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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U ime Naučnog i Počasnog odbora

CONTENT

Plant production, Plant protection and food safety, Genetic resources

Original Scientific paper

Effects of foliar nutrition on production biomass of broomcorn millet (*Panicum miliaceum* L.)

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Abstract

The cultivar Biserka, in the experiment carried out in 2018, in the experimental field of Institute of Field and Vegetable Crops, in Bački Petrovac, has achieved excellent agronomic characteristics. Stems of cultivar Biserka was light green, erect, sometimes branched at the base, and grow 0.9–1.3 m tall. Leaves alternate along the stem were covered with short hair and arching leaves may reach and over 30 cm length. Plants have shallow, fibrous root systems and produce few tillers. Cultivar Biserka has a drooping branched compact inflorescence 20–30 cm long made of many stalked, ovoid spikelet and reproduces by seeds yellow color, 2.5–3 mm long.

Analysis of variance was found highly significant effect of nutrition in all tested characters. Foliar nutrition had the most highly significant influence on plant height. Investigation where showed a considerable variation of biomass yield which was independence from foliar nutrition. The highest biomass yields were in the variant with nutrition. Plant height was statistically significantly higher in the variant with foliar nutrition compared to the control a difference of 17.67 cm was achieved or 18.73%. The yield of green biomass in a variant with nutrition was higher than the control by 8.2%. Seed yield per plant ranged from 6.52 g in control, up to 9.24 g in a variant with foliar nutrition. The yield of biomass has a significant positive correlation on plant height (r=0.79), length of leaf (r=0.99) and grain yield per plant (r=0.93).

Nutrition was significantly positively and strong correlated with plant height and grain yield per plant (r=0.99 and r=0.92), and significantly positively correlated with yield biomass (r=0.74).

Keywords: *millet, foliar nutrition, productivity, biomass yield, correlation*

Introduction

Millets are small-seeded annual cereals grown for food, feed, forage, and fuel. About 20 different species of millet have been cultivated throughout the world at different points in time (Fuller, 2006). Commonly cultivated millet species include proso millet (*Panicum miliaceum* L.), pearl millet (*Pennisetum glaucum* L.R. Br.), finger millet (*Eleusine coracana*), kodo millet (*Paspalum setaceum*), foxtail millet (*Setaria italica* L. Beauv.), little millet (*Panicum sumatrense*), and barnyard millet (*Echinochloa utilis*). Millet ranks sixth among the world's most important cereal grains, sustaining more than one-third of the world's population. Proso millet was likely domesticated in China sometime around 10,000 BP. Asian and African countries are the biggest millet producers (Glamoclija et al., 2015; FAO 2017, Graph. 2). Millet has many nutritional and medical functions. Millets are rich in health-promoting considered functional foods. Consumption of millet and other millets is associated with reduced risk of type-2 diabetes mellitus because whole grains like millet are a rich source of magnesium. Magnesium acts as a co-factor in a number of enzymatic reactions that regulate the secretion of glucose and insulin. Magnesium can also reduce the frequency of migraine headaches and heart attacks, and is beneficial for people suffering from atherosclerosis and diabetic heart disease. Since millets are high in fiber, antioxidants, and complex carbohydrates, they can be valuable in preventing CVD and cancer (Habiyaremye et al., 2017). It is currently the economic force of Brazil and United States where biomass contributes in three percent of their total energy resources. Millet can be used as a quick growing catch crop planted into corn and sorghum stubble fields. It does well plant in combination with cowpea or soybeans. It has one of the lowest water requirements of any cereal (Lyon et al., 2008), and could be useful in low-input sustainable systems. Earlier summer (June) plantings produce the greatest biomass. It can be terminated by mowing or disking. The aim of the research was tested influence of foliar nutrition on production biomass of millet c. Biserka.

