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 x 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 nutrition on biomass production of Lacy phacelia in organic cropping system

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Abstract

The experiment with *Phacelia tanacetifolia* cultivar NS Priora was conducted during 2018 on experimental plots of the Institute of Field and Vegetable Crops, location in Bački Petrovac, in two variants: control, without nutrition and variant with nutrition, in organic cropping system. Foliar fertilization was applied with Phytograss & clover preparation, by Phytocomplex, two times during the intensive growth of the plants. Phytograss nutrition is a cocktail with micro and macro elements and N (1%), P_2O_5 (0.5%), K_2O (0.05%), S (0.1%), La (0.2 mg kg^{-1}), vitamins, etc. The trial was set up in a randomized block design with three replications. Six parameters were analyzed: biomass yield (t/ha), plant height (cm), length of the leaf (cm), mass of inflorescence (g), length of root (cm) and grain yield per plant (g).

Foliar nutrition had a positive effect on all the tested characteristics. Analysis of variance was found highly significant effect of nutrition on leaf length and yield of biomass. The highest biomass yields were in the variant with nutrition. The yield of green biomass and plant height was higher in a variant with nutrition than the control by 8.9% and 22.18%. Plant height ranged from 70.66 cm in control, up to 86.33 cm in a variant with foliar nutrition. Grain yield per plant ranged from 0.71 g in control, up to 0.96 g in a variant with foliar nutrition. The yield of biomass has a significant positive correlation with grain yield per plant (r=0.77*), length of leaf (r=0.73*), plant height (r=0.66*), mass of inflorescence (r=0.56*), and a higher significant positive correlation with length of root (r=0.83**). Foliar nutrition has shown a significant effect on the production of Lacy phacelia in organic cropping system.

Key words: *Phacelia tanacetifolia,* nutrition, production, organic cropping system

Introduction

Phacelia tanacetifolia Benth. is a annual herb, has a flowering period lasting from 6 to 8 weeks, and which is listed in the top 20 pollen producing flowers for honeybees. Phacelia has been used for seed production and as a forage crops, either on its own or in a mix with peas or vetch to provide forage and honey production as a source of high quality nectar and pollen. Phacelia blooms in the summer months with the blue - purple color blooms which are attracting beneficial pollinators. As a commercial species *Phacelia tanacetifolia* Bent. has long been recognised by beekeepers as a preferred foraging plant for honeybees (Teittinen, 1980; Popovic et al., 2017a) with a high potential for honey yield (Orsi and Bionoi, 1987). Phacelia has also been used as a green manure crop in Europe for a number of years (Anon, 1989). When ploughed as a green manure, increases carbon and nitrogen

content in soil to a depth of over 80 cm (Beckmann, 1977). The crop is also reported to have nematicidal properties (Cazzola, 1987; Anon., 1989; Booker Seeds, 1990). Phacelia has also been used as a forage crop, either on its own (Danial and Zobelt, 1986) or in a mix with peas or vetch to provide forage and honey production (Petkov, 1966; Popovic *et al.*, 2017b). Phacelia has been found to have high energy and protein content, but some questions were raised about possible allelochemical properties of the plant (Danial and Zobelt, 1986). It has a great habit of flowering abundantly and for a long period. This increases beneficial insect numbers and diversity. It's highly attractive to honey bees, bumblebees, etc.

It provides high quantities of nectar, being the second plant after the acacia which gives most nectar. A single flower can give up to 4.5 mg of nectar, with a sugar concentration of 28%. 1ha can produce between 300 and 1000 kg of phacelia honey. It is a sweet and complete flower for the honey bees because it provides both pollen (for protein – needed for egg production) and nectar (for carbohydrates – needed for energy). For humans it is highly important as it provides us with honey in times when other flowers cannot resist the bad weather conditions (Foucault et al., 2013; Popović et al., 2016; 2017a; 2017b; 2018). Phacelia produces relatively abundant biomass. Protein content ranges from 6.7% to 19.8% at the pre-bloom stage (Popović et al., 2017). Phacelia are suitable for the remediation of soils contaminated with heavy metals. Green manure plants absorb nitrogen from the soil, preventing its leaching out of the soil (Foucault et al., 2013).

Picture 1. Lacy phacelia field, Bački Petrovac, 2018 (Photo: Popović, 2018)

The crucial importance play 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). Authors 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 (Đekić *et al*. 2013, 2014; Glamočlija *et al.*, 2015; Terzić *et al*., 2018).

The study was to determined the effect of foliar nutrition on the yield parameters of phacelia cultivar NS Priora.

Materials and Methods

Experimental design and soil conditions

Experiment with phacelia cultivar NS Priora carried out on experimental field of Institute of Field and Vegetable Crops at certified plots in Bački Petrovac, Serbia, in 2018 in two variants: 1. Control; and 2.

