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Effect of Integrated Nitrogen Sources on Growth Parameters and Yield of Pearl Millet

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ABSTRACT

A field experiment was conducted during *kharif,* 2019 on sandy soils of Agricultural College Farm, Bapatla. The experiment was laid out in randomised block design with eight treatments and replicated thrice. The results indicated that plant growth characters like plant height, tillers m^{-2}, drymatter accumulation, grain and stover yield were higher with 75% Soil Test Based Nitrogen + 25% vermicompost + *Azospirillum* @ 5 kg ha^{-1} which was significantly superior to the rest of the treatments except 100% STBN + *Azospirillum* @ 5 kg ha^{-1}.

Keywords: *STBN and Azospirillum, Vermicompost.*

Pearl millet (*Pennisetum glaucum* [L.] R.Br.) is the most important coarse grain crop native to Africa, belongs to the gramineae (poaceae) family and is mostly grown in arid and semi-arid regions. In India, area under pearl millet is about 7.12 million hectares and its production is 8.07 million tonnes with an average productivity of 1132 kg ha^{-1}. In Andhra Pradesh pearl millet is grown in about 0.042 million hectares with a production of 0.072 million tonnes and average productivity of 1718 kg ha^{-1}. However, average yield of pearl millet is low when compared to its potential yield as it is mostly grown on marginal lands. Therefore, productivity has to be improved by adopting better agronomic practices. However, long term applications of inorganic fertilizers have caused environmental problems, degraded soil physico-chemical and biological properties thereby lead to poor crop. Therefore, only chemical fertilizers application may not sustain the soil fertility.

Combined use of chemical fertilizers along with organic manures has been proved promising not only in maintaining high productivity but also ensuring stability to crop production. In an attempt to safe guard the environment, maintaining soil fertility with sustainable crop yields, integrated nutrient management has been found promising not only in sustaining the productivity but also preserving soil microbial load thereby stabilizing the crop production (Jakhar *et al*., 2018).

Farm yard manure is popularly known as store house of plant nutrient,s improves soil moisture retention and helps to supply nutrients. Vermicompost is a rich combination of macro and micro nutrients. It also improves availability of nitrogen, phosphorous, improves microbial action and enhances the chemical properties of the soil. *Azospirillum* is free living bacteria that can fix 20 kg N ha^{-1} approximately. Keeping all these points in view an experiment was conducted to evaluate integrated nitrogen management practices on growth and yield of pearl millet.

Table 1. Growth parameters at different intervals in pearl millet as influenced by organic and inorganic sources of nitrogen

Treatments	Plant height (cm)			Number of tillers m^{-2}			Drymatter accumulation (kg ha^{-1})		
	30 DAS	60 DAS	Maturity	30 DAS	60 DAS	Maturity	30 DAS	60 DAS	Maturity
T_1: 100% STBN	94.57	177.42	185.67	24.83	29.3	23.5	831	3597	7344
T_2: 75% STBN + 25% FYM	90.73	176.1	183.27	24.73	28.97	23.47	823	3558	7475
T_3: 75% STBN + 25% vermicompost	93.5	179.19	189.95	25.47	29.37	23.87	863	3671	7649
T_4: 75% STBN + 25% FYM + *Azospirillum* @ 5 kg ha^{-1}	92.13	188.21	198.1	26.17	29.9	24.46	887	3863	7992
T_5: 75% STBN + 25% vermicompost + *Azospirillum* @ 5 kg ha^{-1}	96.43	195.82	208.57	29.25	33.09	28.76	1022	4506	9130
T_6: 50% STBN + 50% FYM + *Azospirillum* @ 5 kg ha^{-1}	87.5	162.69	171.33	22.67	24.46	20.1	732	2928	6574
T_7: 50% STBN + 50% vermicompost + *Azospirillum* @ 5 kg ha^{-1}	91.03	174.77	182.33	24.2	27.67	22.91	813	3393	7287
T_8: 100% STBN + *Azospirillum* @ 5 kg ha^{-1}	95.24	193.96	200.33	27.4	30.2	26.97	954	4289	8631
S.Em ±	2.45	5.24	6.07	0.91	1.03	1.15	47.32	154.23	242.66
CD (P = 0.05)	NS	15.89	18.41	2.77	3.11	3.5	143.54	467.8	736.06
CV (%)	4.59	5.06	5.58	6.16	6.13	8.37	9.62	7.33	5.5