Millet and sorghum are among the oldest of the cereals, and in the ancient world they were common bread grains (Glamoclija et al., 2015; Sikora et al., 2016; Ikanovic et al., 2011; 2017). Sorghum and millet are two of the most basic foods for the poor and rural people in the dry regions that are poor in terms of other grains. When the production regions of these products are reviewed, it is seen that Africa, Central America and South Asia are at the front. Used in various fields such as human food, feed and biofuel; these products are an important food source for the African countries that are especially poor in terms of other grain products. In some parts of Turkey, millet is another name for corn and so most of the time millet is mistaken for corn. However, millet is cultivated around the world for food and feed; it has smaller seeds than corn; it is a really different cereal in comparison to corn in terms of appearance of its plant. Flowers of all millet species stand upright and inclined in shape of dense or sparse bunches. Its seeds do not form a regular sequence around the rachis as it is in wheat or barley. Efficiency and nutrition of millet seeds are much lower than most of the other grains. Liking sandy soil and being drought-tolerant, millet is summer crop which is cultivated in spring. It is warm climate plant which does not need rainfall and can be cultivated even in most arid lands. It is not affected by heavy rainfall. Proso millet and foxtail millet do not like moisture much. Millet seeds sprout in 8-12 ^{0} degree (Anderson, 1949; 2016).

Vast quantities of agricultural and agro-industrial residues that are generated as a result of diverse agricultural process represent one of the most important energy-rich resources. Accumulation of this biomass, in large quantities, results in a huge loss of valuable nutritional materials as potentially useful for man and animals. Biomass contributes about twenty-five percent of the world energy requirement equivalents to twenty million barrels of fuels of oil per day. It is currently the economic force of Brazil and the United States where biomass contributes in three percent of their total energy resources (Bassaria, 2003). Millet can be used as a quick growing catch crop planted into corn and sorghum stubble fields. It does well plant in combination with cowpea or soybeans (Schonbeck & Morse, 2006). It has one of the lowest water requirements of any cereal (Lyon et al., 2008), and could be useful in low-input sustainable systems. Earlier summer (June) plantings produce the greatest biomass (Schonbeck & Morse, 2006). It can be terminated by mowing or disking. Winter wheat has been successfully no-till planted into millet stubble in the fall in the Great Plains (Lyon et al., 2008).

Agro-ecological and agro-technical practices have a significant effect on plant productivity (Popović, 2010; 2015; Đekić et al., 2014; 2015; Maksimovic et al., 2018; Ugrenović et al., 2018;). The small millets are valued by traditional farmers for their nutritional content and health-promoting properties, ability to grow under low input conditions and tolerance to extreme environmental stress, especially drought. In a world facing limiting natural resources and climate change, these crops thus hold tremendous potential as valuable instruments in the toolkit of the New Green Revolution. It is hoped that germplasm resources combined with modern genomic tools can help to accelerate the exploitation of this biodiversity (Goron & Raizada, 2015). Nutrition plays a vital role in improving biomass yields and productivity of millet.

The aim of the study was to determined the effect of foliar nutrition on the yield parameters of millet (*Panicum miliaceum* L.).

Material and methods

This paper analyses the cereals production parameters in the world for the 2016. The data for cereals production in the world were taken from the FAO database (http:// faostat.fao.org/), and data of millet production, c. Biserka, taken from the Institute of Field and Vegetable Crops, Novi Sad, Serbia.

