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YIELD, NUTRIENT UPTAKE AND POST-HARVEST SOIL AVAILABLE NUTRIENT STATUS OF PROSO MILLET AS INFLUENCED BY VARIETIES AND NITROGEN LEVELS

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ABSTRACT

A field experiment was conducted during *kharif*, 2021 on sandy loam soils of Tirupati in a split-plot design with four proso millet varieties (TNAU 202, GPUP 8, GPUP 21 and PPV 1) in combination with three nitrogen levels (20, 40 and 60 kg N ha^{-1}). The results of the experiment revealed that among the four proso millet varieties, PPV 1 recorded the higher grain and straw yield, nutrient uptake and lower amount of post-harvest soil available nutrients. Application of 60 kg N ha^{-1} markedly improved the yield, nutrient uptake and post-harvest soil available nutrients. The results concluded that the proso millet variety PPV 1 or TNAU 202 with the application of 60 kg N ha^{-1} was more productive and maintains soil health.

KEYWORDS: Proso millet, varieties, nitrogen, yield

INTRODUCTION

Proso millet, also known as broomcorn millet, common millet, hog millet, russian millet and various other names in different regions, is an important small millet. Proso millet is well adapted to a wide range of soil conditions and has high energy efficiency. It has the potential for agricultural diversification because of its lower water and nutrient requirements. In comparison to other basic cereals, proso millet grains are high in proteins, vitamins, minerals and micronutrients. As a result, it can meet both food and nutritional needs. Despite its immense potential, the crop has yet to acquire widespread acceptance and is still seen as a poor man's food.

In India, the yield potential of proso millet is poor when compared to the potential output. So, the selection of suitable variety is an important factor responsible for enhancing the productivity of millets. Growing variety with short duration, medium height, drought resistance and high yielding capacity is most important to get viable yields under semi-arid regions. Nitrogen is the first limiting nutrient in most of the Indian soils among the three major nutrients. The addition of nitrogen promotes healthy, vigorous, green pigmented plants and increases the proliferation and distribution of roots. As several crop species are specific in their nitrogen requirement levels, there is a need for fixation of optimum dose of nitrogen as per the requirement. Hence, it is necessary to find out the suitable variety and correct dose of nitrogen for maximizing proso millet yields in the Southern Agro-climatic Zone of Andhra Pradesh.

MATERIAL AND METHODS

The present investigation was carried out at dryland farm, S.V. Agricultural College, Tirupati campus of Acharya N.G. Ranga Agricultural University which is in the Southern Agro-climatic Zone of Andhra Pradesh. The experiment was laid out in a split-plot design with four main plots and three sub-plots replicated thrice. The main plots consist of four varieties *viz*., V_1: TNAU 202, V_2: GPUP 8, V_3: GPUP 21 and V_4: PPV 1 and three sub-plots consist of nitrogen levels *viz*., N_1: 20 kg N ha^{-1}, N_2: 40 kg N ha^{-1} and N_3: 60 kg N ha^{-1}. The crop was sown at a spacing of 25 cm x10 cm. The experimental field was sandy loam in texture which is low in organic carbon (0.26 %). The soil is neutral in reaction (pH 6.9), low in available N (134 kg ha^{-1}) and medium in available phosphorus (43 kg ha^{-1}) and potassium (228 kg ha^{-1}). Total rainfall of 591.4 mm was received in 34 rainy days during the crop growing period. Nitrogen was applied as per the treatments in the form of urea and phosphorus

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was applied to all the plots in common as basal in the form of SSP. Available soil nitrogen (N) was estimated by the method as described by Subbiah and Asija (1956), soil available phosphorus was determined as described by Olsen *et al*. (1954) using a spectrophotometer and soil available potassium was estimated by neutral normal ammonium acetate extraction method using flame photometry (Stanford and English, 1949) and were expressed in kg ha^{-1}. Plant samples collected for estimation of dry matter production were used to estimate the nutrient uptake by the crop at harvest. The oven dried samples of plant material were ground in a willey mill and analyzed for N, P and K contents. The nitrogen, phosphorus and potassium uptake were calculated by multiplying the nutrient content of the plant sample with the corresponding total dry matter and expressed in kg ha^{-1}. The data collected were analyzed statistically following the procedure given by Panse and Sukhatme (1978) wherever the treatment differences were significant, critical differences were worked out at a five per cent probability level. Treatment differences that were not significant are denoted as NS.

