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Effect of Times of Sowing and Nitrogen Levels on Yield and Yield Attributes of Proso Millet (*Panicum miliaceum* L.)

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ABSTRACT

Background: Optimum sowing time which enables the utilization of all the available resources is prerequisite to achieve the potential crop yield. Quantifying nitrogen requirement of a crop is important as nitrogen directly influences the crop yield. The objective of this study was to evaluate sowing time and nitrogen levels on proso millet yield and yield attributes.

Methods: 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 [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.

Result: Among the sowing times tried, II FN of June (S_1) sown crop resulted in the higher yield attributes, grain and straw yield. While their lowest were with the crop sown during I FN of August (S_4). Significantly higher yield attributes, grain and straw yield were observed with the application of 60 kg N ha^{-1} (N_4) than with 40 kg N ha^{-1} (N_3). Reduced yield attributes, grain and straw yield were observed with no nitrogen application (N_1).

Key words: Nitrogen levels, Proso millet, Times of sowing, Yield attributes, Yield.

INTRODUCTION

Proso millet (*Panicum miliaceum* L.) is a warm season grass with a growing season of 60-100 days. Proso millet (*Panicum miliaceum* L.) is locally known as cheena, common millet, hog millet, broom corn, yellow hog, hershey and white millet. It is a highly nutritious cereal grain used for human consumption, bird seed and/or ethanol production. Unique characteristics, such as drought and heat tolerance, make proso millet a promising alternative cash crop. 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. An efficient strategy for producing crops under water-deficient conditions is to grow crops adapted to drought instead of crops that require more water (Seghatoleslami *et al*., 2008). Since millets are adapted to drought conditions, they can be keystone crops to avert food shortage and famine (Amadou *et al*., 2013).

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. Appropriate sowing time is the important non-monetary input in crop production, which affects the yield of a crop to greater extent. Poor soil fertility and erratic rains are the most important constraints to crop production in arid and semiarid region. Soil fertility management *i.e.,* nutrient management particularly nitrogen plays a major role in increasing production and productivity of proso millet. Nitrogen is an essential nutrient and key limiting factor in crop production of different agro-ecosystems. The systematic study on the performance of proso millet sown at different times with varied doses of nitrogen is not conducted in this region. Thus, the purpose of this study is to gain more information on the response of yield parameters and yield of proso millet under different times of sowing and nitrogen levels.

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MATERIALS 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. 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 with a gross plot area of 5.0 m × 4.0 m and net plot area of 3.5 m × 3.4 m. The 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. Yield attributes *viz.,* numbers of panicles m^{-2}, length of the panicle, weight of grains $panicle^{-1}$ and thousand grain weight observed at harvest were presented. Number of panicles were counted from one square meter area of net plot in each treatment. Length of the panicle and weight of grains $panicle^{-1}$ were recorded from the average of five tagged plants in the net plot. Thousand grain weight was recorded from a representative sample of grains from the net plot yield.

RESULTS AND DISCUSSION

Yield attributes

Yield parameters differed significantly due to sowing time and nitrogen levels while their interaction did not had significant influence (Table 1). Numbers of panicles m^{-2}, length of the panicle, weight of grains $panicle^{-1}$ and thousand grain weight increased significantly when the crop was sown during II FN of June (S_1) than that of I FN of July (S_2) sown crop. Significantly lesser yield attributes of proso millet were with the crop sown during I FN of August (S_4). Increased yield attributes with early sown crop might be due to the fact that early sown proso millet enjoyed congenial climatic conditions along with required biotic and abiotic resources, which enabled the plant to produce higher number of panicles m^{-2} (Miller *et al*., 1991), increased panicle length, grain weight $panicle^{-1}$ and thousand grain weight. It can be to higher sink capacity because of which the efficient translocation of assimilates from source to sink occurred. Similar findings were observed with Himasree (2016). Among the nitrogen levels tested, application of 60 kg N ha^{-1} (N_4) revealed significantly higher number of panicles m^{-2}, length of the panicle, weight of grains $panicle^{-1}$ and thousand grain weight compared to that with 40 kg N ha^{-1} (N_3) while their lowest were obtained with 0 kg N ha^{-1} (N_1). The increased yield attributes with higher dose of nitrogen might be attributed to the fact that higher availability of nitrogen have equipped the plant with luxuriant availability of photosynthates which inturn favoured the better partitioning of assimilates from source to sink. Linear increase in panicle length with increased doses of nitrogen as evident in this investigation was found to be similar with the findings of Pradhan *et al.* (2015) and Charate *et al.* (2018). The results were closely related with the findings of Jyothi *et al.* (2016).

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).

Table 1: Yield attributes and yield of prosomillet as influenced by times of sowing and nitrogen levels.

Treatments	Number of panicles m^{-2}	Length of the panicle (cm)	Weight of grains $panicle^{-1}$ (g)	1000 grain weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
Times of sowing (S)						
S_1- II FN of June	113	25.7	5.66	6.07	1239	2909
S_2- I FN of July	105	24.8	5.48	5.90	1145	2688
S_3- II FN of July	95	23.2	5.26	5.60	1052	2428
S_4- I FN of August	78	20.4	4.54	5.32	745	2131
SEm±	2.4	0.31	0.041	0.045	25.4	52.6
CD (P=0.05)	8	1.1	0.14	0.16	90	185
Nitrogen levels (N)						
N_1- Control	81	20.4	4.42	5.28	796	2058
N_2- 20 kg ha^{-1}	93	22.8	4.79	5.56	954	2448
N_3- 40 kg ha^{-1}	103	24.5	5.45	5.89	1127	2672
N_4- 60 kg ha^{-1}	114	26.5	6.29	6.14	1304	2977
SEm±	2.7	0.25	0.067	0.089	36.3	71.9
CD (P=0.05)	8	0.7	0.20	0.23	107	211
Times of sowing (S) × Nitrogen levels (N)						
N at S						
SEm±	4.7	0.63	0.081	0.089	50.9	105.2
CD (P=0.05)	NS	NS	NS	NS	NS	NS
S at N						
SEm±	5.3	0.53	0.123	0.144	67.9	135.3
CD (P=0.05)	NS	NS	NS	NS	NS	NS

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 was recorded with control (N_1). Nitrogen metabolism results in production of carbon assimilates and their utilization for reproductive growth. 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 Arshewar *et al*. (2018).

CONCLUSION

From the present experiment it can be inferred that proso millet sown during II FN of June (S_1) resulted in significantly higher yield attributes, grain and straw yields. With respect to nitrogen levels, crop provided with 60 kg N ha^{-1} (N_4) resulted in superior yield attributes, grain and straw yield. Hence, it is concluded that the optimum time of sowing for proso millet is II fortnight of June supplied with 60 kg N ha^{-1}.

Conflict of interest

All authors declared that there is no conflict of interest.

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