GREEN ROOM SESSIONS 2018

Book of Proceedings

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FOREWORD

Green Room Sessions International Conference aims to be platform for international scientific discussion on agriculture in general as well as agriculture in conjunction with economics and ecology, food and nutrition science and technology, rural development, environment and forestry. Green Room Sessions brings together and is connecting research, industry, social concepts and practices. The scientific core is based on applying Eco-Eco (ecological-economical) concepts and principles to optimize interactions between natural, social and built components of the rural environments: plants, animals, soil, water, air, humans and man-made structures. In addition, Green Room Sessions placed social issues at the centre of solutions for a sustainable and fair food system. Green Room Sessions are targeting to multiple benefits to society and the environment, by bringing people together and providing them the opportunity to sit together and exchange ideas and connect the business.

In November 2018, the 1st Green Room Sessions International Conference provided an opportunity for sharing experiences and builds the evidence base on agriculture, forestry, human interactions and built environment, as well as reaching a consensus on the priorities for achieving more sustainable food systems. It also endorsed Institutional roles of National services, Regional and International organisations in supporting further implementation and promotion of Eco-Eco (ecological-economical) concepts and principles.

Dialogue between the participants targeted:

- Enhancing smallholder and family farmers' adaptation and resilience to the impacts of climate change;
- Improving nutrition including through more diversified diets;
- Protecting and enhancing agro-biodiversity in support of ecosystem services;
- Improving livelihoods in rural areas;
- National Food Wealth, the holy trinity: agriculture, economics and ecology ($a \times e^2$);
- Mutual interconnections and how to deal with them and how this mix influence National Food Wealth and National Health.

achieving a transformative change in agricultural practices towards sustainable development.

The Green Room Sessions International Conference synthesized and build on the outcomes of the regional meetings, and provided an opportunity to share and discussed policies that can help scale-up and scale-out agriculture, rural development, agroecology, nutrition in order to achieve the Sustainable Development Goals.

The Symposium also moved the topic of agriculture and rural development from dialogue to activities at the regional and country level by complementing on-going initiatives to integrate biodiversity and ecosystem services in agriculture, identifying opportunities for synergies with National Strategic Programmes and Regional Initiatives, and facilitating regional and International cooperation between the scientists and business.

Green Room Sessions International Conference as a final goal is looking forward to assist people from the rural areas, related business, agriculture and allied sectors to take the advantage of:

- Natural resources, secure access to land and water, and improved natural resource management and conservation practices;
- Improved agricultural technologies and effective production services;
- Linking the interested parties with financial services;
- Transparent and competitive markets for agricultural inputs;
- Opportunities for rural off-farm employment and enterprise development;
- Local and national policy and programming.

We launch this with the aim of unlocking innovative, integrated, multidisciplinary science and technology with activation of all dimensions of sustainable development goals for all the participants.

In this Book of Proceedings we published part of the original scientific full papers presented at the Conference. The other part is provided for publication at the journal Agriculture and Forestry (ISSN 0554-5579, Printed; ISSN 1800-9492, Online), all based on the requests of the authors who participated at the Conference.

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PREDGOVOR

Međunarodna konferencija Green Room Sessions imala je za cilj da bude platforma međunarodne naučne diskusije o poljoprivredi uopšte, poljoprivredi vezano sa pitanjima ekonomije i ekologije, nauci o tehnologiji hrane i prehrane, ruralnim razvojem, životnom sredinom i šumarstvom. Green Room Sessions okupila je i povezivala nauku, istraživanje, industriju, društvene koncepte i prakse.

Naučni principi zasnovani su na primjeni Eko-Eko (ekološko-ekonomskih) koncepata za optimizaciju interakcije između prirodnih, socijalnih i komponenti ruralnih sredina: biljka, životinja, zemljište, voda, vazduh, kao i strukture koje su nastale kao plod rada ljudi. Pored toga, Green Room Sessions je težila da postavi društvena pitanja u centar rješenja održivog i fer sistema proizvodnje hrane. Brojni sastanci održani su tokom Konferencije sa ciljem da imaju višestruke koristi za društvo i sredinu koja nas okružuje, približavajući tokom ovih komunikacija ljude jedne drugima, pružajući im priliku da međusobno komuniciraju na jednom mjestu, razmenjuju ideje i povezuju poslovanja.

