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# EFFECT OF RECOMMENDED DOSE OF FERTILIZER WITH ZINC SULPHATE FERTILIZATION ON YIELD OF MAIZE AND AVAILABLE NUTRIENT STATUS OF SANDY LOAM SOIL

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## Abstract

A field experiment was conducted to evaluate the effect of recommended dose of fertilizer with zinc sulphate fertilization on yield of maize in sandy loam soil of vanniyarpalayam village belongs to vadalapakkam series (*Typic Rhodustalf*), low in organic carbon, low in alkaline $KMnO_4$ – N (182 kg $ha^{-1}$), low in Bray - P (9.3 kg $ha^{-1}$) and medium in $NH_4OAc$ - K (235 kg $ha^{-1}$). Field experiment was conducted with six treatments *viz.*, $T_1$ - 50% RDF, $T_2$ - 100% RDF, $T_3$ - 150% RDF, $T_4$ - 150% RDF + $ZnSO_4$ @ 25 kg $ha^{-1}$, $T_5$ - 150% RDF + $ZnSO_4$ @ 25 kg $ha^{-1}$ + Neem cake @ 200 kg $ha^{-1}$, $T_6$ - 150% RDF + $ZnSO_4$ @ 25 kg $ha^{-1}$ + *Azotobacter* @ 2 kg $ha^{-1}$, $T_7$ - 150% RDF + $ZnSO_4$ @ 25 kg $ha^{-1}$ + Neem cake @ 200 kg $ha^{-1}$ + *Azotobacter* @ 2 kg $ha^{-1}$. The experiment was carried out in Randomized Block Design (RBD) with four replications and tested with maize var. Dhanvi - 166 as test crop. The results of the study indicated that the application of 150 % recommended dose of fertilizer, zinc sulphate @ 25 kg $ha^{-1}$ and neem cake @ 200 kg $ha^{-1}$ along with *azotobacter* @ 2 kg $ha^{-1}$ was significantly superior in increasing the grain yield (7620.48 kg $ha^{-1}$) of maize and available nutrient status in soil and application of 50% recommended dose fertilizer registered lowest growth and yield of maize. Among the treatments, *azotobacter* @ 2kg $ha^{-1}$, neem cake @ 200kg $ha^{-1}$ and zinc sulphate 25 kg $ha^{-1}$ along with 150% recommended dose of fertilizer registered maximum available nitrogen, phosphorous, potassium and zinc of 247.26, 22.31, 282.62 kg $ha^{-1}$ and 2.52 mg $kg^{-1}$ at 30 DAS, 232.82, 18.5, 240.36 kg $ha^{-1}$ and 2.15 mg $kg^{-1}$ at 60 DAS, 201.92 ,15.30, 226.3 kg $ha^{-1}$ 2 and 1.63 mg $kg^{-1}$ at harvest stages respectively.

***Key words:*** Nitrogen, Phosphorus, Potassium, Zinc sulphate, Neem cake, *Azotobacter* and Maize.

## Introduction

Maize is the third most important cereal next to rice and wheat, in the world as well as in India. It is a versatile crop and can be grown in diverse environmental conditions and has multiple uses. In India, area and production of maize is about 9.19 million ha and 24.17 million tonnes, respectively with productivity of about 2632 kg $ha^{-1}$ during the year 2014-15 (Anonymous, 2016). In Tamil Nadu, maize is cultivated in an area of 0.20 million hectares with a production of 0.24 million tonnes and productivity of 1189 kg $ha^{-1}$ (crop report, 2017). The fertilizers have played a prominent role in increasing the productivity of crops in the country, the use of chemical fertilizers would remain the main stay of agricultural production in future too. However, continuous and imbalanced use of fertilizers caused deterioration of soil health and crop productivity that is not commensurable to consumption of fertilizers. On the other hand, organic manures improved soil physical, chemical and biological properties and thus resulting in enhanced crop productivity along with maintaining soil health. Although, the organic manures contain plant nutrients in small quantities as compared to the chemical fertilizers, presence of growth hormones and enzymes, besides plant nutrients make them essential for improving soil fertility, productivity and health (Bhuma, 2001). Response to applied zinc for better growth and yield of several important field crops has been reported from many countries (Shivay *et al.,* 2008). Neem is used as manure for improving the soil fertility and thus promoting plant growth. Neem manure is gaining popularity because it is environmental friendly and also the compounds found in it help to increase the nitrogen and phosphorous content in soil. It is rich in sulphur,

