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PRODUCTIVITY, NUTRIENT UPTAKE AND POST HARVEST SOIL NUTRIENT STATUS AS INFLUENCED BY TIMES OF SOWING AND NITROGEN LEVELS IN PROSO MILLET

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ABSTRACT

A field experiment was conducted during *kharif*, 2019 on sandy loam soils of dryland farm of S.V. Agricultural College, Tirupati campus of Acharya N.G. Ranga Agricultural University. The experiment was laid out in split-plot design with three replications having four times of sowing II FN of June (S_1), I FN of July (S_2), II FN of July (S_3), and I FN of August (S_4) as main plots and four nitrogen levels viz., 0 kg N ha^{-1} (N_1), 20 kg N ha^{-1} (N_2), 40 kg N ha^{-1} (N_3) and 60 kg N ha^{-1} (N_4) as sub plots. Among different sowing times tried, II FN of June (S_1) sown crop resulted in the higher grain yield, straw yield and nutrient uptake at harvest. Whereas, higher post- harvest soil available nutrients were noticed with I FN of August (S_4) sown crop. The lowest grain, straw yield and nutrient uptake were realized with I FN of August (S_4) sown crop. Crop sown during II FN of June (S_1) resulted in lowest post- harvest soil nutrient status. Application of 60 kg N ha^{-1} (N_4) markedly improved the grain and straw yield of crop while, their lowest with no nitrogen (N_1) application. Similar trend was followed with regard to nutrient uptake of the crop at harvest and post- harvest soil available nitrogen. Whereas, higher post- harvest soil available phosphorus and potassium were recorded with control and their lowest values were obtained with application of 60 kg N ha^{-1} (N_4).

KEY WORDS: Nitrogen levels, nutrient status, nutrient uptake, proso millet, times of sowing.

INTRODUCTION

Millets are small-seeded grasses that are hardy and grow well in dry zones as rain-fed crops under marginal conditions of soil fertility and moisture. They are known for their climate- resilient features including adaptation to a wide range of ecological conditions, less irrigation requirement, better growth and productivity in low nutrient input conditions, less reliance on synthetic fertilizers, and minimum vulnerability to environmental stresses unlike the major cereals.

Proso millet (*Panicum miliaceum* L.) is locally known as cheena, common millet, hog millet, broom corn, yellow hog, hershey and white millet. In India, proso millet is grown mostly in Southern India although it is cultivated in scattered localities in central and hilly tract of North India. It is a short duration crop sometimes used as contingency or insurance crop against a crop failure, due to unfavourable weather conditions or natural calamities. It also possesses special characters for adoption under adverse conditions such as drought, high temperature, low soil fertility and occurrence of disease and pests. It has very low water requirement and is well adapted to a range of climates, soils and elevations (Doggett, 1989). Time of sowing is one of the important non- monetary inputs provided to a crop which has a major impact in realizing higher yield. Favourable environmental conditions experienced with optimum time of sowing results in better performance of the crop. Hence, determination of optimum time of sowing is an important aspect in semi-arid regions during *kharif* with a short rainy season. Among the major nutrients, nitrogen plays an important role in increasing the productivity of a crop by improving the uptake of other nutrients available. Hence, the present study was conducted to find out the optimum time of sowing and nitrogen dose for higher yield and nutrient dynamics.

MATERIAL AND METHODS

A field trail was conducted during *kharif*, 2019 at dryland farm of S. V. Agricultural College, Tirupati campus of Acharya N G Ranga Agricultural University during. The soil of the experimental site was sandy loam in texture, neutral in soil reaction (7.3), low in organic content (0.46%) and available nitrogen (197.20 kg ha^{-1}), medium in available phosphorus (38.10 kg ha^{-1}) and available potassium (274.40 kg ha^{-1}). The experiment was laid out in a split-plot design and replicated thrice. The

