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# OPTIMISATION THE ORGANIC, INORGANIC AND BIOFERTILISER NEEDS FOR SUSTAINED PRODUCTIVITY OF MAIZE (*Zea mays* L.)

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**ABSTRACT**

A field experiment was conducted during *kharif* season of 2017-18 on sandy loam soils of S.V. Agricultural College Wetland Fam, Tirupati to optimise the organic, inorganic and biofertilizer needs for sustained productivity of maize (*Zea mays* L.). Seven treatments comprising all possible combinations of chemical fertilizer, organic manure (vermicompost, FYM) with and without biofertilizer (*Azospirillum* and PSB) were laid out in randomized block design with three replications. Application of 100 per cent RDF ($T_1$) (180-60-50 kg N, $P_2O_5$ and $K_2O$ ha$^{-1}$) produced significantly higher yield attributes and kernel (5207 kg ha$^{-1}$) and stover yield (6751 kg ha$^{-1}$). The next best treatment was 50 per cent RDF + Vermicompost @ 1t ha$^{-1}$ + *Azospirillum* @ 5 kg ha$^{-1}$+ PSB @ 5 kg ha$^{-1}$ ($T_7$) with kernel (4683 kg ha$^{-1}$) and stover yield (6394 kg ha$^{-1}$) which was in turn comparable with 50 per cent RDF + FYM@ 5 t ha$^{-1}$ + *Azospirillum* @ 5 kg ha$^{-1}$+ PSB @ 5 kg ha$^{-1}$ ($T_6$).

**KEY WORDS:** Biofertilizers, yield attributes, yield, maize

## INTRODUCTION

Maize an important food and feed crop of the world and often referred to as "Queen of cereals. It has special significance as a staple food of the tribal areas, which provides nutritional security due to its high nutritional profile. On account of its quick growth habits, maize is a highly nutrient exhaustive crop. The demand of maize plant for nitrogen and phosphorus is more than any other essential element for the development of crop. It is absolutely necessary that essential nutrient elements should be supplied in appropriate proportion to maintain soil fertility and to get higher yield.

Maize being a heavy feeder, the productivity largely dependents on nutrient management to express its full potential. Under the present trend of exploitive agriculture in India, inherent soil fertility can no longer be maintained on sustainable basis as the capacity of the soil to supply plant nutrient is steadily declining under intensive cropping systems. Organic manures particularly FYM and vermicompost, not only supply macronutrients but also meet the requirement of micronutrients, besides improving soil health (Kannan *et al.*, 2013) and biofertilizers play an important role for supplementing the essential plant nutrients for sustainable agriculture (Hashim *et al.,* 2016). Integrated nutrient management is an option that utilizes all the available organic and inorganic sources to build an ecologically sound and economically viable farming system.

## MATERIAL AND METHODS

A field experiment was conducted at S.V. Agricultural College Wetland Farm, Tirupati during *kharif ,* 2017. Total rainfall received during the crop growth period was 833.6 mm with 42 rainy days. The soil of the experimental field was sandy loam in texture, slightly alkaline in soil reaction (pH 7.9), low in organic carbon

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(0.25 per cent) and available N (125 kg $ha^{-1}$) and medium in available phosphorus (11.7 kg $ha^{-1}$) and available potassium (223.3 kg $ha^{-1}$).

The experiment was laid out in Randomized Block Design (RBD) with seven treatments and replicated thrice. The treatment details are furnished below

**$T_1$:** 100 per cent recommended dose of fertiliser

(RDF =180-60-50 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$)

**$T_2$:** FYM @ 10 t $ha^{-1}$ + *Azospirillum* @ 5 kg $ha^{-1}$ + PSB @ 5 kg $ha^{-1}$

**$T_3$:** Vermicompost @ 2 t $ha^{-1}$ + *Azospirillum* @ 5 kg $ha^{-1}$ + PSB @ 5 kg $ha^{-1}$

**$T_4$:** 50 per cent RDF + FYM @ 5 t $ha^{-1}$

**$T_5$:** 50 per cent RDF + Vermicompost @ 1 t $ha^{-1}$

**$T_6$:** 50 per cent RDF + FYM @ 5 t $ha^{-1}$ + *Azospirillum* @ 5 kg $ha^{-1}$ + PSB

@ 5 kg $ha^{1}$

**$T_7$:** 50 per cent RDF + Vermicompost @ 1 t $ha^{-1}$ + *Azospirillum* @ 5 kg $ha^{-1}$ + PSB

@ 5 kg $ha^{-1}$

Farm yard manure and vermicompost were incorporated in marked plots as per treatments and its composition on dry weight basis was 0.51 per cent N, 0.25 per cent $P_2O_5$, 0.52 per cent $K_2O$ for FYM and 1.7 per cent N, 1.1 per cent $P_2O_5$, 1.0 per cent $K_2O$. Full dose of phosphorus (60 kg $ha^{-1}$) and potassium (50 kg $ha^{-1}$) in the form of single super phosphate (SSP) and muriate of potash (MOP) was applied as basal dose at the time of sowing. Nitrogen (180 kg $ha^{-1}$) in the form of urea was applied as per the treatments in three splits *viz.,* 1/3$^{rd}$ as basal, 1/3$^{rd}$ at knee height stage and the remaining 1/3$^{rd}$ at tasseling stage through band placement. The crop was harvested on 28 october in 2017.