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potassium, calcium, nitrogen etc. It can be used directly by mixing with soil or can be blended with urea and other organic manures like farmyard manure and sea weeds for best results. It has many benefits like bio-degradability and eco-friendly, nourishes the soil and plants by providing all the macro and micro-nutrients. Helps in eliminating bacteria responsible for denitrification. Increases the yield of crops, helps to reduce the usage of fertilizers thus reducing the cost of cultivation. (Subbalakshmi *et al.,* 2012). Application of inorganic fertilizers along with biofertilizer significantly increased maize yield (Abou El-Magd *et al.,* 2006).

## Materials and Methods

A field experiment was conducted to study the effect of recommended dose of fertilizer with zinc sulphate fertilization on yield of maize and available nutrient status in sandy loam soil. The initial soil of the experimental site had a pH–6.0 and EC-0.40 $dSm^{-1}$. The soil was low in available N (182 kg $ha^{-1}$), P (9.3 kg $ha^{-1}$) and medium in available K (235 kg $ha^{-1}$) respectively. The low status of DTPA-Zn is 1.05 mg $kg^{-1}$. The treatment imposed *viz.*, $T_1$- 50% RDF, $T_2$- 100% RDF, $T_3$ - 150% RDF, $T_4$- 150% RDF + $ZnSO_4$ @ 25 kg $ha^{-1}$, $T_5$- 150% RDF + $ZnSO_4$ @ 25 kg $ha^{-1}$ + Neem cake @ 200 kg $ha^{-1}$, $T_6$- 150% RDF + $ZnSO_4$ @ 25 kg $ha^{-1}$ + *Azotobacter* @ 2 kg $ha^{-1}$, $T_7$- 150% RDF + $ZnSO_4$ @ 25 kg $ha^{-1}$ + Neem cake @ 200 kg $ha^{-1}$ + *Azotobacter* @ 2 kg $ha^{-1}$. The experiment was laid out in Randomized Block Design (RBD) with four replications using maize var. Dhanvi-166 as test crop. A fertilizer dose of 135: 62.5: 50 kg of N, P and K per hectare for maize was applied as urea, single super phosphate and muriate of potash, respectively. Entire N, $P_2O_5$ and $K_2O$ were applied as basal. A required quantity of zinc sulphate @ 25 kg $ha^{-1}$ was also applied as basal as per the treatment schedule. Composted neem cake @ 200 kg $ha^{-1}$ were applied basally and well incorporated in to the soil as per the treatment schedule. The biofertilizer namely *Azotobacter* @ 2 kg $ha^{-1}$ was applied to all the experimental plots. The yield and yield attributes *viz.*, cob weight, cob length, cob girth, grain yield and Stover yield were recorded and nutrient status of soil was at 30, 60 DAS and harvest stage.

## Result and Discussion

### Available nutrient status

The available N, P, K and Zn in the soil were significantly influenced by various treatments. The highest available nutrients of nitrogen (247.26, 232.82 and 201.92), phosphorus (22.3, 18.5 and 15.30), potassium (282.62, 240.36 and 226.32) and zinc (2.42, 2.15 and 1.63) at the time of 30, 60 DAS and harvest stage of maize were obtained from the treatment with 150% recommended dose of fertilizer, zinc sulphate @ 25 kg $ha^{-1}$, neem cake @ 200 kg $ha^{-1}$ along with *azotobacter* @ 2 kg $ha^{-1}$ followed by treatment with 150 % recommended dose of fertilizer, zinc sulphate @ 25 kg $ha^{-1}$ plus neem cake @ 200 kg $ha^{-1}$ recorded available nutrients of nitrogen (240.62, 223.05 and 195.81), phosphorus (21.17, 16.58 and 14.222), potassium (275.76, 265.23 and 222.48) and zinc (2.28, 2.08 and 1.58). The various levels (50 %, 100% and 150%) of recommended dose fertilizer alone treatments gave the lower values of growth attributes than the other combined application treatments Table 1. Application of different levels of recommended dose of fertilizer, neem cake, *azotobacter* and micro nutrient increased the soil physical properties as well as to enhance the microbial activities increase the soil nutrient status. The higher nutrient status could be due to addition of different forms of neem cake to soil which increases the nutrient availability to crop and also due to its decomposition rate and duration of decomposition. These results are in accordance with the findings of Laxminarayana, (2006) observed that application of RDF in combination with neem cake significantly improved the organic carbon, available N, P and K content of soil as well as its residual fertility. Different levels of recommended dose of fertilizer, zinc