Variant with foliar nutrition. The standard technology for growing c. NS Priora was applied during the experiment. Sowing was carried out at the optimum time (10 kg ha^{-1}). Crop cultivation were applied during the vegetation period. Nutrition was aplied in two times before flowering plants. The harvest is carried out manually in technological maturity, after 130 days. Plant height (cm), yield of green biomass (kg ha^{-1}) and seed yield per plant were investigated.

Chemical caracteristic of soil

Chernozem soil at a depth of 30 cm was low in humus (2.32%), slightly alkaline reaction, pH in H_2O was 7.35., medium carbonat soil (4.64%, $CaCO_3$), hight level Al–K_2O and P_2O_5 (37.50 mg/100 g, 35.90 mg/100 g soil).

Climatic data of the experimental area

The climatic data for the growing period 2018 in Bački Petrovac, near Novi Sad, in the Vojvodina region, Serbia, are shown in Fig. 1.

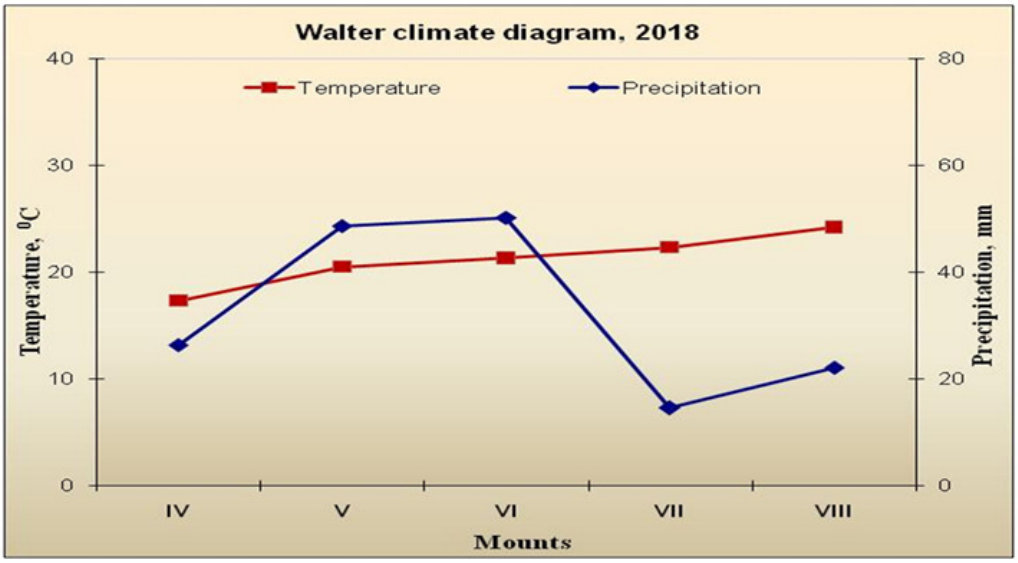

Fig. 1. Mean monthly air temperature and total precipitation, 2018, Bački Petrovac, Serbia

During the vegetation period in 2018, there was total precipitation of 368.20 mm and average temperature of 20.7^{0}C.

Statistical Analysis

Experiment was set as one factorial split plot method (split-plot), with three replications were analyzed with ANOVA by descriptive and analytical statistics. Results were interpreted by using a statistical package Statistics 12. 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 Discussion

For successful production it is necessary to select several stability and adaptability genotypes, most suitable for a certain agro-ecological area. Genotype is just one of the many, but also the most important factor of production, whose effect, fortunately, can be controlled (Popović, 2010; 2015). There are many definitions of stability and adaptability but the following ones prevail. Stability is the

ability of a genotype to have always the uniform yield regardless of environmental effects (Hill et al., 1998; Citate: Becker, 1981). Adaptability is the ability of a variety to provide stable and high yield under different environmental conditions (Hill et al., 1998; Citate: Finly and Wilkinson, 1963). Stability and adaptability of genotypes are best assessed by evaluating the cultivars in different environments and ecological regions (Božovic et al., 2018; Jankovic et al., 2018). Grain yield is one of the most important parameters for estimating cultivar value, in almost all programs of selection and breeding of standard grain quality.

The analysis of variance of tested productivity parameters of cultivar phacelia NS Priora during to 2018 years, are shown in Table 1.