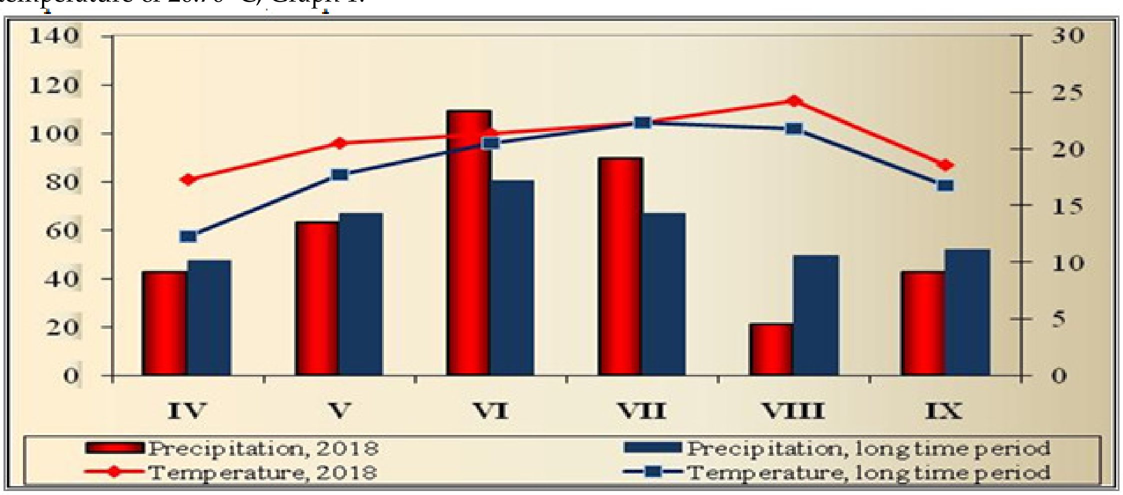
Experiment with millet cultivar Biserka was carried out on experimental field of Institute of Field and Vegetable Crops at certified plots in Bački Petrovac, Serbia, 2018 in two variants: 1. Control; and 2. Variant with foliar nutrition. The millet cultivar Biserka used in the experiment is a cultivar developed by the Institute of Field and Vegetable Crops, from Novi Sad, Serbia. The standard technology for growing c. Biserka was applied during the experiment. Sowing was carried out at the optimum time (50 kg ha^{-1}). Crop cultivation was applied during the vegetation period. This investigation included: foliar nutrition and control without nutrition. Foliar fertilization was applied with Phytocereals preparation, two times during the intensive growth of the plants. Phytocereals preparation is a cocktail with micro and macro elements, vitamins, amino acids, and growth stimulants. The trial was set up in a randomized block design with three replications. Nutrition was applied two times before flowering plants. The crop was harvested at full maturity. The harvest is carried out manually in technological maturity, after 115 days. Four parameters were analyzed: plant height (cm), length of the leaf (cm), biomass yield (t/ha) and grain yield per plant (g).

Statistical Analysis

The experiment was set as one factorial split-plot method, with three replications. Results were interpreted by using a statistical package, Statistic 12. Relative dependence was defined by method of correlation analysis.

Climatic data

The climatic data for the growing period in Bački Petrovac, near Novi Sad, are shown in Graph. 1a, b. During the vegetation period in 2018, there was total precipitation of 368.20 mm and an average temperature of 20.70 ^{0}C, Graph 1.



Figue-. 1. Meteorological data for the growing period of millet in Bački Petrovac, 2018, Serbia

Results and Discussion

World millet production

Of the total world cereals production (2814.98 mil. t) 90.62% were under maize (37.66%), wheat (26.63%) and rice (26.33%). The ten most important cereals in the world sowed at area of 702.40 mil. ha (wheat at 220.11 mil. ha, maize to 187.96 mil. ha, rice to 159.81 mil. ha, barley at 46.92 mil. ha, sorghum to 44.77 mil. ha, millet on 31.71 mil. ha, 4,40 mil. ha at rye, triticale to 4.16 mil. ha, buckwheat on 2.37 mil. ha and quinoa at 0.19 mil. ha, Tab. 1.

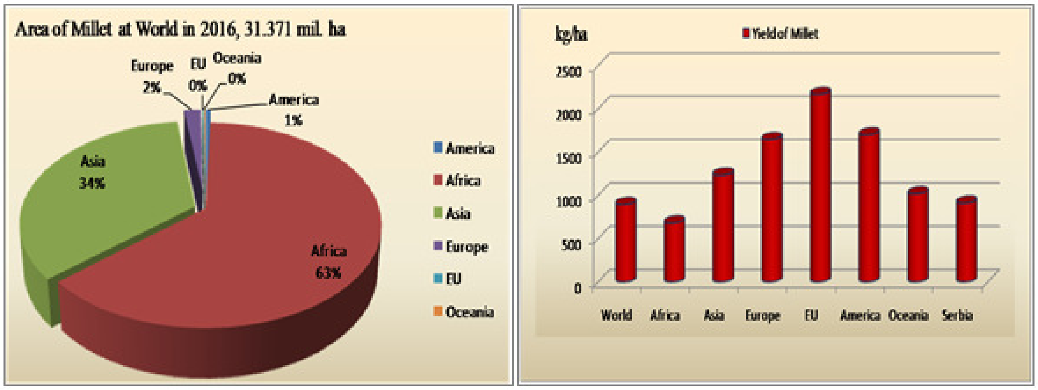
Table 1 Cereals production in the World, 2016

