop yield in bean. Biological Control, 54: 241–247;

Kocięcka J. and D. Liberacki (2021) The Potential of Using Chitosan on Cereal Crops in the Face of Climate Change. Plants, 10: 1160. (https://doi.org/10.3390/ plants10061160);

Ludwig N., Cabrini R., Faoro F., Gargano M., Gomarasca S., Iriti M., Picchi V. and C. Soave (2010) Reduction of evaporative flux in bean leaves due to chitosan treatment assessed by infrared thermography. Infrared Physics & Technology, 53 (1): 65-70;

Ghule M.R., Ramteke P.K., Ramteke S.D., Kodre P.S., Langote A., Galkwad A.V., Holkar S.K. and H. Jambhekar (2021) Impact of chitosan seed treatment of fenugreek for management od root rot disease caused by Fusarium solani under in vitro and in vivo conditions. Biotech., 11: 290 (https://doi.org/10.1007/s13205-021-02843-3);

Nikolić B., Waisi H., Đurović S., Dugalić M. and V. Jovanović (2019) Some aspects of application of pesticides and fertilizers on nutritive value and other characteristics of crop plants. Pesticides& Phytomedicine, 34(3-4): 145-156;

Safaei Z., Azizi M., Yarahmadi M., Aroiee H., and G. Davarynejad (2014) The Effect of different irrigation intervals and anti-transpiration compounds on yield and yield components of Black Cumin (Nigella sativa). International journal of Advanced Biological and Biomedical Research, 2 (4/2): 2014: 326-335;

Sanchez-Vallet A., Mesters J.R. and B.P.H.J. Thomma (2014) The battle for chitin recognition in plant-microbe interactions. FEMS Microbiology Reviews, 39,: 171–183;

Trouvelot S., Héloir M.-C., Poinssot B., Gauthier A., Paris F., Guillier C., Combier M., Trdá L., Daire X. and M. Adrian (2014) Carbohydrates in plant immunity and plant protection: roles and potential application as foliar sprays. Front. Plant Sci., 5: 592 (https://doi.org/10.3389/fpls.2014.00592);

Waisi H., Nikolić B., Jovanović V., Đurović S. and Z. Milićević (2014) The influence of other fertilizers and special products on horticultural plants. 2. Yield, Pomological and Biochemical Characteristics of Apple Fruits. Plant Protection, Belgrade (on Serbian), 65(4): 170-175;

Živković S., Stevanović M., Durović S., Ristić D. and St. Stošić (2018) Antifungal activity of chitosan against Alternaria alternata and Colletotrichum glerosporoides. Pesticides nad Phytomedicine, Belgrade, 33(3-4): 197-204.