U novembru 2018. godine, Green Room Sessions International Conference pružila je mogućnost razmjene iskustava potvrđenih praksi u poljoprivredi, šumarstvu, interakcijama čovjeka i njegovog okruženja, struktura koje su nastale kao plod rada ljudi. Ovo je postignuto organizovanjem susreta naučnika i stručnjaka iz ove oblasti, te razmjenom iskustava, doprinoseći unapređenju održivijeg sistema proizvodnje i prerade. Iskustva drugih koji su gostovali istakli su značaj institucionalne uloge nacionalnih službi, regionalnih i međunarodnih organizacija u podršci i daljoj promociji eko-eko (ekološko-ekonomskih) koncepata i principa.

Dijalog između učesnika bio je usmjeren na:

- Prilagođavanje malih proizvođača i porodičnih farmera i jačanje njihove otpornosti na uticaj klimatskih promjena;
- Zaštitu i unapređenje agro-biodiverziteta, podrške održivosti ekosistema;
- Poboljšanje životnih uslova, životnog standarda u ruralnim područjima;
- „Sveto trojstvo": poljoprivreda, ekonomija i ekologija ($a \times e^2$), njihove međusobne veze i kako se baviti njima, te kako ovaj miks međusobnih relacija utiče na proizvodnju domaće hrane i zdravlje nacije;

- Postizanje tranzicionih promjena u poljoprivrednim praksama u skladu sa principima održivog razvoja.

Konferencija je dijelom uradila sintezu i nadograđivala rezultate regionalnih sastanaka i pružiti priliku da podijeli svoja iskustva sa učesnicima, diskutuje o politikama koje mogu pomoći u povećanju poljoprivredne proizvodnje, ruralnog razvoja, agroekologije, ishrane kako bi se postigli ciljevi održivog razvoja.

Konferencija je takođe inicirala pomjeranje teme poljoprivrede i ruralnog razvoja od dijaloga ka konkretnim aktivnostima na lokalnom i regionalnom nivou, tražeći rješenja očuvanja biodiverziteta u poljoprivredi, identifikujući mogućnosti za sinergiju sa nacionalnim strateškim programima i regionalnim inicijativama, pospješujući regionalnu i međunarodnu saradnju između naučnika i biznisa.

Učesnici na Konferenciji tražili su načine da se pruži pomoć ljudima iz ruralnih područja, njihovim malim biznisima, poljoprivredi i srodnim sektorima da iskoriste prednosti:

- Prirodnih resursa, bezbjednog pristupa zemljištu i vodama, poboljšavajući prakse upravljanja prirodnim resursima i pristupe konzervacije;
- Poboljšane poljoprivredne tehnologije i efikasnijih proizvodnih usluga;
- Povezivanje zainteresovanih strana sa finansijskim servisima;
- Mogućnosti za zapošljavanje i razvoj preduzeća u ruralnim područjima;
- Lokalnih i nacionalnih politika i programiranja.

Ovo inicijativa je pokrenuta sa ciljem otvaranja i susreta sa inovativnom, integrisanom, multidisciplinarnom naukom i tehnologijom uz aktiviranje svih dimenzija ciljeva održivog razvoja za sve učesnike.

U ovom Zborniku radova objavili smo dio originalnih naučnih radova (*Full papers*) predstavljenih na Konferenciji. Drugi dio je proslijeđen za objavljivanje časopisu Poljoprivreda i šumarstvo (ISSN 0554-5579, print; ISSN 1800-9492, online), sve na osnovu zahtjeva autora koji su učestvovali na Konferenciji.

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CONTENT

Plant production, Plant protection and food safety, Genetic resources

Environment protection, natural resources management, Rural development and Forestry