Table 1. Analysis of variance for tested parameters

Effect	SS	Deg.of Freed.	MS	F	p
Yield of crude biomass					
Intercept	3308812	1	33088012	11959.52	0.00000
Variant	58017	1	58017	20.97**	0.00102
Error	11067	4	2767		
Plant height					
Intercept	36973.50	1	36973.50	364.87	0.00004
Variant	368.17	1	368.17	3.6332	0.12933
Error	405.33	4	101.33		
Leaf length					
Intercept	1320.16	1	1320.17	360.05	0.00005
Variant	60.17	1	60.17	16.41**	0.01547
Error	14.67	4	3.67		
Length of root					
Intercept	620.16	1	620.17	61.00	0.00145
Variant	20.17	1	20.17	1.98	0.23178
Error	40.66	4	10.17		
Mass of flowering					
Intercept	55.3281	1	55.3281	20.007	0.01105
Variant	9.3251	1	9.3251	3.372	0.14019
Error	11.0616	4	2.765		
Grain yield per plant					
Intercept	4.2168	1	4.2168	149.09	0.00026
Variant	0.0938	1	0.0938	3.315	0.14278
Error	0.1131	4	0.0283		

Based on the analysis of variance, it can be concluded that are highly significant differences at yield of crude biomass regard the nutrition of investigation (F_{exp}=20.97**). Highly significant differences in leaf length regard the nutrition of investigation (F_{exp}=16.41**), Table 1.

Results clearly show that at yield of crude biomass were significantly affected by foliar nutrition (Table 2). The yield of crude biomass of c. phacelia NS Priora significantly varied between variant, from 2250 kg/ha (in control) to 2446.66 kg/ha, in variant with nutrition, Table 2.

Nutrition was positively effects with tested productivity parameters of c. NS Priora. The plant height of c. phacelia NS Priora varied between variant, from 86.33 cm (in control) to 70.66 cm, in variant with nutrition. Leaf length of c. phacelia NS Priora varied between variant, from 18.00 cm (in control) to 11.67 cm, in variant with nutrition. Length of root of c. phacelia NS Priora varied between variant, from

8.33 cm (in control) to 12.00 cm, in variant with nutrition. Grain yield per plant varied between variant, from 0.72 g (in control) to 0.96 g, in variant with nutrition, Table 2.

Table 2. Descriptive statistics of tested parameters of cultivar NS Priora

Parameter	Factor	No repl.	Mean	Std. dev.	Std. Error	-95.00%	+95.00
Yield of crude biomass, kg/ha							
Total		6	2348.33	177.54	47.98	2224.97	2471.68
Variant	1	3	2250.00	50.00	28.87	2125.79	2374.20
Variant	2	3	2446.66	55.08	31.79	2309.85	2583.48
Plant height, cm							
Total		6	78.50	12.44	5.08	65.45	91.55
Variant	1	3	70.66	10.07	5.82	45.66	95.67
Variant	2	3	86.33	10.06	5.81	61.33	111.33
Leaf length, cm							
Total		6	14.83	3.86	1.58	10.77	18.89
Variant	1	3	11.67	2.52	1.45	5.41	17.92
Variant	2	3	18.00	1.00	0.58	15.52	20.48
Length of root, cm							
Total		6	10.16	3.48	1.42	6,51	13.83
Variant	1	3	8.33	4.04	2.33	1.71	18.37
Variant	2	3	12.00	2.00	1.15	7.03	16.97
Mass of flowering, g							
Total		6	3.04	2.02	0.82	0.91	5.16
Variant	1	3	1.79	0.38	0.22	0.83	2.74
Variant	2	3	4.28	2.32	1.33	1.48	10.05
Grain yield per plant, g							
Total		6	0.84	0.20	0.08	0.63	1.05
Variant	1	3	0.72	0.18	0.11	0.25	1.17
Variant	2	3	0.96	0.14	0.09	0.59	1.33

Figure 2 shows a graphic arrangement and a comparison of nutrition according to the expression of plant height, grain yield/plant and yield of biomass and in Figure 3, a comparison of nutrition according to the expression of leaf length, mass of flowering and length of root.

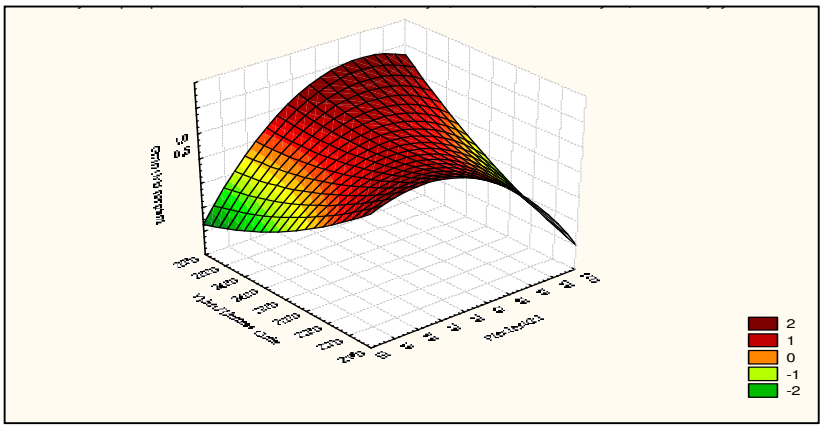

Fig. 2. 3 D Surface Plot for plant height, grain yield/plant and yield of biomass