MATERIALS AND METHODS

The present research was carried out at Agricultural College Farm, Agricultural College, Bapatla during *kharif,* 2019. The experiment was laid out in randomized block design with eight treatments each replicated thrice. The treatments consisted of *viz.*, T_1: 100% STBN (Soil Test Based nitrogen), T_2: 75% STBN + 25% FYM, T_3: 75% STBN + 25% vermicompost, T_4: 75% STBN + 25% FYM + *Azospirillum* @ 5 kg ha^{-1}, T_5: 75% STBN + 25% vermicompost + *Azospirillum* @ 5 kg ha^{-1}, T_6: 50% STBN + 50% FYM + *Azospirillum* @ 5 kg ha^{-1}, T_7: 50% STBN + 50% vermicompost + *Azospirillum* @ 5 kg ha^{-1} and T_8: 100% STBN + *Azospirillum* @ 5 kg ha^{-1}. The soil of the experimental site was neutral in reaction, sandy in texture with 0.30 % organic carbon, 172 kg ha^{-1} of N, 29.2 kg ha^{-1} of P_2O_5 and 235 kg ha^{-1} of K_2O. The pearl millet hybrid (Rana) was sown on 14th August 2019. Thinning and gap filling were done after 10 DAS. Fertilizers were applied as per the treatments. Soil test based nitrogen @ 75 kg ha^{-1} was applied as per the treatments in 2 equal splits *i.e.*, ½ at basal and remaining ½ was top dressed at 40 days after sowing. As initial soil N status was low, additional 15 kg N (25%) apart from recommended dose of nitrogen (60 kg) was added. Entire dose of 40 kg P_2O_5 ha^{-1} in the form of single super phosphate and 25 kg K_2O ha^{-1} in the form of muriate of potash were uniformly applied basally to all the plots.

Observations on plant height, number of tillers m^{-2} and drymatter accumulation (kg ha^{-1}) were recorded from five randomly selected plants from each plot. Subsequently the grain yield (kg ha^{-1}) and stover yield (kg ha^{-1}) were estimated after harvest.

All the data recorded in the study were subjected to statistical analysis using Fisher's method of analysis of variance as outlined by Fisher (1950) for the design adopted in this study. Statistical significance was tested by applying F-test at 0.05 level of probability.

RESULTS AND DISCUSSION

Growth parameters

Growth parameters such as plant height, number of tillers m^{-2} and drymatter production were significantly influenced by organic and inorganic sources of nitrogen. Among all the treatments tested, the plant height at 30 DAS was not significantly influenced whereas at 60 DAS and maturity was influenced significantly by the nitrogen treatments. Application of 75% STBN through urea and 25% N through vermicompost along with *Azospirillum* @ 5 kg ha^{-1} recorded significantly highest plant height (195.82 cm and 208.57 cm) at 60 DAS and at maturity and the treatments T_8 and T_4 (100% STBN + *Azospirillum* @ 5 kg ha^{-1} and 75% STBN + 25% N FYM + *Azospirillum* @ 5 kg ha^{-1}) remained on par. Increased plant height observed could be due to improvement in crop growth due to better nutritional environment in the root zone as organic manure improves the physiochemical and biological properties of the soil and supply all essential macro and micronutrients for growth of the plant. The results of present investigation were in conformity with those of Yadav *et al.* (2019) and Hussain *et al.* (2017).

Number of tillers m^{-2} have increased from 30 DAS to 60 DAS and then decreased gradually. Maximum no. of tillers m^{-2} (29.25, 33.09 and 28.76) was recorded with the application of 75 % STBN through urea and 25% N through vermicompost along with *Azospirillum* @ 5 kg ha^{-1} (T_5) which was significantly superior to the other treatments except T_8 (100% STBN + *Azospirillum* @ 5 kg ha^{-1}). This may be attributed due to increased availability of essential nutrients. In addition to that growth promoting hormones were also released and increased the shoot growth. Positive responses to integrated

Table 2. Grain yield (kg ha^{-1}), stover yield (kg ha^{-1}) and harvest index (%) of pearl millet as influenced by organic and inorganic soures of nitrogen

