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EVALUATION OF BIOFERTILIZERS FOR PHOSPHORUS ECONOMY IN SWEET CORN (*Zea mays* L.)

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ABSTRACT

A field experiment was carried out during *kharif*, 2018 on sandy clay loam soils of dryland farm of S. V. Agricultural College, Tirupati, Acharya, N. G. Ranga Agricultural University. The experiment was laidout in randomized block design with ten phosphorus management practices and replicated thrice. Dry matter production and yield was significantly influenced by the different phosphorus management practices. Application of 100 per cent recommended dose of phosphorus along with Arbuscular mycorrhizae (AM) @ 12.5 kg ha^{-1} and Phosphate Solubilizing Bacteria (PSB) @ 5 kg ha^{-1} recorded significantly higher dry matter production, green cob (14033 kg ha^{-1}) and green fodder yield (17950 kg ha^{-1}) in sweet corn. However, 75 per cent RDP + AM @ 12.5 kg ha^{-1} + PSB @ 5 kg ha^{-1} has given a remarkable green cob (13400 kg ha^{-1}) and green fodder yield (17210 kg ha^{-1}).

KEY WORDS: Arbuscular mycorrhizae, biofertilizers, phosphate solubilizing bacteria

INTRODUCTION

Maize an important food and feed crop of the world, which is often referred to as 'Queen of cereals and miracle crop'. Being an exhaustive crop, it depletes approximately 24.3 kg N, 6.4 kg P and 18.3 kg K to produce one tonne of grain and its productivity, largely, depends on nutrient management system. Under the present trend of exploitive agriculture in India, inherent soil fertility can no longer be maintained on sustainable basis. Increasing awareness is being created on the use of organics including biofertilizers, which are the source of macro, secondary and micronutrients to sustain the soil fertility and productivity. Phosphatic fertilizers are becoming costlier day by day and added to this recovery of phosphatic fertilizers is only 20-25 per cent due to fixation of phosphates in soil. Thus, the microbial inoculants are becoming more popular in India as these are inexpensive and easy to use with no side effects. Usage of phosphorus fertilizers along with biofertilizers *i.e.* either phosphate solubilizer / mobiliser may find a solution to reduce the quantity of phosphatic fertilizer, which could be a more sustainable way of phosphorus management, by reducing chemical fixation and solubulizing the insoluble form of phosphorus.

MATERIALS AND METHODS

A field experiment was conducted at S.V. Agricultural College Farm, Tirupati campus of Acharya N. G. Ranga Agricultural University during *kharif,* 2018. Total rainfall received during the crop growth period was 260.2 mm in 19 rainy days. The soil of the experimental field was sandy clay loam in texture, with neutral pH (6.6), low in organic carbon (0.43 per cent) and available N (206.3 kg ha^{-1}), high in available phosphorus (60.0 kg ha^{-1}) and medium in available potassium (258 kg ha^{-1}).

The field experiment was laid out in Randomized Block Design (RBD) with ten treatments and three replications.

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The treatments consisted of 100, 75 and 50 per cent recommended dose of phophorus alone and in combintaion with Arbuscular Mycorrhizae (AM) and Phosphate Solubilizing Bacteria (PSB) (Table 1).

The recommended dose of fertilizer was 180-60-50 kg N, P_2O_5 and K_2O ha^{-1}. Phosphorus was applied as per the treatments while nitrogen and potassium was applied uniformly to all the treatments as [er the package of practices of Acharya N G Ranga Agricultural University. Phosphate solubilizing bacteria (PSB) @ 5 kg ha^{-1} and Arbuscular Mycorrhizae (AM) @ 12.5 kg ha^{-1} were applied along with FYM at the time of sowing. The crop was sown on 13.7.2018 with Sugar-75 (Syngenta) as test variety and crop was harvested on 3rd October, 2018.

RESULTS AND DISCUSSION

Dry matter production

Dry matter production of sweet corn showed an increasing trend with the advancement of the crop (Table 1). At all the stages of observation application of 100 per cent RDP + AM @ 12.5 kg ha^{-1} + PSB @ 5 kg ha^{-1} resulted in maximum dry matter, which was in turn on par with that of 100 per cent RDP + PSB @ 5 kg ha^{-1} (T_3) at 20 and 40 DAS. Continuous steady release of phosphorus through both inorganics and biofertilizers might have resulted in enhancing the carbohydrate metabolism and formation of starch and cellulose resulting in production of more dry matter. These findings are in agreement with Hashim *et al*. (2015).The next best treatment in recording highest dry matter accrual was 100 per cent RDP + AM @ 12.5 kg ha^{-1}. The increase in total dry matter accumulation with increase in phosphorus probably may be due to phosphorus being the component of ATP might have contributed to a higherphotosynthetic rate, abundant vegetative growth and assimilates formation and partitioning (Amanullah and Khalid, 2015).

Green cob yield

Conspicuous differences in green cob yield and green fodder yield of sweet corn was noticed due to different phosphorus management practices (Table 2). The highest green cob yield of sweet corn was with 100 per cent RDP + AM @ 12.5 kg ha^{-1} + PSB @ 5 kg ha^{-1} closely followed by 100 per cent RDP + PSB @ 5 kg ha^{-1}, which were at par and significantly superior to 50 per cent RDP + PSB @ 5 kg ha^{-1} and 50 per cent RDP + AM @ 12.5 kg ha^{-1} + PSB @ 5 kg ha^{-1} . Higher green cob yield might be attributed due to better growth parameters like plant height, leaf area index and dry matter production and yield attributing characters like number of kernels cob^{-1}, number of cobs plant^{-1} and cob weight. This is in accordance with the results reported by Jaliya *et al*. (2008).