RESULTS AND DISCUSSION

YIELD

Among the proso millet varieties tried, higher grain and straw yield was recorded with the PPV 1 (V_4) which was however comparable with TNAU 202 (V_1). The next best variety was GPUP 21 (V_3) followed by GPUP 8 (V_2) with significant disparity between each other. The variety GPUP 8 (V_2) registered significantly lower grain and straw yield (Table. 1). The difference in yields among the varieties can be attributed to their genetic potentiality to utilize and translocate photosynthates from source to sink. The superiority of the variety PPV 1 (V_4) in producing number of tillers m^{-2}, number of productive tillers m^{-2}, panicle length and grain weight $panicle^{-1}$ which had positive effect on the yield of proso millet. Similar results were reported by (Thirumala, 2020).

The highest grain and straw yield were realized with the application of 60 kg N ha^{-1} (N_3) which was significantly superior to the rest of the treatments tried (Table 1). It was followed by 40 kg N ha^{-1} (N_2) and 20 kg N ha^{-1} (N_1) in the order of descent with significant differences between them. Lower grain and straw yield were with the application of 20 kg N ha^{-1} (N_1). The improvement in yield with enhanced nitrogen application might be attributed to better availability and uptake of nutrients which in turn lead to efficient metabolism. Higher levels of biomass accrual and efficient translocation of photosynthates from source to sink at higher N level might be responsible for the production of an elevated level of yield stature. The results of the present investigation were in agreement with the findings of Hasan *et al*. (2013) and Vimalan *et al.* (2019).

NUTRIENT UPTAKE

The uptake of nutrients *i.e.* nitrogen, phosphorus and potassium were higher with the variety PPV 1 (V_4) which was however comparable with that of TNAU 202 (V_1). The next best variety was GPUP 21 (V_3) which was significantly higher than that of GPUP 8 (V_2) and latter recorded the lower nutrient uptake (Table. 1). The difference in the rooting pattern of varieties might have resulted in a difference in nutrient uptake. The variety PPV 1 (V_4) could be efficient in exploring the nutrients exhaustively from the soil. The present investigation confirms the documented evidence of Prabudoss *et al*. (2014), Sarawale *et al*. (2017) and Vimalan *et al*. (2019).

Application of 60 kg N ha^{-1} (N_3) resulted in higher nutrient uptake followed by that with 40 kg N ha^{-1} (N_2) and 20 kg N ha^{-1} (N_1) in the order of descent with significant difference between any two of the three nitrogen levels tested (Table. 1). Application of 60 kg N ha^{-1} (N_3) might have improved the microbial activity through enhanced root exudates and increased translocation of nutrients which probably have contributed to higher nitrogen, phosphorus and potassium contents respectively in the plant tissue. These results are in accordance with the findings of Jyothi *et al*. (2016) and Chavan *et al*. (2018).

POST-HARVEST SOIL AVAILABLE NUTRIENT STATUS

The higher values of post-harvest soil available nitrogen, phosphorous and potassium were recorded with the variety GPUP 8 (V_2) followed by GPUP 21 (V_3) and TNAU 202 (V_1) with a significant difference between any two of the three varieties in the order of descent. The variety PPV 1 (V_4) recorded lower post-harvest soil available nutrients, which was however comparable with that of TNAU 202 (V_1) (Table. 2). Better nutrient uptake efficiency of the variety PPV 1 (V_4) might have reflected in low post-harvest soil available nitrogen, phosphorous and potassium. There was increase in post-harvest soil

