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Full Length Research Article

Sustainable Agriculture through Integrated Soil Fertility Management in Soghum

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ABSTRACT

Field investigation was conducted at the experimental farm at Annamalai University, Annamalai Nagar to study the influence of integrated Nutrient management practices on the growth and yield of sorghum during summer 2009. The experiments were laid out in randomized block design with ten treatments with replicated thrice. The results shows that application of 100 per cent recommended dose of NPK fertilizers with vermicompost @ 5 t ha^{-1} and soil application of *Azospirillum* @ 2kg ha^{-1} followed by 75 percent recommended dose of NPK fertilizers along with vermicompost @ 5 t ha^{-1} + soil application of *Azospirillum* @ 2kg ha^{-1}. It also recorded the highest grain yield of 2352.00 kg ha-4 and the highest return per rupee invested of 2.31 in 2013. The uptake of N,P and K was also the highest with the above treatment combination. The least yield and uptake of nutrients by crop was noticed under 75 per cent recommended crop was noticed under 75 percent recommended dose of NPK fertilizers in 2013.

Key words: Uptake, Gross income, Sorghum and Soil fertility economics.

INTRODUCTION

Sorghum is one of the main stable crop for the world's poorest and most food insecure people. The crop is genetically suited to hot and dry ecologies where it is difficult to grow other food grains, sorghum is truly a dual purpose crop, where both grain and Stover are highly valued outputs. Sorghum is mainly cultivated for food feed, feeder and more recently for bio-fuel and sugar production. It is being considered as the second largest grain crop till the green revolution in India and presently occupies third place among the food in terms of average and production (Anonymous 2010). Sorghum is one among the give major levels of the world being grown ion tropical and subtropical environments. In world being grown in tropical and subtropical environments. In world, sorghum is cultivated over an area of 44 million hectare with a production of 69 million tonnes with an average productivity of 1463 kg ha^{-1}. In India. Sorghum ranks third in area with production of 7.98 mt and productivity of 850 kg ha^{-1}. However, the area under sorghum is declinig every year (from 18 mha in 1960 to 105 m ha in 2004) in all parts of India. This is mainly due to the lack of decline in used of sorghum. In India, Maharashtra is the largest sorghum producer and consumer with a production of 5.8 million tonnes followed by Karnataka, Madhya Pradesh and Andhra pradesh. Use of organic manures alone as a substitute to inorganic fertilizer is not profitable and wild not be enough to maintain the present levels of crop productivity of high yielding varieties. Application of organic manures along with inorganic fertilizers into soil increases the productivity of the system and also sustained the soil health for a longer period (Gawai and Pawar, 2007). Integrated nutrient management includes the integrated use of organic, inorganic and biological sources so as to sustain crop yield and maintain the soil physical and chemical properties and provide crop nutrition which are economically feasible and environmentally safe (Tondon, 1992).

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MATERIALS AND METHODS

A field experiment was conducted to find out the efficient INM practices in Sorghum during 2009 at experimental farm at Annamalai University, Annamalai Nagar. The soil of the experimental site was clay loam having a pH of 5.9 with available nitrogen of 229 kg ha^{-1}. Phosphorus 24 kg ha^{-1} and potassium 214 kg ha^{-1}. The soil having low organic carbon content of 0.34 percent with an electrical conductivity of 0.23 limhoscm-41. The experiments was conducted during 2013. The Sorghum variety Co5 was chosen for the study. The experiment was conducted adopting randomized block design with three replications. The treatment details are as follows: T_1 – 100 percent of recommended dose (90:45:45 kg NPK ha^{-1}), T_2 – 75 percent of recommended dose (67.5:34:34 kg NPK ha^{-1}), T_3 – 100 percent of recommended dose + enriched farm yard manure @ 750 kg ha^{-1}, T_4 – 75 percent of recommended dose + EFYM @ 750 kg ha^{-1}, T_5 – 100 percent of recommended dose + vermicompost @ 5 t ha^{-1}, T_6 – 75 percent of recommended dose + vermicompost @ 5 t ha^{-1}, T_7 - 100 percent of recommended dose + EFYM @ 750kg ha^{-1} + Soil application with *Azospirillum* @ 2 kg ha^{-1}, T_8 – 75 percent of recommended dose + EFYM @ 750kg ha^{-1} + Soil application with *Azospirillum* @ 2 kg ha^{-1}, T_9 – 100 percent of recommended dose NPK fertilizer + Vermicompost @ 5 t ha^{-1} + Soil application with *Azospirillum* @ 2kg ha^{-1}, T_{10} – 75 percent of recommended dose +Vermicompost @ 5 t ha^{-1} + Soil application with *Azospirillum* @ 2 kg ha^{-1}. Farmyard manure, Biofertilizers, vermicompost were applied as organic sources of nutrients. Organic manures were applied into specified plots as per the treatment schedule before fifteen days of sowing.

Gross plot size of 4.2 ×3.6m and net plot size was 3.0 × 1.8 m was maintained. The individual plot were marked as per the layout and made links at 45 cm apart before sowing of sorghum crop sowing was done by dibbling the seeds @ 2 seeds hill $^{-1}$ to a depth of cm in lined adopting a spacing of 45 × 15 cm between rows subsequent irrigations were given at 7 to 10 days interval.

