International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(2): 1025-1028

Received: 11-01-2019
Accepted: 15-02-2019

B Vimalan
Department of Soils and Environment, Agricultural College and Research Institute (TNAU), Madurai 625 104, Tamil Nadu, India

S Thiyageshwari
Department of Soils and Environment, Agricultural College and Research Institute (TNAU), Madurai 625 104, Tamil Nadu, India

K Balakrishnan
Department of Soils and Environment, Agricultural College and Research Institute (TNAU), Madurai 625 104, Tamil Nadu, India

A Rathinasamy
Department of Soils and Environment, Agricultural College and Research Institute (TNAU), Madurai 625 104, Tamil Nadu, India

K Kumutha
Department of Soils and Environment, Agricultural College and Research Institute (TNAU), Madurai 625 104, Tamil Nadu, India

Correspondence
B Vimalan
Department of Soils and Environment, Agricultural College and Research Institute (TNAU), Madurai 625 104, Tamil Nadu, India

Response of different levels of NPK fertilizers on yield attributes and quality of barnyard millet (*Echinochloa frumentacea* (Roxb.) Link) in Typic Haplustert soil

B Vimalan, S Thiyageshwari, K Balakrishnan, A Rathinasamy and K Kumutha

Abstract
Field experiment was carried out at Agricultural College and Research Institute, Madurai during *kharif* season of 2017 to study the response of different levels of NPK fertilizers on yield attributes and quality of barnyard millet (*Echinochloa frumentacea* (Roxb.) Link) in Typic Haplustert soil. The experiment was laid out in randomized block design with two replication. The treatments comprised of different NPK levels *viz*., N – 4 levels (30, 40, 50 & 60 kg ha^{-1}), P – 3 levels (15, 20 & 25 kg ha^{-1}), K – 3 levels (0, 7.5 & 15 kg ha^{-1}), respectively and absolute control without fertilizer application. It was found that soil application of 40:15:15 kg NPK ha^{-1} significantly increased higher number of productive tillers per plant, earhead weight per plant (g), thousand grain weight (g), grain yield (kg ha^{-1}), straw yield (kg ha^{-1}), protein (%) and starch content (%) of barnyard millet.

Keywords: Typic Haplustert, barnyard millet, yield and quality content

Introduction
Small millets are a group of small seeded cereals *viz*., finger millet, proso millet, barnyard millet, Italian millet, kodo millet, little millet etc. They have immense untapped genetic and nutrient potential. Minor millets are the major food source for millions of people, especially those who live in hot and dry areas of the world. Though they occupy relatively a lower position among food crops in Indian agriculture, they are quite important from the point of food security at regional farm level.

In India, out of the total net sown area of 141.0 M ha, rainfed area accounts for 85.0 M ha spread over 177 districts. This constitutes approximately 60 per cent of the total farming area in the country. Rainfed agriculture contributes 44 per cent of the total food grain production of the country and produces 75 per cent of pulses and more than 90 per cent of sorghum, millet and groundnut from arid and semiarid regions. Even after half a century of neglect, the rainfed regions provide livelihood to nearly 50 per cent of the total rural workforce and sustain 60 per cent of cattle population of the country (Millet Network of India Deccan Development Society FIAN, India,2015) [3].

In the year of 2014-15, the total production of minor millets in India is 6.83 lakh tonnes, cultivated in an area of about 6 lakh hectares with an average productivity of 630 kg ha^{-1}. In Tamil Nadu, small millets are cultivated in an area of about 32 thousand hectares with a production of about 35 thousand tonnes. The average productivity of small millets is about 1086 kg ha^{-1} (Ministry of agriculture and Farmers Welfare, 2015) [11]. Barnyard millet cultivation is dominant in dry lands and hill areas by tribal farmers in Ramanathapuram, Madurai, Virudhunagar, Theni, Salem, Namakkal, Dharmapuri, Krishnagiri, Villupuram, Dindigul, Coimbatore and Erode districts of Tamil Nadu (Senthil *et al*. 2005) [8].

Each of the millets is a storehouse of dozens of nutrients in large quantities. They include major and micro nutrients needed by the human body. Hence they can help people withstand malnutrition. Nutrient content of barnyard millet is, protein (11.2 g), fibre (10.1 g), minerals (4.4 g), iron (15.2 mg) and calcium (11 mg). It is rich in protein (11.8 %), iron (15 %) & crude fiber (9.8 %) and out of the total protein, it also consists of 16.6 per cent of amino acid, Leucine, which is twice that present in Rice. (Prakash and Vanniarajan, 2013) [6].

The carbohydrate content is slowly digestible, which makes the barnyard millet a nature's gift for the modem mankind who is engaged in sedentary activities.