Original Scientific paper

Effects of fertilization on production traits of winter wheat

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Abstract

The wheat cultivar used in the experiment was Kruna. This investigation included an untreated seven variants of fertilization: 1-control, 2-80 kg/ha N, 3-60 kg/ha P_2O_5, 4-80 kg/ha N, 60 kg/ha P_2O_5, 5-80 kg/ha N, 100 kg/ha K_2O, 6-80 kg/ha N, 60 kg/ha P_2O_5, 60 kg/ha K_2O and 7-80 kg/ha N, 100 kg/ha P_2O_5, 60 kg/ha K_2O. Total amounts of phosphorus and potassium fertilizers and half the nitrogen rate are regularly applied during pre-sowing cultivation of soil. The trial was set up in a randomized block design with five replications. The crop was harvested at full maturity. Grain yield (t/ha) was harvested and reported at 14% moisture. Three parameters were analyzed: test weight (kg/hl), 1000-grain weight (g) and grain yield (t/ha). Investigation where showed a considerable variation of grain yield which were in dependence from mineral nutrition. The highest grain yields were the highest with mineral fertilizer in the combined $N_{80}P_{100}K_{60}$ (4.738 t/ha). Over the two-year period, all investigated treatments of wheat achieved the highest average 1000-grain weight in the combined $N_{80}P_{60}$ (43.08 g). The highest test weight was the highest with mineral fertilizer in the combined $N_{80}P_{60}K_{60}$ (73.63 kg/hl). Analysis of variance was found highly significant effect of years on 1000 grains weight.

Keywords: fertilization, yield, quality, wheat

Introduction

Mineral nutrition of wheat grown on acid soil reaction is specific. The crucial importance plays equilibred nutrition by nitrogen and phosphorus with higher impact of phosphorus nutrient. Mineral fertilizers play a vital role towards improving crop yields but one of the main constraints in achieving proven crop potential is imbalanced use of nutrients, particularly low use of phosphorus as compared to nitrogen. Đekić *et al*. (2014) and Jelic *et al.* (2015) found it to be absolute mass the grain has a significant influence on the application of mineral fertilizers, was significantly higher in intensified fertilizer treatments, especially nitrogen. The optimum rate of phosphorus application is important in improving yields of most crops (Popović, 2010; 2015; Đekić *et al*. 2013, 2014; Jelić *et al.*, 2013, 2014; Terzić *et al*., 2018; Ugrenovic *et al*., 2018).

In Serbia, farmers are using only nitrogen fertilizers for fodder crops while the use of phosphorus fertilizer is negligible. These crops are often grown on marginal lands. Hence, the production is low and quality is poor. The absence of record yields indicates that an answer could be sought in soil, the main substrate for field crop production. Additionally, the major previous crops of small grains also suffer from negative nutrient balance. The use of incomplete production technology in previous decades had definitely affected the potential and actual soil fertility.

Because of appearance of new demanded cultivars at permanent changes in soil fertility level and environmental conditions, still exist need to researches mineral nutrition of wheat, as well as determine optimal rates and balanced nutrition ratios in concrete agro-ecological conditions. The main goal of this research was to investigate the effect of long-term applications of identical amounts and ratios of nitrogen, phosphorus and potassium on the yield components of winter wheat variety „Kruna“. The objective of this study was to evaluate the effect of different fertilization systems on the grain yield and quality of wheat grown on a vertisol soil. The study was also aimed at optimizing fertilization for maximum profitability in the future wheat production of Central Serbia.

Materials and Methods

Experimental design and soil conditions

The study was carried out in a stationary field trial involving fertilization over a two years period from 2011/12 to 2012/13. Trials were first set up in the experimental fields of the Small Grains Research Centre in Kragujevac in 1970. Plot size was 50 m^2. The wheat cultivar used in the experiment was Kruna, the dominant cultivar in the production region of Serbia. This investigation included an untreated seven variants of fertilization: C-control, N-80 kg/ha N, P_1-60 kg/ha P_2O_5, NP_1-80 kg/ha N, 60 kg/ha P_2O_5, NP_2-80 kg/ha N, 100 kg/ha K_2O, NP_1K-80 kg/ha N, 60 kg/ha P_2O_5, 60 kg/ha K_2O and NP_2K -80 kg/ha N, 100 kg/ha P_2O_5, 60 kg/ha K_2O. A non-fertilized variant served as a control. Total amounts of phosphorus and potassium fertilizers and half the nitrogen rate are regularly applied during pre-sowing cultivation of soil. The trial was set up in a randomized block design with five replications. Fertilization was regular and followed a long-time scheme.

The crop was harvested at full maturity. Grain yield (t/ha) was harvested and reported at 14% moisture. Three parameters of grain quality, namely test weight (kg/hl) and 1000-grain weight (g) were analyzed. Thousand grain weight was determined using an automatic seed counter.