**Table 1:** Effect of macro and micro nutrient fertilizers with organic sources of nutrients on available nutrient status in soil

| Treatments | Nitrogen (kg $ha^{-1}$) | | | Phosphorus (kg $ha^{-1}$) | | | Potassium (kg $ha^{-1}$) | | | Zinc (g $ha^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30 DAS | 60 DAS | Harvest stage | 30 DAS | 60 DAS | Harvest stage | 30 DAS | 60 DAS | Harvest stage | 30 DAS | 60 DAS | Harvest stage |
| $T_1$ | 190.45 | 156.94 | 126.58 | 7.36 | 4.07 | 4.00 | 230.54 | 197.25 | 180.52 | 1.08 | 1.02 | 0.87 |
| $T_2$ | 200.48 | 168.95 | 140.56 | 10.54 | 6.02 | 5.78 | 239.72 | 203.71 | 186.49 | 1.34 | 1.29 | 1.10 |
| $T_3$ | 212.13 | 181.42 | 154.25 | 13.81 | 9.27 | 8.26 | 248.73 | 212.62 | 201.63 | 1.69 | 1.55 | 1.24 |
| $T_4$ | 223.84 | 196.74 | 170.42 | 16.97 | 11.87 | 10.98 | 258.64 | 220.96 | 212.64 | 1.93 | 1.77 | 1.39 |
| $T_5$ | 240.62 | 223.05 | 195.81 | 21.17 | 16.58 | 14.22 | 275.76 | 265.23 | 222.48 | 2.28 | 2.08 | 1.58 |
| $T_6$ | 229.71 | 207.36 | 180.48 | 18.30 | 13.77 | 12.20 | 265.61 | 225.86 | 215.84 | 2.03 | 1.89 | 1.45 |
| $T_7$ | 247.26 | 232.82 | 201.92 | 22.3 | 18.5 | 15.30 | 282.62 | 240.36 | 226.32 | 2.42 | 2.15 | 1.63 |
| SEd | 4.15 | 5.11 | 5.85 | 1.19 | 0.87 | 0.59 | 3.56 | 2.55 | 2.08 | 0.08 | 0.05 | 0.04 |
| CD (p=0.050) | 9.15 | 11.26 | 12.88 | 2.63 | 1.95 | 1.31 | 7.84 | 5.62 | 4.58 | 0.18 | 0.13 | 0.09 |

**Table 2:** Effect of macro and micro nutrient fertilizers with organic sources of nutrients of maize on cob weight cob$^{-1}$(g), cob length (cm), cob girth (cm), grain yield (kg) and stover yield (kg).

| Treatments | Cob weight (g) | Cob length (cm) | Cob girth (cm) | Grain yield | Stover yield |
|---|---|---|---|---|---|
| $T_1$ | 150.03 | 16.35 | 7.14 | 5578.64 | 6526.48 |
| $T_2$ | 161.40 | 17.98 | 7.60 | 6048 .22 | 6986.00 |
| $T_3$ | 175.10 | 20.46 | 8.84 | 6487.84 | 7464.63 |
| $T_4$ | 190.92 | 21.13 | 11.26 | 6809.42 | 7902.74 |
| $T_5$ | 211.60 | 25.35 | 13.46 | 7442.15 | 8651.66 |
| $T_6$ | 200.10 | 21.57 | 11.60 | 7018.44 | 8192.35 |
| $T_7$ | 212.5 | 25.51 | 13.74 | 7620.48 | 8951.91 |
| SEd | 5.08 | 0.23 | 0.16 | 134.34 | 178.38 |
| CD (p=0.050) | 11.18 | 0.51 | 0.36 | 295.55 | 392.45 |