Cereals in World	Area mil. ha	Yield t ha^{-1}	Production mil. t	Chare of production, % *
10 Cereals	**702.40**	**2.75**	**2814,79**	**100.00**
Maize	187.96	5.64	1,060.10	37.66
Wheat	220.11	3.41	749.46	26.63
Rice	159.81	4.64	740.96	26.33
Barley	46.92	3.01	141.28	5.02
Sorghum	44.77	1.43	63.93	2.27
Millet	31.71	0.90	28.36	1.01
Triticale	4.16	3.66	15.22	0.54
Rye	4.40	2.94	12.94	0.46
Buckwheat	2.37	1.01	2.39	0.08
Quinoa	0.19	0.80	0.15	0.005
Source: Fao, 2018, http://www.fao.org/faostat/en/#data/QC, *Calculated of authors				

Today millet is an important grain product for the developing countries in Asia and Africa with semi-arid tropical climate. Millet flour is used to make bread and also to make alcohol and boza after fermented. It is used as feed for birds and is one of the most important foodstuff in North African countries. In these regions millet seeds are consumed as mash or flatbread after boiled or milled. In addition, stems and seeds of all kinds of millets are used as animal feed (Anderson, 1949).

According to the data of FAO showing 2016, global harvest area for millet was 31.71 mil. ha and have average yield of 900 kg ha^{-1}, Graph. 2a, 2b.

According to FAO which announced that world millet production amount in the 2016 years is 28.36 million tons, world millet production. According to the estimates of FAO in 2016, the most important producers are Africa and Asia. World's largest consumption in millet used mostly as human food and feed is India that also ranks first in the production. India's millet consumption is slightly higher than the production, Table 1, Graph. 2a and 2b.



a.

b.

Figure 2. Area, ha, and grain yield of millet in world, 2016

Millets are generally among the most suitable crops for sustaining agriculture and food security on marginal lands with low fertility. Millet crops are grown on marginal lands and under low-input agricultural conditions—situations in which major cereal crops often produce low yields (Amadou et al., 2013). Millet can be productive even under harsh growing conditions, especially in regions such as India and Sub-Saharan and West Africa, where average rainfall is often less than 500 mm and soils are sandy and slightly acidic (Changmei and Dorothy, 2014).

Of all the millets cultivated in Africa, 74% are grown in Sub- Saharan and West Africa, accounting for 28% of the world's production (Changmei and Dorothy, 2014). Historically, millets and other warm season crops such as sudan grass and sorghum were grown as forage and grain feed for livestock and birds in different regions of Oregon (Schoth and Rampton, 1939).

The planting time of millet fits well in rotation with winter annual crops such as winter wheat or warm-season broad leaf crops such as sunflower (Herdrich, 2001). Successful millet production in Nebraskai sattributed to the practice of eco - fallow—planting millet in standing wheat stubble in the spring to control weeds and to conserve stored soil moisture (Anderson, 1990).

Effect foliar nutrition of millet plants

Nutrition in critical plant development stages of millet is a crucial factor for the successful production. Nutrition was highly significant effect of all tested morphological characteristics. Total biomass yield was 29.93 t ha^{-1}. The highest biomass yields were in the variant with nutrition. The yield of green biomass in a variant with nutrition was higher than the control by 8.2%, graph. 3. Average plant height was 1.3 m. Foliar nutrition had the most highly significant influence on plant height. Plant height was statistically significantly higher in the variant with foliar nutrition compared to the control a difference of 17.67 cm was achieved or 18.73%.