Barnyard millet is often grown without much fertilizer. But with improved agricultural techniques and a greater emphasis on increased yields, this situation is rapidly changing in many developing countries and application of major nutrients in chemical form is receiving greater attention. Although some research findings suggest that increased application rates of inorganic fertilizers improve barnyard millet yield and productivity, scheduled fertiliser management recommendation for barnyard millet is scarce, limiting the ability of agricultural extension officers to assist subsistence farmers.

Considering the above issues, the present investigation was taken up to study the response of different levels of NPK fertilizers on yield attributes and quality of barnyard millet (*Echinochloa frumentacea* (Roxb.) Link) in Typic Haplustert soil.

Materials and Methods

The experiment in black soil, belongs to Typic Haplustert was carried out during kharif 2016-17 in field No. B-50 (09°96'75.04" North latitude and 78°20'71.66" East longitude) of AC&RI, Madurai with MDU 1 barnyard millet as test crop with scheduled treatment combinations. The various physico-chemical properties of the experimental soil were analysed as per standard methods. The texture was found to be sandy clay with a bulk density of 1.25 Mg m^{-3}, particle density of 2.50Mg m^{-3}, pH of 8.09, EC of 0.26 dS m^{-1} and soil organic carbon of 4.93 g kg^{-1}. The cation exchange capacity of the soil was 27.2 C mol (p^+) kg^{-1}. The available N, P, K of the experimental soil was low, high and high with a value of 276, 25 and 370 kg ha^{-1}, respectively. The $CaCO_3$ status of soil was 4.93 per cent. The DTPA extractable Fe, Zn, and Cu were sufficient in the experimental soil recording a value of 7.20, 5.85 and 1.25 mg kg^{-1}, respectively. The soil was deficient in Mn recording 1.61 mg kg^{-1} of Mn lower than the critical value of 2.0 mg kg^{-1}. The micronutrients were estimated through Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES), at the Department of Soils and Environment, AC&RI, Madurai. The experimental soil is classified as Typic Haplustert. The experiment was laid out in RBD design with two replications. The treatments comprised of different NPK levels *i.e.,* N – 4 levels (30, 40, 50 & 60 kg ha^{-1}), P – 3 levels (15, 20 & 25 kg ha^{-1}), K – 3 levels (0, 7.5 & 15 kg ha^{-1}), respectively. In order to evaluate the response of different levels of NPK fertilizers on yield attributes and quality of barnyard millet, the data were statistically analyzed using "Analysis of variance test". The critical difference at 5% level of significance was calculated to find out the significance of different treatments over each other (Gomez and Gomez, 1984) [1].

Result and Discussions

Yield Characters of Barnyard millet

Distinct variation in number of productive tillers per plant of barnyard millet was recorded due to soil application of different levels of NPK. Soil application of NPK @ 40:15:15 kg ha^{-1} recorded significantly higher number of productive tillers per plant (7.96) while the lowest value was recorded in absolute control (1.48). The significant effect of different levels of NPK was exhibited in the earhead weight per plant**.** Application of 40:15:15 kg ha^{-1} of NPK recorded the maximum earhead weight per plant of 22.07 g, respectively. In the present experiment, it was observed that the earhead weight per plant was increased by increasing the NPK level upto 40:15:15 kg NPK ha^{-1} and thereafter a decline at higher levels of NPK. Increase in earhead weight per plant is due to the increase in levels of NPK and nutrient availability. There was no significant effect of NPK levels on thousand grain weight of barnyard millet. Application of 40:15:15 kg ha^{-1} recorded higher test weight of 4.00 g over the control. These results are in line with Maqsood *et al.* (2001) [4] who found significant differences of NPK on number of tillers. Sharma *et al*., 1998 [10] who found no significant effect of NPK fertilizer levels on grain weight of cereals. The application of inorganic fertilizer stimulates better crop emergence reported by Rurinda *et al*. 2014 [7].

Grain and Straw Yield

The grain and straw yield of barnyard millet was found to be more in soil application of 40:15:15 kg NPK ha^{-1} is significantly recorded the highest grain and straw yield of 3127 and 7508 kg ha $^{-1}$ as against 1706 and 3267 kg ha^{-1} for absolute control. The yield ranged from 1706 to 3127 kg ha^{-1} in grain and from 3267 to 7508 kg ha^{-1} in straw. The highest yield was obtained when NPK was applied and an increase in grain yield from 9.66 to 45.44% in grain over the control. The results indicated that the highest grain and straw yield might be attributed due to conjoint use inorganic sources of nutrients. The soil application of NPK increased photosynthetic rate and turns energy to sink. Rurinda *et al*. 2014 [7] found that finger millet emergence was low without inorganic NP fertilizer.