Significantly higher green cob yield in treatments including AM and PSB could be attributed to build up of population of phosphate solubilising and mobilizing microorganisms in rhizosphere due to soil inoculation which increased the availability of phosphorus to plant through solubilization effect and translocation of nutrient through network of hyphae in soil absorbing P from non rhizospheric zone and transport to plant roots (Hilda and Fraga, 1999).

Green fodder yield

Among the different phosphorus management practices, higher green fodder yield of sweet corn was recorded with 100 per cent RDP + AM @ 12.5 kg ha^{-1} + PSB @ 5 kg ha^{-1} . Next best treatment was 100 per cent RDP + PSB @ 5 kg ha^{-1}. This might be due to relative higher level of phosphorus, probably increased mobility, absorption and translocation of nutrients leading to increased production of photosynthates by the crop resulting in increased biomass accumulation. Combined application of 100 per cent RDP and biofertilizers enhanced the green fodder yield. This might be due to synergistic effect of AM and PSB which influenced SSP solubility and stimulated maize roots to absorb nutrients from soil and thus accelerated the photosynthetic rate, adequate biomass production that reflected on green fodder yield. The present results were in close conformity with the findings of Minaxi *et al*. (2013).

Evaluation of biofertilizers for phosphorus economy in sweetcorn *(Zea mays* L.)

Table 1. Dry matter production (kg ha^{-1}) of sweet corn as influenced by different Phosphorus management practices

Phophorus management practices	Dry matter production			
	20 DAS	40 DAS	60 DAS	At harvest
100 per cent recommended dose of P_2O_5 (RDP)	333	3734	7477	10888
100 per cent RDP + Arbuscular Mycorrhizae (AM) @ 12.5 kg ha^{-1}	343	3970	7758	11094
100 per cent RDP + Phosphate solubilizing bacteria (PSB) @ 5 kg ha^{-1}	357	4054	7846	11216
100 per cent RDP + AM @ 12.5 kg ha^{-1} + PSB @ 5 kg ha^{-1}	380	4299	8182	11610
75 per cent RDP + AM @ 12.5 kg ha^{-1}	312	3636	7268	10652
75 per cent RDP + PSB @ 5 kg ha^{-1}	326	3705	7362	10713
75 per cent RDP + AM @ 12.5 kg ha^{-1} + PSB @ 5 kg ha^{-1}	342	3926	7552	10903
50 per cent RDP + AM @ 12.5 kg ha^{-1}	275	3029	6706	10016
50 per cent RDP + PSB @ 5 kg ha^{-1}	287	3189	6852	10159
50 per cent RDP + AM @ 12.5 kg ha^{-1} + PSB @ 5 kg ha^{-1}	300	3364	7165	10294
SEm±	9.4	106.5	219.6	310.9
CD (P = 0.05)	28	316	652	923

able 2. Green cob yield and green fodder yield (kg ha^{-1}) of sweet corn as influenced by different phosphorus management practices

Phophorus management practices	Green cob yield (kg ha^{-1})	Green fodder yield (kg ha^{-1})
100 per cent recommended dose of P_2O_5 (RDP)	13110	17143
100 per cent RDP + Arbuscular Mycorrhizae (AM) @ 12.5 kg ha^{-1}	13567	17266
100 per cent RDP + Phosphate solubilizing bacteria (PSB) @ 5 kg ha^{-1}	13603	17550
100 per cent RDP + AM @ 12.5 kg ha^{-1} + PSB @ 5 kg ha^{-1}	14033	17950
75 per cent RDP + AM @ 12.5 kg ha^{-1}	12967	16866
75 per cent RDP + PSB @ 5 kg ha^{-1}	12907	17086
75 per cent RDP + AM @ 12.5 kg ha^{-1} + PSB @ 5 kg ha^{-1}	13400	17210
50 per cent RDP + AM @ 12.5 kg ha^{-1}	11997	15896
50 per cent RDP + PSB @ 5 kg ha^{-1}	12107	16066
50 per cent RDP + AM @ 12.5 kg ha^{-1} + PSB @ 5 kg ha^{-1}	12183	16233
SEm±	389.6	392.7
CD (P = 0.05)	1157	1167

CONCLUSION

In conclusion, the present study indicated that combined application of 100 per cent RDP + AM @ 12.5 kg ha^{-1} + PSB @ 5 kg ha^{-1} to sweet corn is the most efficient integrated phosphorus management practice for better growth and yield. 75 per cent RDP with AM @ 12.5 kg ha^{-1} and PSB @ 5 kg ha^{-1} was found to be economically feasible and ecologically sustainable practice over 100 per cent RDP. Hence, application of 75 per cent recommended dose of phosphorus in combination with biofertilizers was best for enhancing crop productivity and economic returns by reducing the inorganic phosphorus requirement up to 25 per cent in sweet corn in scarce raifall zone and southern agroclimatic zone of Andhra Pradesh.

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