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treatments include four sowing times allotted to main plots *viz.*, II FN of June (S_1), I FN of July (S_2), II FN of July (S_3) and I FN of August (S_4) and four nitrogen levels allotted to sub plots *viz.*, 0 kg N ha^{-1}(N_1), 20 kg N ha^{-1} (N_2), 40 kg N ha^{-1} (N_3) and 60 kg N ha^{-1} (N_4). The test variety of proso millet used was DHPM-2769 and the spacing adopted was 25 cm ×10 cm. Nitrogen was applied through urea as per the subplot treatments where 50 per cent was applied as basal and the remaining half was top dressed at 20 DAS. Phosphorus was applied @ 20 kg ha^{-1} common to all the plots as basal. The soil samples collected after harvest of crop from each treatment were shade dried, pounded and sieved through 2 mm sieve and analysed for soil available nutrient status N (Subbiah and Asija, 1956), P_2O_5 (Olsen *et al*., 1954) and K_2O (Jackson, 1973). The nutrient uptake at harvest (N, P and K) of proso millet were analysed by standard procedures.

RESULTS AND DISCUSSION

Grain and straw yield

Times of sowing and nitrogen levels significantly influenced the grain and straw yield. However their interaction effect was not statistically traceable (Table 1). The higher grain and straw yield was realized with II FN of June (S_1) sown crop which was significantly higher than that of I FN of July (S_2). Whereas the crop sown during I FN of August (S_4) resulted in lower yield. Increased grain and straw yield with early sown crop might be due to favourable weather conditions experienced by the crop with prolonged photoperiod due to which efficient translocation of assimilates was observed thereby increasing the yield. These results were inline with the findings of Mubeena *et al*. (2019) and Nandini and Sridhara (2019). Significantly higher grain and straw yield were noticed with 60 kg N ha^{-1} (N_4) compared to other lower nitrogen levels tried. Lowest grain and straw yield were recorded with control (N_1). Higher rate of nitrogen metabolism with 60 kg N ha^{-1} (N_4) might have resulted in production of more carbon assimilates, its efficient translocation from source to sink and their utilization for reproductive growth thereby increasing grain and straw yield. Similar results were obtained by Jyothi *et al*. (2016) and Arshewar *et al*. (2018).

Nutrient uptake at harvest

Among the sowing times tried, crop sown during II FN of June (S_1) resulted in higher uptake of nutrients (N, P and K) as presented in the Table 2. Lower nutrient uptake was recorded with I FN of August (S_4) sown crop (Table 2). The longer vegetative lag phase of the early sown crop might have helped in efficient use of growth resources due to which dry matter production was increased and thus nutrient uptake. These results were in accordance with the findings of Mubeena *et al*. (2019). With respect to nitrogen levels, higher dosage of nitrogen *i.e.* 60 kg ha^{-1} (N_4) increased the uptake of N, P and K and their lower values were with control (N_1). At higher nitrogen level, increased microbial activity through enhanced root exudates and increased translocation of nutrients might have contributed to higher nitrogen, phosphorus and potassium contents respectively in the plant tissue. The interaction effect was found non- significant. These results corroborates with the findings of Jyothi *et al.* (2016).

Table 1. Grain and straw yield of proso millet as influenced by times of sowing and nitrogen levels

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
Times of Sowing (S)		
S_1 : II FN of June	1239	2909
S_2 : I FN of July	1145	2688
S_3 : II FN of July	1052	2428
S_4 : I FN of August	745	2131
SEm±	25.4	52.6
CD (P=0.05)	90	185
Nitrogen levels (N)		
N_1 : Control	796	2058
N_2 : 20 kg N ha^{-1}	954	2448
N_3 : 40 kg N ha^{-1}	1127	2672
N_4 : 60 kg N ha^{-1}	1304	2977
SEm±	36.3	71.9
CD (P=0.05)	107	211
Times of sowing (S) × Nitrogen levels (N)		
N at S		
SEm±	50.9	105.2
CD (P=0.05)	NS	NS
S at N		
SEm±	67.9	135.3
CD (P=0.05)	NS	NS

Table 2. Nutrient uptake by proso millet at harvest as influenced by of sowing and nitrogen levels