The reason was attributed to the increased more number of productive tillers and higher test weight besides higher uptake of nutrients. Nitrogen being a growth promoter, its role in increasing grain yield is adequately proved (Mengel and Wilson, 1981) [5]. The positive effects of P on yield resulted from increase in number of productive tillers. As grain yield, the straw yield was also influenced by levels of fertilizers. Higher dose of fertilizer favored vegetative growth, DMP and development of more number of tillers resulted in higher straw yield. The favorable effect of applied N on growth, DMP and nutrient uptake had reflected on straw yield. Similar findings which indicates their suitability for cultivation with NPK as increased in yield traits with the fertilizer doses were also reported by Gupta *et al*., (2012) [2] in fingermillet.

Quality Parameter

The different levels of NPK had significant influence on the protein and starch content of barnyard millet. The highest protein and starch content was found with soil application of 40:15:15 kg NPK ha^{-1} while the lowest with absolute control. The maximum protein content is 11.93 % and 56.22 % of starch content. This might be due to the availability of higher nitrogen content available from inorganic sources. The nitrogen is act as an integral part of protein and hence higher protein and starch content found in grain. The plant with more N uptake and more nitrate reductase activity gave higher concentration of proteins and starch. This is in accordance with earlier findings of Sharma *et al*. (2011) [9].

Table 1: Effect of different levels of NPK fertilizers on number of productive tillers per plant, earhead weight per plant, 1000 grain weight, grain yield and straw yield of barnyard millet in Typic Haplustert soils

Treatments	No. of productive tillers per plant	earhead weight per plant (g)	1000 grain Weight (g)	Grain Yield (kg ha^{-1})	Straw Yield (kg ha^{-1})
T_1 – Absolute Control	1.48	14.94	2.9	1706	3267
T_2 – 30:15:0	2.06	17.01	2.9	2034	3980
T_3 – 40:15:0	2.65	17.95	3.0	2211	4305
T_4 – 50:15:0	3.85	18.58	3.2	2352	4772
T_5 – 60:15:0	4.86	19.12	3.4	2471	5201
T_6 – 30:20:0	2.53	17.47	2.9	2104	3912
T_7 – 40:20:0	2.76	17.99	3.0	2220	4343
T_8 – 50:20:0	4.33	18.67	3.3	2371	4851
T_9 – 60:20:0	4.93	19.20	3.4	2488	5271
T_{10} – 30:25:0	2.54	17.90	2.9	2201	4263
T_{11} – 40:25:0	2.88	18.06	3.0	2235	4406
T_{12} – 50:25:0	4.50	18.78	3.3	2396	4955
T_{13} – 60:25:0	5.21	19.27	3.4	2504	5272
T_{14} – 30:15:7.5	3.18	18.13	3.0	2251	4412
T_{15} – 40:15:7.5	3.62	18.31	3.1	2291	4579
T_{16} – 50:15:7.5	4.70	18.85	3.3	2412	5021
T_{17} – 60:15:7.5	5.76	19.77	3.5	2615	5659
T_{18} – 30:20:7.5	3.44	18.18	3.1	2263	4462
T_{19} – 40:20:7.5	3.72	18.40	3.1	2311	4601
T_{20} – 50:20:7.5	4.73	18.94	3.3	2432	5040
T_{21} – 60:20:7.5	5.86	19.89	3.5	2643	5773
T_{22} – 30:25:7.5	3.53	18.28	3.1	2285	4554
T_{23} – 40:25:7.5	3.84	18.49	3.2	2332	4689
T_{24} – 50:25:7.5	4.86	19.03	3.3	2451	5118
T_{25} – 60:25:7.5	6.44	20.02	3.6	2670	5883
T_{26} – 30:15:15	5.41	19.39	3.5	2532	5386
T_{27} – 40:15:15	7.96	22.07	4.0	3127	7508
T_{28} – 50:15:15	7.31	20.94	3.8	2876	6576
T_{29} – 60:15:15	6.80	20.59	3.7	2798	6333
T_{30} – 30:20:15	5.50	19.52	3.5	2560	5501
T_{31} – 40:20:15	7.54	21.10	3.9	2910	6640
T_{32} – 50:20:15	6.53	20.22	3.6	2715	5997
T_{33} – 60:20:15	6.44	20.13	3.6	2695	5916
T_{34} – 30:25:15	5.68	19.62	3.5	2582	5525
T_{35} – 40:25:15	7.83	21.57	4.0	3016	7064
T_{36} – 50:25:15	6.99	20.77	3.8	2838	6423
T_{37}– 60:25:15	6.76	20.38	3.7	2751	6143
SEd	0.14	0.49	-	60	105
CD (P=0.05)	0.28	0.99	NS	121	213

Table 2: Effect of different levels of NPK fertilizers on protein content and starch content of barnyard millet in Typic Haplustert soils