The trial was set up on a vertisol soil in a process of degradation, with heavy texture and very coarse and unstable structure. The humus content in the surface layer of soil was low (2.22%). Soil pH indicates high acidity (pH in H_2O 5.19; pH in KCl 4.27), nitrogen content in soil is medium (0.11-0.15%), while the content of available phosphorus ranges from very low (1.7-2.9 mg/100 g soil) in the N variant to very high (26.9 mg P_2O_5/100 g soil) in the NPK variants of fertilization. Available potassium contents are high, ranging from 19.5 to 21.0 mg K_2O/100 g soil.

2.2. Agroecologial conditions

This study was conducted over a three-year period in the Šumadija region, Central Serbia, on a Vertisol soil, at Kragujevac location, 173-220 m a. s. l. (**44° 22′ N, 20° 56′ E**), in a temperate continental climate having an average annual temperature of 11.5°C typical of Šumadija districts in Serbia and a rainfall amount of about 550 mm.

The data in Table 1 for the investigated period (2011-2013) clearly indicate that the years in which the researches were conducted differed from the typical multi-year average of Kragujevac region regard the meteorological conditions. The average air temperature in 2011/12 was higher by 0.08°C and 2012/13 was higher by 1.81°C. The sum of rainfall precipitation in 2011/12 was higher by 23.7 mm, where the sum of rainfall in 2012/13 was 24.5 mm higher than the average of many years and with a very uneven distribution of precipitation per months. During the Mart in 2011/12 it was 102.0 mm of rainfall, what was 58.5 mm more compared with the perennial average. During the month of May in 2011/12 it was 87.3 mm of rainfall, what was 22.5 mm and in 2012/13 it was 70.8 mm of rainfall, what was 6.0 mm more compared with the perennial average. In the first year of investigation, higher amounts of rainfall were recorded in April, May and June, which led to water logging lodging of crops and lower yield.

Table 1. Mean monthly air temperature and precipitation (Kragujevac)

Year	Months									Average
	X	XI	XII	I	II	III	IV	V	VI	
Mean monthly air temperature (°C)										
2011/12	10.4	3.1	4.6	0.7	-3.7	8.1	12.9	16.1	23.0	8.4
2012/13	13.5	9.5	1.7	2.0	4.0	6.1	16.5	18.0	19.9	10.13
Average	11.8	5.6	1.9	0.6	2.0	6.2	11.2	16.2	19.4	8.32
The amount of precipitation (mm)										
2011/12	33.3	1.3	43.3	117.2	60.1	5.7	74.5	87.3	57.8	480.5
2012/13	56.2	17.7	16.4	62.4	84.3	102.0	41.2	70.8	30.3	481.3
Average	47.5	50.0	49.5	36.8	33.9	43.5	51.5	64.8	79.3	456.8

Statistical Analysis

On the basis of achieved research results the usual variation statistical indicators were calculated: average values. Experimental data were analyzed by descriptive and analytical statistics using the statistics module Analyst Program SAS/STAT (SAS Institute, 2000) for Windows. All evaluations of significance were made on the basis of the ANOVA test at 5% and 1% significance levels. Relative dependence was defined through correlation analysis (Pearson's correlation coefficient), and the coefficients that were obtained were tested at the 5% and 1% levels of significance.

Results and Discussions

The grain yield of wheat significantly varied across years, from 0.917 t/ha to 4.603 t/ha in 2011/12, from 1.034 t/ha to 4.873 t/ha in 2012/13. In the first investigation year (2011/12), treatment NP_2K achieved the highest yield of grain (4.603 t/ha), and the second investigation year (2012/13), the grain yield of treatments NP_1K and NP_2K achieved the highest yield of grain (4.622 t/ha and 4.873 t/ha). The study showed that among investigated fertilization variants the highest grain yields were achieved in variant NP_2K with 80 kg/ha nitrogen rate, phosphorus rate of 100 kg/ha P_2O_5 and potassium rate of 60 kg/ha K_2O (4.738 t/ha). Results clearly show that yield components were significantly affected by fertilization (Table 2), the lowest values for grain yield and yield components were obtained in the untreated control. Achieved statistically significantly higher yields in 2012/13 were, primarily, the result of heavy rainfall and their good distribution as well as favorable air temperatures during the vegetation period (Table 1).