## RESULTS AND DISCUSSION

### Yield attributes

The length and girth of the cob was significantly influenced by different nutrient management practices (Table 1). Application of 100 per cent recommended dose of nutrients through fertilizers ($T_1$) produced the higher cob length and girth, which was significantly superior to 100 per cent organic and integrated treatments. The next best treatments were 50 per cent RDF + Vermicompost @ 1t $ha^{-1}$ + *Azospirillum* @ 5 kg $ha^{-1}$ + PSB @ 5 kg $ha^{-1}$ ($T_7$) which was on par with $T_6$ (50 per cent RDF + FYM@ 5 t $ha^{-1}$ + *Azospirillum*@ 5 kg $ha^{-1}$ + PSB @ 5 kg $ha^{-1}$) and these two treatments were significantly superior to rest of the treatments. In general treatments with 100 per cent organics ($T_3$, $T_2$) recorded lower cob length and girth than the treatments received combined application of organics, inorganics and biofertlizers. These results were in close conformity with Athokpam *et al.* (2017) Nagaral *et al.* (2017) and Meena *et al.* (2013).

Highest cob weight was recorded with $T_1$ (100 per cent recommended dose of nutrients through fertilizers) which was significantly superior to rest of the treatments (Table 1), which might be due to a rapid and a large assimilate supply to the sink. Combined application of FYM and Vermicompost each at 50 per cent level recorded significantly higher cob weight than with 100 per cent organics (T2 and T3).

The maximum number of kernel rows cob $^{-1}$, kernels $row^{-1}$, kernel weight $cob^{-1}$, test weight was recorded with $T_1$ (100 per cent RDF). The next best treatment was $T_7$ (50 per cent RDF + Vermicompost @ 1t $ha^{-1}$ + *Azospirillum* @ 5 kg $ha^{-1}$ + PSB @ 5 kg $ha^{-1}$) which was found to be comparable with $T_6$ (50 per cent RDF + FYM@ 5 t $ha^{-1}$ + *Azospirillum*@ 5 kg $ha^{-1}$ + PSB @ 5 kg $ha^{-1}$). Lowest performance was observed with FYM @ 10 t $ha^{-1}$ + *Azospirillum* @ 5 kg $ha^{-1}$ + PSB @ 5 kg $ha^{-1}$ ($T_2$). Integrated nutrient supply through biofertlizers with vermicompost / FYM with RDF had continuous and favourable effect on yield attributes. These result are in conformity with Umesha *et al*. (2014) and Beigzade *et al.,* (2013).

## Yield

Adequate nutrient management in maize either with inorganic sources or their combined use with organics significantly enhanced kernel and stover yield. Application of 100 per cent NPK through inorganic sources of fertilizer significantly improved the maize yield ($T_1$) than with 100 per cent organic and integrated nutrient management practices (Table 2). The next best treatment was $T_7$ (50 per cent RDF + Vermicompost @ 1t $ha^{-1}$ + *Azospirillum* @ 5 kg $ha^{-1}$ + PSB @ 5 kg $ha^{-1}$) which was on par with $T_6$ (50 per cent RDF + FYM@ 5 t $ha^{-1}$ + *Azospirillum* @ 5 kg $ha^{-1}$ + PSB @ 5 kg $ha^{-1}$).

Integration of *Azospirillum* and PSB along with FYM, vermicompost and RDF produced remarkable yield compared to sole application of organics. Therefore, substitution of 50 per cent inorganic fertilizers with vermicompost / FYM in combination with bio fertilizer had given the kernel yield which was comparable to 100 per cent RDF. These results are in confirmation with the findings of Shah and Wani (2017).

Integration of biofertilizer in $T_7$ (50 per cent RDF + vermicompost @ 1t $ha^{-1}$ + *Azospirillum* @ 5 kg $ha^{-1}$ + PSB @ 5 kg $ha^{-1}$ ) and $T_6$ (50 per cent RDF + FYM@ 5 t $ha^{-1}$ + *Azospirillum* @ 5 kg $ha^{-1}$ + PSB @ 5 kg $ha^{-1}$) resulted in 19 and 23 per cent higher yield compared to $T_4$ (50 per cent RDF + FYM@ 5 t $ha^{-1}$) and $T_5$ (50 per cent RDF + Vermicompost @ 1t $ha^{-1}$) which did not include biofertilizer. These results are in accordance with the findings of Beigzade *et al*. (2013) Hashim *et al.* (2015) and Rasool *et al.* (2015).