Treatments	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Harvest Index (%)
T_1: 100% STBN	2403	4491	34.73
T_2: 75% STBN + 25% FYM	2399	4476	34.79
T_3: 75% STBN + 25% vermicompost	2419	4804	33.52
T_4: 75% STBN + 25% FYM + *Azospirillum* @ 5 kg ha^{-1}	2527	4998	33.56
T_5: 75% STBN + 25% vermicompost + *Azospirillum* @ 5 kg ha^{-1}	2955	5867	34.81
T_6: 50% STBN + 50% FYM + *Azospirillum* @ 5 kg ha^{-1}	2182	4241	34.05
T_7: 50% STBN + 50% vermicompost + *Azospirillum* @ 5 kg ha^{-1}	2277	4322	33.81
T_8: 100% STBN + *Azospirillum* @ 5 kg ha^{-1}	2691	5590	32.5
S.Em ±	115.04	239.62	1.48
CD (P = 0.05)	348.32	726.8	NS
CV (%)	8.13	8.75	7.52

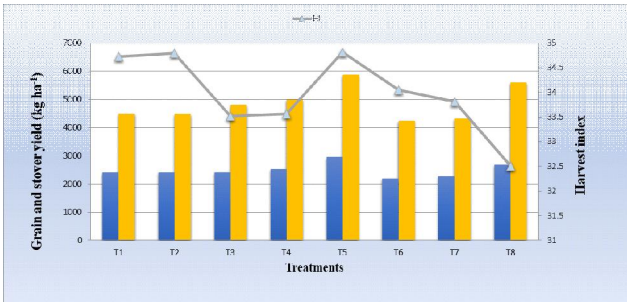

Fig. 1. Grain, Stover yield (kg ha^{-1}) and harvest index (%) of pearl millet as influenced by organic and inorganic sources of nitrogen.

nitrogen management have also been reported by Samruthi *et al*. (2019) and Togas *et al*. (2017).

Significantly higher drymatter accumulation (1022, 4506 and 9130 kg ha^{-1}) was recorded at 30, 60 DAS and at maturity respectively with T_5 treatment (75% STBN + 25% vermicompost + *Azospirillum* @ 5 kg ha^{-1}) and the T_8 treatment have maintained parity with T_5. Higher production of drymatter might be due to supply of all essential plant nutrients and relatively high amounts of micronutrients to the plants, helping in higher uptake of nutrients, accelerating the growth of new tissues and development of new shoots that have ultimately increased drymater accumulation and also due to biofertilizer component (*Azospirillum*) in the treatment which may have synergistic and additive effect on drymatter accumulation. These reports are in agreement with the findings of Narolia *et al*. (2009) and Bana *et al*. (2012).

The grain yield and stover yield of pearl millet were significantly influenced by the different treatments applied. Among all the treatments observed, significantly highest grain yield (2955 kg ha^{-1}) and stover yield (5867 kg ha^{-1}) was observed with the application of 75% STBN through urea and 25% N through vermicompost along with *Azospirillum* @ 5 kg ha^{-1} and it was closely followed by treatment which received 100% STBN along with *Azospirillum* @ 5 kg ha^{-1} and both treatments were at par with each other. Lowest grain (2182 kg ha^{-1}) and stover yield (4241 kg ha^{-1}) was recorded with the application of 50% STBN through urea and 50% N through FYM along with *Azospirillum* @ 5 kg ha^{-1}. Harvest index was not significantly altered by different treatments.

The improvement in yield may be due to the increased yield attributes like earheads m^{-2}, earhead weight, ear head length and test weight coupled with the higher crop drymatter observed with these treatments due to increased availability of nitrogen to plant through inorganic nitrogen source initially and then by organic manures during the later stages of crop which corresponds to the need of crop throughout the growing season by slow mineralization of nutrients. Corroborative results have also been reported by Rathore *et al*. (2004), Chaudhari *et al*. (2016) and Shrivastava *et al*. (2017).

CONCLUSION

Based on the above results and discussions, it can be concluded that application of 75% STBN through urea and 25% N through vermicompost along with *Azospirillum* @ 5 kg ha^{-1} gave higher growth and yield of pearl millet.

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