The study showed that among investigated fertilization variants the highest grain yields were achieved in variant NP_2K with 80 kg/ha N, 100 kg/ha P_2O_5 and 60 kg/ha K_2O. Usage of fertilizers and certain amendments on extremely acid soils in certain years, particularly those less favorable for production, almost certainly had different effects on grain filling, resulting in diverse relationships between productive and qualitative traits. Presented results confirm the opinion of many authors that the traits analyzed are genetically determined, but strongly modified by the nutrient status and weather conditions (Đekić *et al*., 2014; Jelić *et al*., 2013).

Table 2. Grain yield, 1000-grain weight and test weight of winter wheat

Traits	Fertilization	Years						Average		
		2011/12			2012/13					
		$\bar{x}$	S	S_x	$\bar{x}$	S	S_x	$\bar{x}$	S	S_x
Grain yield, ($t\ ha^{-1}$)	C	0.917	0.253	0.113	1.034	0.218	0.098	0.975	0.231	0.073
	N	2.428	0.574	0.257	2.810	0.586	0.262	2.619	0.583	0.184
	P_1	2.554	0.378	0.169	2.798	0.385	0.172	2.676	0.382	0.121
	NP_1	3.462	0.321	0.144	4.031	0.562	0.251	3.746	0.525	0.166
	NP_2	4.020	0.835	0.374	4.329	0.233	0.104	4.174	0.601	0.190
	NP_1K	4.090	0.054	0.024	4.622	0.477	0.204	4.376	0.430	0.136
	NP_2K	4.603	0.406	0.181	4.873	0.497	0.222	4.738	0.450	0.142
1000-grain weight, (g)	C	33.22	0.626	0.280	38.30	2.081	0.931	35.76	3.044	0.963
	N	36.30	1.859	0.831	42.32	0.701	0.314	39.31	3.438	1.087
	P_1	37.56	0.940	0.420	41.86	1.144	0.511	39.71	2.472	0.782
	NP_1	40.68	4.068	1.819	45.48	0.890	0.398	43.08	3.756	1.188
	NP_2	40.26	2.663	1.191	45.72	0.356	0.159	42.99	3.390	1.072
	NP_1K	41.66	1.951	0.873	44.46	1.352	0.605	43.06	2.164	0.684
	NP_2K	40.26	0.488	0.218	44.24	0.817	0.365	42.25	2.191	0.693
Test weight (kg/hl)	C	70.77	1.968	0.880	70.97	1.339	0.599	70.87	1.590	0.503
	N	70.85	1.020	0.456	70.69	2.238	1.001	70.77	1.642	0.519
	P_1	71.81	1.486	0.664	71.69	2.022	0.904	71.75	1.674	0.529
	NP_1	72.29	1.187	0.531	72.81	0.297	0.133	72.55	0.860	0.272
	NP_2	71.77	1.092	0.488	71.92	1.179	0.527	71.84	1.074	0.340
	NP_1K	73.01	1.802	0.806	74.25	1.612	0.721	73.63	1.740	0.550
	NP_2K	71.49	1.711	0.765	72.57	1.073	0.480	72.03	1.462	0.462

Thousand grain weight of wheat significantly varied across years, from 33.22 g to 41.66 g in 2011/12, from 38.30 g to 45.72 g in 2012/13. During the first year of investigations, the highest average value of 1000-grain weight achieved the NP_1K (80 kg/ha N, 60 kg/ha P_2O_5 and 60 kg/ha K_2O) and NP_1 (80 kg/ha N, 60 kg/ha P_2O_5) treatments (41.66 and 40.68 g). During the second year of investigations

(2012/13), the highest average value of 1000 grain weight achieved the NP_1 (80 kg/ha N, 60 kg/ha P_2O_5) and NP_2 (80 kg/ha N, 100 kg/ha P_2O_5) treatments (45.48 and 45.72 g). The study showed that among investigated fertilization variants the highest thousand grain weight of wheat were achieved in NP_1 (80 kg/ha N, 60 kg/ha P_2O_5) and NP_1K (80 kg/ha N, 60 kg/ha P_2O_5 and 60 kg/ha K_2O) variants (43.08 and 43.06 g). A number of authors (Đekić *et al*., 2013, 2015; Jelić *et al*., 2013, 2014; Jelic *et al*., 2015; Terzic *et al*., 2018) underlined that 1000-grain weight is a cultivar-specific trait, with considerably higher variations being observed among genotypes than among treatments or environmental factors.