Table 1. Performance of Sorghum as influenced by INM Practices

Treatments	Plant height (cm)	LAI	DMP (Kg ha^{-1})	No. of grains ear head^{-1}	Test weight (g)	Grain Yield (t ha^{-1})
T_1	264.29	5.39	16543.36	987.21	32.69	528.29
T_2	259.37	5.18	16041.69	984.19	30.87	359.36
T_3	274.12	6.01	18021.34	988.26	35.34	1243.18
T_4	267.59	5.59	17029.47	982.15	33.59	801.109
T_5	282.63	6.56	19496.68	989.29	37.72	1905.28
T_6	280.59	6.38	19009.24	993.07	36.91	1682.39
T_7	277.29	6.21	18514.69	990.18	36.15	1463.23
T_8	270.68	5.79	17489.41	989.21	34.42	1026.13
T_9	290.28	6.96	20436.29	996.65	38.43	2349.17
T_{10}	286.24	6.72	19986.32	994.84	38.59	2129.69
S.Ed	1.56	0.11	245.28	0.47	0.42	112.18
CD (p = 0.05)	3.28	0.22	493.29	0.95	0.84	224.36

Hand housing and weeding were done on 45th day after sowing pre-emergence application of atrazine @ 0.2 kg a.i kg ha^{-1} as pre – emergence herbicide was applied in third day after sowing using knapsack sprayer fitted with a flood jet nozzle.

RESULTS AND DISCUSSION

Grown Components: Among the different treatments, the highest plant height was observed under T_9 (100 percent of recommended dose NPK fertilizers with vermicompost @ 5t ha^{-1} and combine with soil application of *Azospirillum* @ 2 kg ha^{-1} at all stages of crop growth. This treatment was found to be significantly superior over other treatments by recording the highest plant height of 79.48, 179.55 and 284.26 cm during 2013. It was followed by the treatments T_{10} (75 percent of recommended dose of NPK fertilizers + vermicompost @ 5 tha^{-1} + soil application with *Azospirillum* @ 2 kg ha^{-1}). The least plant height was recorded with T_2 (75 percent recommended dose of NPK fertilizers) during 30 DAS and 60 DAS and harvest are presented in Table 1. The data recorded on dry mater production at 60 DAS are presented in Table 1. Production of Vigorous plant due to synergistic and cumulative effect of vermicompost and *Azosprillum* could be the reason for better performance of sorghum in terms of plant height, dry matter production and lead area index. All the growth parameters viz., plant height leaf area index increased at higher level of NPK.

This might have influenced the total dry matter production favorably as the result of higher uptake. This finding is in conformity with results of satab *et al* (1997) who obtained maximum dry matter and production of sorghum with application of higher level of NPK. The fertilizer treatments generally enhances the plant height number of leaves, leaf area index and dry matter accumulation. These results are in accordance with the findings of guled *et al*., (2003). Vermicompost were reported to possess biological factors, particularly gibberellins, cytokinin and auxins which play an important role in rooting and plant development that also facilitates easy availability of plant nutrients to crops. These results are convoluted with the reports of Thirumurugan 2003. *Azospirillum* increased the plant height number of leaves, leaf area, etc., This could be due to fixing atmospheric nitrogen by *Azospirillum* and the effect of growth promoting substances and polysaccharides from *Azospirillum*. This results are in accordance with the findings of Bandyopadhyaya *et al*., 2004.

Yield components: Among the treatments 100 per cent recommended dose of NPK fertilizers + Vermicompost @ 5 t ha^{-1} + soil application with *Azospirillum* @ 2 kg ha^{-1} recorded the highest yield components viz., number of ear head m-2, number of grains ear head $^{-1}$ and thousand grain weight. This could be due to synergistic and cumulative effect of the interaction of vermicompost and biofertilizer which might have exerted a marked influence on the yield components of sorghum. The increased leaf number, leaf are index, better nutrient uptake and translocation of photosynthesis with recommended dose of fertilizers might have improved the yield components like number of ear head m^{-2}, number of grains and mustard grain weight. Those results are in correlated with the reports of Banik and Bejbarunah 2004. The increase in photosynthesis rates nutrient uptake, and consequently seed filling percentage might have influenced the test weight. Higher thousand grain weight was obtained with the application of 90:45:45 kg NPK ha^{-1}. This clearly indicates that application of 90:45:45 kg NPK^{-1} is sufficient for providing the metabolites for better grain formation in sorghum. These results are accordance with the findings of Bhande *et al* 2002. Application of vermicompost increased the yield components viz., number of ear head m^{-2}, No. of grains ear head^{-1}, and 1000 grain weight, which might have increased the yield. These results are broadly in line with the findings of Banik and Bejbaruah (2004). Application of *Azospirillum* might have resulted in increased availability of nitrogen fixation and also increased nitrogenase content in plants. Better root development and nutrient availability are reported to facilitate better flowering and consequently increased sink capacity. These results are in correlated with the reports of Jadhao *et al* 2002 and Mahi *et al* 2002.

Yield: The grain were the highest in 100 per cent recommended dose of NPK fertilizers + Vermicompost @ 5 t ha^{-1} + soil application of *Azospirillum* @ 2 kg ha^{-1}. The increased yield was mainly due to yield attributing characters. The yield attributes have contributed to increased yield potential of the crop as reflected by the higher grain yield. These findings are in consonance with the reports of Jaishankar and wahab 2005.

The improved plant growth, significant translocation and storage of photosynthesis from source to sink might have resulted in higher grain yield. The highest level of N and P resulted in the significant increase in yield. The results are in conformity with the findings of Ramamoorthy 1996. The increased grain yield was attributable to higher plant height, dry matter production and leaf area index recorded with recommended dose of fertilizer. The results are in confirming with the finding of Jamwal 2006. Vermicompost contains macro and micro nutrients which might have influenced the grain yield. These findings are in agreement with the khadtare *et al*., 2006. In respect of *Azospirillum* inoculated treatments, a well development root system compiled with increased availability of nutrients could have promoted greater uptake of nutrients resulting in higher grain yield (Pathak and mali 2001).

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