Treatments	Protein content (%)	Starch content (%)
T_1 – Absolute Control	7.20	45.08
T_2 – 30:15:0	7.71	49.18
T_3 – 40:15:0	8.52	49.81
T_4 – 50:15:0	9.37	51.48
T_5 – 60:15:0	9.86	52.50
T_6 – 30:20:0	7.86	49.58
T_7 – 40:20:0	8.60	50.08
T_8 – 50:20:0	9.39	51.53
T_9 – 60:20:0	9.95	52.72
T_{10} – 30:25:0	8.29	49.72
T_{11} – 40:25:0	8.69	50.32
T_{12} – 50:25:0	9.52	51.76
T_{13} – 60:25:0	10.07	52.87
T_{14} – 30:15:7.5	8.75	50.40
T_{15} – 40:15:7.5	9.02	50.86
T_{16} – 50:15:7.5	9.64	51.99
T_{17} – 60:15:7.5	10.78	53.64
T_{18} – 30:20:7.5	8.83	50.68
T_{19} – 40:20:7.5	9.10	51.20
T_{20} – 50:20:7.5	9.72	52.21
T_{21} – 60:20:7.5	10.89	53.76
T_{22} – 30:25:7.5	8.96	50.79

T_{23} – 40:25:7.5	9.21	51.33
T_{24} – 50:25:7.5	9.72	52.44
T_{25} – 60:25:7.5	11.05	53.89
T_{26} – 30:15:15	10.22	52.95
T_{27} – 40:15:15	11.93	56.22
T_{28} – 50:15:15	11.54	54.89
T_{29} – 60:15:15	11.47	54.65
T_{30} – 30:20:15	10.43	53.06
T_{31} – 40:20:15	11.67	55.21
T_{32} – 50:20:15	11.34	54.48
T_{33} – 60:20:15	11.20	54.36
T_{34} – 30:25:15	10.59	53.40
T_{35} – 40:25:15	11.86	55.98
T_{36} – 50:25:15	11.49	54.71
T_{37}– 60:25:15	11.36	54.53
SEd	0.06	0.53
CD (P=0.05)	0.13	1.07

Conclusion

Among the different levels of NPK, the soil application of 40:15:15 kg NPK ha^{-1} registered higher yield and increased the quality content of barnyard millet. This was followed by soil application 40:25:15 kg NPK ha^{-1}.

References

1. Gomez KA, Gomez AA. Statistical procedures for Agricultural Research. Jon Wiley and sons, 2nd Ed., New York. 1984.
2. Gupta N, Atul K, Anil K. Relationship of nitrogen use efficiency with the activities of enzymes involved in nitrogen uptake and assimilation of finger millet genotypes grown under different nitrogen inputs. The Scientific World Journal. 2012; 1-10.
3. India MN. of. Millets (future of food and farming). Dds, Millets Millet Network of India - Deccan Development Society - FIAN, India. 2013, 2-16.
4. Maqsood M, Abid AM, Iqbal A, Hussain MI. Effect of variable rate of nitrogen and phosphorus on growth and yield of maize (golden). Online Journal of Biological Sciences. 2001; 1:19-20.
5. Mengel DB, Wilson FE. Water management and nitrogen fertilization of ratoon crop rice. Agronomy journal. 1981; (73):1008-1010.
6. Prakash R, Vanniarajan C. Genetic Variability for Panicle Characters in Indigenous and Exotic Barnyard Millet (*Echinochloa frumentacea* (Roxb.) Link) Germplasm over Environment. Vegetos- An International Journal of Plant Research. 2013; 26. http://doi.org/10.5958/j.2229-4473.26.2.088
7. Rurinda J, Mapfumo P, van Wijk MT, Mtambanengwe F, Rufino MC, Chikowo R, Giller KE. Comparative assessment of maize, finger millet and sorghum for household food security in the face of increasing climatic risk. Eur. J Agron. 2014; 55:29-41.
8. Senthil N, Nirmalakumari A, John Joel A, Selvi B, Raveendran TS, Ramamoorthy K and Ramanathan A. Barnyard mllet. In small millets for nutritional security. Kalaiselvam Pathippagam. Coimbatore. 2015; 1-56.
9. Sharma R, Sud RK, Prasad R, Pakade YB, Chand P. Determination of Essential & Toxic Metal and Its Transversal Pattern from Soil to Tea Brew. Food and Nutrition Sciences. 2011; 2(10):1160-1165. http://doi.org/10.4236/fns.2011.210155
10. Sharma MP, Gupta JP. Effect of organic materials on grain yield and soil properties in maize- wheat cropping systems. Indian Journal of Agriculture Sciences. 1998; 68:715-717.
11. Welfare F, Welfare F. State of Indian Agriculture, 2015-16. http://doi.org/ISBN: -3\3832AGRI