## CONCLUSION

In the present study, higher yields coupled with higher monetary returns were obtained with application of 100 per cent RDF, but integration of different sources of nutrients from inorganic, organic and bio fertilizer sources not only improved the total crop productivity but also maintained and sustained soil health. Hence, adoption of a balanced nutrient management approach will safeguard the higher crop productivity and economic returns. Continuous adoption of combined use of fertilizers and organics is expected to match and even excel the sole fertilizer based production strategy.

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**Table 1. Yield attributes of maize as influenced by integrated nutrient management practices**

| Treatments | Cob length (cm) | Cob girth (cm) | Number of kernel rows $cob^{-1}$ | Number of kernels $row^{-1}$ | Cob weight (g) | Kernel weight $Cob^{-1}$ (g) | Test weight (g) |
|---|---|---|---|---|---|---|---|
| $T_1$ : 100 per cent RDF (180 - 60 -50 kg N, $P_2O_5$, and $K_2O$ $ha^{-1}$) | 17.7 | 16.8 | 12.9 | 24.4 | 225 | 70.1 | 24.5 |
| $T_2$ : FYM @ 10t $ha^{-1}$ + *Azospirillum* @ 5 $kgha^{-1}$+ PSB @ 5 kg $ha^{-1}$ | 11.9 | 11.5 | 10.2 | 20.1 | 178 | 41.9 | 20.6 |
| $T_3$ : Vermicompost @ 2t $ha^{-1}$ + *Azospirillum* @ 5 kg $ha^{-1}$ + PSB @ 5 kg $ha^{-1}$ | 12.5 | 12.1 | 10.3 | 20.5 | 180 | 42.4 | 20.8 |
| $T_4$ : 50 per cent RDF + FYM @ 5 t $ha^{-1}$ | 13.9 | 13.3 | 11 | 21.4 | 192 | 52.1 | 22.3 |
| $T_5$ : 50 per cent RDF + Vermicompost @ 1t $ha^{-1}$ | 14.2 | 13.5 | 11 | 21.7 | 196 | 52.4 | 22.6 |
| $T_6$ : 50 per cent RDF + FYM@ 5 t $ha^{-1}$ + *Azospirillum* @ 5 kg $ha^{-1}$+ PSB @ 5 kg $ha^{-1}$ | 15.7 | 15.0 | 11.9 | 22.9 | 210 | 63.8 | 23.7 |
| $T_7$ : 50per cent RDF + Vermicompost @ 1t $ha^{-1}$ + *Azospirillum* @ 5 kg $ha^{-1}$+ PSB @ 5 kg $ha^{-1}$ | 16.1 | 15.2 | 12 | 23.6 | 213 | 65.6 | 24.1 |
| SEm± | 0.42 | 0.33 | 0.21 | 0.23 | 3.3 | 1.38 | 0.07 |
| CD (P=0.05) | 1.3 | 1.01 | 0.65 | 0.71 | 10.1 | 4.3 | 0.20 |

**Table 2. Kernel yield, stover yield (kg ha$^{-1}$) and harvest index of maize as influenced by integrated nutrient management practices**

| Treatments | Kernel yield (kg ha$^{-1}$) | Stover yield (kg ha$^{-1}$) | Harvest index (per cent) |
|---|---|---|---|
| $T_1$ : 100 per cent RDF (180 - 60 -50 kg N, $P_2O_5$, and $K_2O$ ha$^{-1}$ ) | 5207 | 6751 | 43.54 |
| $T_2$ : FYM @ 10t ha$^{-1}$ + *Azospirillum*@ 5 kg ha$^{-1}$+ PSB @ 5 kg ha$^{-1}$ | 2059 | 4937 | 29.43 |
| $T_3$ : Vermicompost @ 2t ha$^{-1}$ + *Azospirillum*@ 5 kg ha$^{-1}$+ PSB @ 5 kg ha$^{-1}$ | 2352 | 4950 | 32.18 |
| $T_4$ : 50 per cent RDF + FYM @ 5 t ha$^{-1}$ | 3660 | 5790 | 38.73 |
| $T_5$ : 50 per cent RDF + Vermicompost @ 1t ha$^{-1}$ | 3949 | 5815 | 40.46 |
| $T_6$ : 50 per cent RDF + FYM@ 5 t ha$^{-1}$ + *Azospirillum* @ 5 kg ha$^{-1}$+ PSB @ 5 kg ha$^{-1}$ | 4534 | 6206 | 42.21 |
| $T_7$ : 50 per cent RDF + Vermicompost @ 1t ha$^{-1}$ + *Azospirillum* @ 5 kg ha$^{-1}$+ PSB @ 5 kg ha$^{-1}$ | 4683 | 6394 | 42.27 |
| SEm± | 88 | 114 | 0.61 |
| CD (P=0.05) | 271 | 317 | 1.87 |