and neem cake in the experiment gave the highest available nitrogen, phosphorus, potassium and zinc was recorded respectively in the treatment that was significantly higher than compared to other treatment combination to the best for the improvement soil chemical properties due to integrated nutrient management Yusuf *et al.,* (2011) and Singh *et al.,* (2017).

**Yield and yield attributes**

The yield attributes such as cob weight, cob length, cob girth, number of Grains per cob, hundred seed weight, grain and Stover yield were significantly influenced by various treatments. The maximum cob weight (212.5 g), longest cob (25.51 cm) and maximum cob girth (13.74 cm) were obtained from the treatment with150 % recommended dose of fertilizer, zinc sulphate @ 25 kg ha$^{-1}$, neem cake @ 200 kg ha$^{-1}$ along with *azotobacter* @ 2 kg ha$^{-1}$ followed by the treatment with 150 % recommended dose of fertilizer, zinc sulphate 25 kg ha$^{-1}$ plus neem cake @ 200 kg ha$^{-1}$ (211.60 g), (25.35 cm) and (13.46 cm). The different levels (50 %, 100% and 150%) of recommended dose fertilizer alone treatments gave the lower values of yield attributes than the other combination treatments Table 2. Significantly higher grain and Stover yields (7620.48 and 8951.91 kg ha$^{-1}$) were recorded with the application of 150 % recommended dose of fertilizer, zinc sulphate @ 25 kg ha$^{-1}$, neem cake @ 200 kg ha$^{-1}$ along with *azotobacter* @ 2 kg ha$^{-1}$. The application of 150 % recommended dose of fertilizer, zinc sulphate @ 25 kg ha$^{-1}$ along with neem cake @ 200 kg ha$^{-1}$ resulted in the next highest grain and Stover yields (7442.15 and 8651.66 kg ha$^{-1}$) respectively. The increased in grain yield of maize might be due to the highest growth attributes in maize and enhanced level of nutrients applied to the crop. The different levels (50%, 100% and 150%) of recommended dose fertilizer alone treatments recorded the lower grain and Stover yield than the other combination treatment Table 2. Grain yield in maize showed positive relationship with increase in potash levels statistically higher value of yield attributes with cob length cob girth, single cob weight and biological yield in maize. The results are in agreement with the Amanullah *et al.,* (2016) and Rakesh *et al.,* (2017). Significantly higher values of most of the above mentioned parameters were recorded under application of *azotobacter* combination treatment. Inoculation of *azotobacter* increased the biomass (straw yield) production which may have favorably contributed for the grain weight. Hence the grain weight registered was higher in the *azotobacter*. This could be owing to better growth of plant in terms of dry matter accumulation under inoculation of *azotobacter*. The present results are in accordance with those reported by Meena *et al.,* (2011), Soleimanzadeh and Gooshchi (2013), Jadav *et al.,* (2018). Neem seed cake, as a form of organic manure on decomposition, promotes an increase in soil microbial communities and this in turn will affect the growth and yield of crops. The combined use of neem seed cake, that is a form of organic manure, and a inorganic fertilizer will increase nutrient use efficiency and reduce environmental stress by Shivakumar *et al.,* (2011) and Verma *et al.,* (2018).

## Conclusion

The results of the study showed that for increased yield and yield attributes of maize and available nutrient status in sandy loam soil, application of 150% recommended dose of fertilizer, zinc sulphate @ 25 kg ha$^{-1}$, neem cake @ 200 kg ha$^{-1}$ along with *azotobacter* @ 2 kg ha$^{-1}$ was identified as best treatment combination to recommend to the farmer's of cuddalore district to realize the maximum net profit in maize yield.

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