Table 1. Yield and nutrient uptake of proso millet at harvest as influenced by varieties and nitrogen levels

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Nitrogen uptake (kg ha^{-1})	Phosphorus uptake (kg ha^{-1})	Potassium uptake (kg ha^{-1})
Varieties (V)					
V_1 - TNAU 202	1599	2579	30.6	16.0	55.3
V_2 - GPUP 8	1097	2137	26.1	12.0	46.7
V_3 - GPUP 21	1367	2356	28.0	13.5	51.1
V_4 - PPV 1	1619	2620	31.7	16.9	58.7
SEm±	37.5	60.8	0.48	0.39	1.06
CD (P=0.05)	132	214	1.7	1.3	3.7
Nitrogen levels (N)					
N_1 - 20 kg ha^{-1}	1152	2187	20.4	12.3	49.5
N_2 - 40 kg ha^{-1}	1457	2433	28.6	15.1	53.3
N_3 - 60 kg ha^{-1}	1653	2647	37.3	16.5	56.1
SEm±	42.2	60.7	0.45	0.34	0.85
CD (P=0.05)	128	183	1.4	1.0	2.5
Varieties (V) × Nitrogen levels (N)					
N at V					
SEm±	64.9	105.3	0.83	0.69	1.83
CD (P=0.05)	NS	NS	NS	NS	NS
V at N					
SEm±	78.4	116.2	0.88	0.68	1.75
CD (P=0.05)	NS	NS	NS	NS	NS

available nutrients with variety GPUP 8 (V_2) which have lower uptake efficiency of nutrients as resulted from the present experiment is similar to the findings of Nigade and More (2013) and Triveni *et al*. (2018).

Post-harvest soil available nitrogen increased significantly with successive increments in nitrogen level from 20 to 60 kg ha^{-1} (Table. 2). Due to increase in nitrogen application, there was increase in the root exudates that act as a substrate for the micro-organisms and mineralize the organic nitrogen, thus increasing the nitrogen status of the soil. Higher soil available phosphorus and potassium were with 20 kg N ha^{-1} (N_1) which was significantly higher than that of 40 kg N ha^{-1} (N_2). Significantly lower soil available phosphorus and potassium were with 60 kg N ha^{-1} (N_3). Application of 60 kg N ha^{-1} (N_3) has led to better uptake of phosphorus and potassium from the soil, resulting in their lower availability in the soil at harvest. These results corroborate the findings of Kiranmai (2015).

In conclusion, the present investigation revealed that higher productivity of proso millet and soil health could be obtained with the cultivation of variety PPV 1 or TNAU 202 with the application of 60 kg N ha^{-1} during *kharif* in Southern Agro-climatic zone of Andhra Pradesh.

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Table 2. Post-harvest soil available nitrogen, phosphorus and potassium as influenced by varieties and nitrogen levels of proso millet

Treatments	Available nitrogen (kg ha^{-1})	Available phosphorus (kg ha^{-1})	Available potassium (kg ha^{-1})
Varieties (V)			
V_1 - TNAU 202	121.7	30.7	172.9
V_2 - GPUP 8	142.0	38.8	192.1
V_3 - GPUP 21	132.5	34.9	182.6
V_4 - PPV 1	117.9	29.2	171.0
SEm±	2.66	0.98	3.03
CD (P=0.05)	9.3	3.4	9.0
Nitrogen levels (N)			
N_1 - 20 kg ha^{-1}	118.3	36.4	189.3
N_2 - 40 kg ha^{-1}	130.9	33.5	178.5
N_3 - 60 kg ha^{-1}	142.1	29.9	166.4
SEm±	3.20	0.79	3.07
CD (P=0.05)	9.6	2.4	9.6
Varieties (V) × Nitrogen levels (N)			
N at V			
SEm±	4.61	1.70	6.06
CD (P=0.05)	NS	NS	NS
V at N			
SEm±	5.87	1.62	6.26
CD (P=0.05)	NS	NS	NS

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