Treatments	Nitrogen uptake (kg ha^{-1})	Phosphorus uptake (kg ha^{-1})	Potassium uptake (kg ha^{-1})
Times of Sowing (S)			
S_1 : II FN of June	24.4	13.4	101.0
S_2 : I FN of July	22.5	12.1	98.0
S_3 : II FN of July	21.5	10.9	92.0
S_4 : I FN of August	18.4	9.4	87.0
SEm±	0.19	0.30	0.79
CD (P=0.05)	0.7	1.0	3.0
Nitrogen levels (N)			
N_1 : Control	16.6	9.1	84.0
N_2 : 20 kg N ha^{-1}	21.0	10.6	92.0
N_3 : 40 kg N ha^{-1}	23.2	12.3	97.0
N_4 : 60 kg N ha^{-1}	26.0	13.8	104.0
SEm±	0.59	0.45	1.26
CD (P=0.05)	1.7	1.3	4.0
Times of sowing (S) × Nitrogen levels (N)			
N at S			
SEm±	0.38	0.59	1.58
CD (P=0.05)	NS	NS	NS
S at N			
SEm±	1.04	0.83	2.32
CD (P=0.05)	NS	NS	NS

Post-harvest soil available nutrient status

With respect to post harvest soil available nitrogen, phosphorus and potassium, higher values were noticed with I FN of August (S_4) sown crop followed by that with II FN of July (S_3), I FN of July (S_2) and II FN of June (S_1) in the order of descent (Table 3). Reduction in soil available nutrients with advance in sowing might be due to higher uptake efficiency of the crop. Similar results were obtained by Gavit *et al*. (2017). Application of 60 kg N ha^{-1} (N_4) resulted in superior post- harvest soil available nitrogen than with other lower doses tried, while their lowest values were with 0 kg N ha^{-1} (N_1). Increased post- harvest soil available nitrogen with increased nitrogen level might be due to higher microbial activity which mineralized the organic nitrogen present in the soil and also due to added nitrogen through urea. With regard to post- harvest soil available phosphorus and potassium, higher values were noticed with I FN of August (S_4) sown crop followed by that with II FN, the significantly higher values were observed with control (N_1) than that of 20 kg N ha^{-1} (N_2) and 40 kg N ha^{-1} (N_3) while their lower values were with 60 kg N ha^{-1} (N_1). Higher uptake of phosphorus and potassium at higher nitrogen level might have resulted in their lower availability in the soil at harvest. The obtained results were in confirmity with the findings of Kiranmai (2015).

CONCLUSION

From the present experiment, it can be concluded that proso millet sown during II FN of June (S_1) resulted in significantly higher grain yield, straw yield and nutrient uptake at harvest, whereas the post- harvest soil available nitrogen, phosphorus and potassium were noticed with I FN of August (S_4) sown crop. With respect to nitrogen levels, crop provided with 60 kg N ha^{-1} (N_4) resulted in superior grain yield, straw yield, nutrient uptake and post-harvest soil available nitrogen. With regard to post-

Table 3. Post- harvest soil available nutrient status as influenced by times of sowing and nitrogen levels in proso millet

Treatments	Nitrogen (kg ha^{-1})	Phosphorus (kg ha^{-1})	Potassium (kg ha^{-1})
Times of Sowing (S)			
S_1 : II FN of June	157.0	27.9	120.0
S_2 : I FN of July	170.0	29.3	131.0
S_3 : II FN of July	183.0	31.3	144.0
S_4 : I FN of August	194.0	32.5	157.0
SEm±	2.89	0.29	3.03
CD (P=0.05)	10.0	1.0	10.0
Nitrogen levels (N)			
N_1 : Control	154.0	32.1	159.0
N_2 : 20 kg N ha^{-1}	170.0	30.8	143.0
N_3 : 40 kg N ha^{-1}	184.0	29.5	131.0
N_4 : 60 kg N ha^{-1}	196.0	28.3	119.0
SEm±	3.77	0.39	3.50
CD (P=0.05)	11.0	1.1	10.0
Times of sowing (S) × Nitrogen levels (N)			
N at S			
SEm±	5.78	0.58	6.06
CD (P=0.05)	NS	NS	NS
S at N			
SEm±	7.14	0.74	6.77
CD (P=0.05)	NS	NS	NS

harvest soil available phosphorus and potassium were concerned, higher values were recorded with 60 kg N ha^{-1} (N_4). Hence, it is concluded that the optimum time of sowing for proso millet is II fortnight of June with 60 kg N ha^{-1}.

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