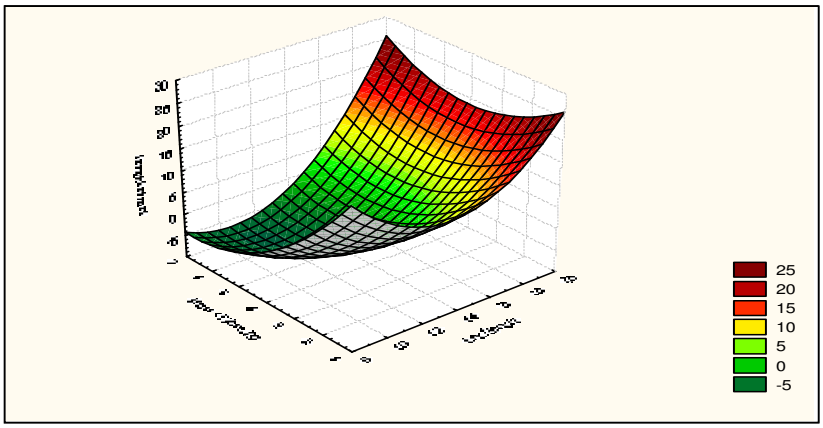

Fig. 3. 3 D Surface Plot for leaf length, mass of flowering and length of root

Correlations of tested parameters

Agro-ecological and agro-technical practices have a significant effect on plant productivity (Popović, 2010; 2015; Kosev *et al.*, 2018). Nutrition was significantly positively and strong correlated with yield of biomass crude and leaf length (r=0.92** and r=0.90**), and significantly positively correlated with plant height, grain yield per plant, mass of flowering and length of root (r=0.69*, r=0.67*, r=0.68* and r=0.58*).

The yield of biomass has a strong significant positive correlation on length of root (r=0.83), and positive correlated of plant height (r=0.66), leaf length and grain yield per plant(r=0.77), Table 3.

Table 3. Correlation coefficients for all tested traits

Parameters	Plant height	Yield of crude biomass	Leaf length	Grain yield per plant	Mass of flowering	Length of root	Nutrition
Plant height	1.00	0,66*	0,76*	0.82**	0.79*	0.31^{ns}	0.69*
Yield of crude biomass	0.66*	1.00	0.73*	0.77*	0.56*	0.83**	0.92**
Leaf length	0.76*	0.73*	1.00	0.57*	0.72*	0.25^{ns}	0.90**
Grain yield per plant	0.82**	0.77*	0.57*	1.00	0.40^{ns}	0.54*	0.67*
Mass of flowering	0.79*	0.56*	0.72*	0.40^{ns}	1.00	0.30^{ns}	0.68*
Length of root	0.31*	0.83**	0.25^{ns}	0.54*	0.30^{ns}	1.00	0.58*
^{ns} – non significant; * and ** significant at 0.1 and 0.5							

Significant and positive correlation between grain yield and nitrogen levels has been established Đekić *et al.* (2014).

NS Priora had high grain yield good quality. Grain yields of NS Priora in 2016 is 902 kg ha^{-1} and flowering plant continues over 60 days (Popović et al, 2017c). Average germination seed, of NS Priora seeds harvested in 2016, was 87% and average germination energy was 77%. The average thousand seeds weight was 1.42 g. NS Priora variety had average nitrogen content is 3.21% and protein content was 20.06% (Popovic et al., 2017c).

Conclusions

Nutrition was positively effects with tested productivity parameters of c. NS Priora. Plant height was average 78.50 cm, and varied at 70.67 cm (control) to 86.33 cm (nutrition). Leaf length was average 14.83 cm, and varied at 11.67 cm (control) to 18.00 cm (nutrition). Grain yield per plant was average 0.84 g, and varied at 0.77 g (control) to 0.96 g (nutrition). Yield of biomass was average 2348 kg/ha, and varied at 2250 kg/ha (control) to 2446 kg/ha (nutrition).

The yield of biomass has a strong significant positive correlation on length of root (r=0.83), and positive correlated of plant height (r=0.66), leaf length and grain yield per plant(r=0.77). Nutrition was significantly positively and strong correlated with yield of biomass crude.

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Conflicts of Interest: The authors declare no conflict of interest.

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