Table 2 presents average values for grain test weight across years and treatments. All testing fertilization variants had test weight greater than 71 kg/hl, except control and 2 variants (80 kg/ha N). During the first year achieved the highest test weight at NP_1K treatment (73.01 kg/hl), followed by NP_1 (72.29 kg/hl), while the lowest test weight was the control treatment (70.77 kg/hl). During the second year of investigations, the test weight of NP_1K variant (80 kg/ha N, 60 kg/ha P_2O_5 and 60 kg/ha K_2O) was the highest with 74.25 kg/hl, while the slightly lower test weight was realized by control and N variants (70.97 kg/hl and 70.69 kg/hl). The average two-year value of test weight the highest at NP_1K treatment (73.63 kg/hl). In all years, the use of different treatments induced a significant increase in grain test weight.

The analysis of yield variance of 1000-grain weight and test weight of tested winter wheat variants grown at investigated in Kragujevac during two growing seasons 2011/12 and 2012/13, are shown in Table 3.

Table 3. Analysis of variance of the tested parameters (ANOVA)

Effect of years on the traits analyzed				
Traits	Mean sqr Effect	Mean sqr Error	F(1. 68)	p-level
Grain yield (t ha^{-1})	2.1644	1.710507	1.265	0.264589
1000-grain weight (g)	375.8406	9.476050	39.662**	0.000000
Test weight (kg hl^{-1})	3.0243	2.803649	1.079	0.302666
Effect of fertilization on the traits analyzed				
Traits	Mean sqr Effect	Mean sqr Error	F(6. 63)	p-level
Grain yield (t ha^{-1})	17.40094	0.223386	77.896**	0.000000
1000-grain weight (g)	76.61600	8.897079	8.611**	0.000001
Test weight (kg hl^{-1})	9.65437	2.154702	4.481**	0.000773
Effect of the year x fertilization interaction on the traits analyzed				
Traits	Mean sqr Effect	Mean sqr Error	F(6. 56)	p-level
Grain yield (t ha^{-1})	0.071510	0.204996	0.345	0.903678
1000-grain weight (g)	2.805238	2.997214	0.936	0.476750
Test weight (kg hl^{-1})	0.777988	2.286679	0.340	0.912616

Based on the analysis of variance, it can be concluded that are highly significant differences at 1000-grain weight regard the year of investigation (F_{exp}=39.662**). Highly significant differences in grain yield, 1000-grain weight and test weight regard the fertilization of investigation (F_{exp}=77.896**; F_{exp}=8.611** and F_{exp}=4.481**). The present results confirm the opinion of many authors that the traits analyzed are genetically determined but are strongly modified by the nutrient status of the environment and weather conditions (Đekić *et al.*, 2014; Jelic *et al.*, 2015; Terzić *et al.*, 2018).The interaction of the investigated factors (Y x G) exhibited no statistically significant effect 1000-grain weight and test weight ($P > 0.05$).

Positive correlations were observed (Table 4) between grain yield and 1000-grain weight in all years. Wheat yield in 2011/12 was positively correlated with test weight (0.32) and positively but strong-dependent significantly correlated with 1000-grain weight (0.75**). Test weight was positively correlated with 1000-grain weight (0.28). During the second year of investigation (2012/13), correlations between 1000-grain weight and test weight were statistically significant (0.51*). Wheat grain yield was positively but strong significantly correlated with 1000-grain weight (0.81**) and test weight (0.43*) (Table 4). The results suggest that grain yield and quality formation is affected by both genetic and environmental factors (Đekić *et al.*, 2015 and Terzić *et al.*, 2018).

Table 4. Correlations between the traits analyzed during 2011-2013

Traits	Correlations in 2011/12			Correlations in 2012/13		
	Grain yield, t/ha	1000-grain weight, g	Test weight, kg/hl	Grain yield, t/ha	1000-grain weight, g	Test weight, kg/hl
Grain yield ($t\ ha^{-1}$)	1.00	0.75**	0.32ns	1.00	0.81**	0.43*
1000-grain weight (g)		1.00	0.28ns		1.00	0.51*
Test weight ($kg\ hl^{-1}$)			1.00			1.00

Positive correlations were observed (Table 5) between grain yield and 1000-grain weight in all treatments. Positively and medium correlations were also found between grain yield and 1000-grain weight in the NP_1 (r=0.68**), NP_2 (r=0.70**), NP_1K (r=0.77**) and NP_2K (r=0.74**) treatments. Recorded significant correlations between analyzed traits are in agreement with investigations of other authors (Đekić *et al.*, 2014; Jelic *et al.*, 2015).