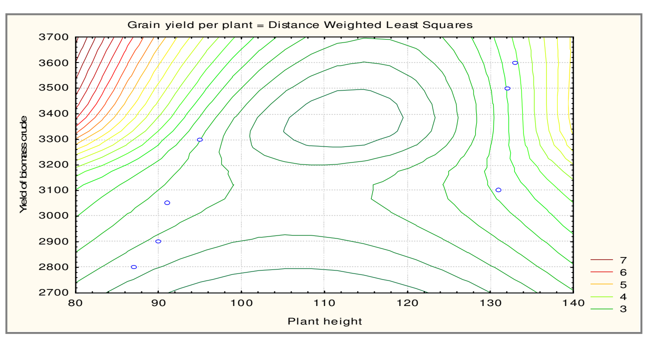


Figure 3. 3D Contour Plot at grain yield/plant, biomass yield and plant height at millet, 2018

Average seed yield per plant was 7.88 g and ranged from 6.52 g in control, up to 9.24 g in a variant with foliar nutrition. Plants of c. Biserka was an average drooping branched compact inflorescence 30 cm long and reproduces by seeds yellow color, 2.5–3 mm long.

Correlation of tested parameters

Agro-ecological and agro-technical practices have a significant effect on plant productivity (Popović, 2010; Đekić et al., 2013; 2015). Nutrition was significantly high positive correlated with plant height and grain yield per plant (r=0.99 and r=0.92), and significantly positively correlated with yield biomass (r=0.74) and with leaf length (r=0.69), Table 2.

Table 2. *Correlation of tested parameters*

Variable	Biomass yield	Grain yield/plant	Plant height	Leaf length	Nutrition
Yield of biomass	-	0.93**	0.79*	0.99**	0.74*
Grain yield/plant	0.93**	-	0.95**	0.91**	0.92**
Plant height	0.79*	0.95**	-	0.75*	0.99**
Leaf length	0.99**	0.91**	0.75*	-	0.69*
Nutrition	0.74*	0.92**	0.99**	0.69*	-
*and ** significant at 0.05 and 0.01					

The yield of biomass has a significant positive correlation on plant height (r=0.79), leaf length (r=0.99) and grain yield per plant (r=0.93), Table 2.

The average protein contents of millet was 12.5%, the carbohydrate was 70.4%, fat 3.4%, fiber was 14.2% and Ca 14%, Table 3.

Table 3. Nutritional composition of millet (*Panicum miliaceum* L.) (in 100 g).

Parameters	Protein, %	Carbo-hydrate, %	Fat, %	Dietaly fiber, %	Mineral mather, %	Ca, %	P, %	Fe, mg
Millet	12.5	70.4	3.1	14.2	1.9	14	206	10
Higher than major cereal sand wheat, adapted from Saha et al. (2016)								

Millets are a major source of energy and protein and have high nutritive value, comparable to major cereals such as wheat, rice, and maize (Amadou *et al.*, 2013; Saleh *et al.*, 2013). Millets are unique among the cereals because of their high calcium, iron, potassium, magnesium, phosphorous, zinc, dietary fiber, polyphenols, and protein content (Hulse et al., 1980; Devi et al., 2014; Gupta et al., 2014).

Millets are gluten-free, ideal for people who are gluten-intolerant, though millet flour cannot be used for raised bread (Hulse et al., 1980; Thompson, 2009; Amadou et al., 2013; Santra, 2013). Millets are easy to digest.

Conclusion

Millet is an important grain product for the countries with semi-arid tropical climate. Millets are valued by traditional farmers for their nutritional content for health, ability to grow under low input conditions and tolerance to extreme environmental stress, especially drought. In a world facing limiting natural resources and climate change, these crops thus hold tremendous potential as valuable instruments in the toolkit of the New Green Revolution.

According to the data of FAO showing 2016, global harvest area for millet was 31.71 mil. ha, production was 28.36 mil. t and was average yield of 900 kg ha^{-1}. The share of the millet in the total world production of cereals was 1.01%.

Foliar nutrition had the most highly significant influence on plant height and yield of biomass of millet. Nutrition plays a vital role at improving biomass yields and productivity of millet.

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