Table 5. Correlation coefficients for the traits analyzed across treatments

Correlations between the traits analyzed in the unfertilized control			
	Grain yield, ($t\ ha^{-1}$)	1000-grain weight, (g)	Test weight, ($kg\ hl^{-1}$)
Grain yield ($t\ ha^{-1}$)	1.00	0.13ns	0.12ns
1000-grain weight (g)		1.00	0.09 ns
Test weight ($kg\ hl^{-1}$)			1.00
Correlations between the traits analyzed in the 80 kg/ha N			
Grain yield ($t\ ha^{-1}$)	1.00	0.37ns	-0.31ns
1000-grain weight (g)		1.00	-0.04 ns
Test weight ($kg\ hl^{-1}$)			1.00

Correlations between the traits analyzed in the 60 kg/ha P_2O_5			
Grain yield (t ha^{-1})	1.00	0.45^{ns}	0.38^{ns}
1000-grain weight (g)		1.00	0.23^{ns}
Test weight (kg hl^{-1})			1.00
Correlations between the traits analyzed in the 80 kg/ha N and 60 kg/ha P_2O_5			
Grain yield (t ha^{-1})	1.00	0.68**	0.20^{ns}
1000-grain weight (g)		1.00	-0.07^{ns}
Test weight (kg hl^{-1})			1.00
Correlations between the traits analyzed in the 80 kg/ha N and 100 kg/ha P_2O_5			
Grain yield (t ha^{-1})	1.00	0.70**	0.41^{ns}
1000-grain weight (g)		1.00	-0.04^{ns}
Test weight (kg hl^{-1})			1.00
Correlations between the traits analyzed in the 80 kg/ha N, 60 kg/ha P_2O_5, 60 kg/ha K_2O			
Grain yield (t ha^{-1})	1.00	0.77**	0.06^{ns}
1000-grain weight (g)		1.00	0.57^{ns}
Test weight (kg hl^{-1})			1.00
Correlations between the traits analyzed in the 80 kg/ha N, 100 kg/ha P_2O_5, 60 kg/ha K_2O			
Grain yield (t ha^{-1})	1.00	0.74**	0.14^{ns}
1000-grain weight (g)		1.00	0.57^{ns}
Test weight (kg hl^{-1})			1.00

The 1000 grain weight had a significant and positive correlation only with the grain weight per spike (Djuric *et al*., 2018). Iftikhar *et al.* (2012) have established that the 1000 grain weight have a positive and statistically significant correlation with grain yield, and emphasize that the number of grains per spike and 1000 grain weight have a direct effect on yield and that, therefore, they can be used as direct selection criteria. Negative correlation between 1000-grain weight and test weight has been established (Terzić *et al*., 2018). Significant and positive correlation between grain yield and nitrogen levels has been established Đekić *et al*. (2014).

Conclusions

Based on the gain results during two-year investigation on seven treatments fertilization, it can be concluded that the highest yield achieved the treatments of three mineral elements NP_2K (N 80 kg/ha, P_2O_5 100 kg/ha and K_2O 60 kg/ha) 4.738 t/ha and NP_1K (80 kg/ha N, 60 kg/ha P_2O_5 and 60 kg/ha K_2O) 4.376 t/ha have achieved satisfactory results, while the poorest results were achieved by the control (0.975 t/ha).

Statistically were highly significantly different between of year on the 1000-grain weight and highly significantly different between of fertilization on the grain yield, 1000 grain weight and test weight. Significantly positively and strong correlated with yield and 1000 grain weight both in 2011/12 (0.75**, respectively), and 2012/13 (0.81**, respectively). Significant positively and medium correlations were observed between grain yield and 1000-grain weight in NP_1 (0.68**, respectively) and NP_2 (0.70**, respectively), and positively and strong correlations were observed in NP_1K (0.77**, respectively) and NP_2K treatments (0.74**, respectively).

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