Indian J. Applied & Pure Bio. Vol. 38(1), 107-113 (2023). **ISSN: 0970-2091**
A web of Science Journal

Effect of IPNSS on growth and yield of hybrid maize

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Abstract

A field experiment entitled "Integrated plant nutrient supply system (IPNSS) for sustaining yield of hybrid maize" variety, Kaveri super - 244 was carried out under field conditions of sandy clay loam soil during *kharif* season at farmer's field, Kalappanaickenpatti village, Sendamangalam block, Namakkal district of Tamil Nadu during July - October 2021. The experiment was laid out in randomized block design with three replication and ten treatments. Growth parameters and yield of maize *viz.,* plant height, leaf area index, dry matter production, grain yield and stover yield was significantly responded better in all treatments at 30, 60 DAS and harvest days after sowing. Where, T_8 – 100 per cent RDF + CPM @ 3 t ha^{-1} + Micronutrient mixture (25 kg ha^{-1}) + Azophos (20 packets) depicted better peformance than other treatments.

Key words : Maize, *kharif*, IPNSS and composted poultry manure (CPM).

The maize (*Zea mays* L.) is one of the most versatile emerging crop with wider adaptability under varied agro-climatic conditions, extending from extreme semi-arid to sub-humid and humid regions of the world. It is the third most important cereal crop in India after rice and wheat which predominantly occupies 82 per cent of the area under cultivation in the *kharif* season.

Intensive cultivation has potentially degraded the resource base. Sustainability of production depends on the maintenance of the key resources, particularly soil. The use of agricultural chemicals for increasing food production is unavoidable in the current trend of agriculture where food security and livelihood issues of the people have attained national priority. The only way out to this gloomy scenario is to develop sustainability and nutrient balanced packages of technology and cropping system, which would increase the food production sustainably without cause any harm to our precious environment.

Maize is considered as most exhaustive crop after sugarcane and requires both micro and macro nutrients to obtain high growth and

yield potentials. In fact, organic nutrients not only provide plant with nutrients but also improve and or sustain the soil health. IPNSS is a judicious use of organic and inorganic sources of nutrient to crop fields for sustaining and maintaining soil productivity. However, the use of appropriate and conjunctive use of suitable nutrients through organic and inorganic solely or in combination can provide the solutions to the problems such as increase in the price of inorganic fertilizers and deterioration effect of soil fertility and productivity. Hence, judicious application of these combinations can sustain the soil fertility and productivity.[11]

A field experiment entitled "Integrated plant nutrient supply system for sustaining yield of hybrid maize" was conducted during *kharif* season at at farmer's field, Kalappanaickenpatti village, Sendamangalam block, Namakkal district of Tamil Nadu during July - October 2021.

The soil of experimental site was sandy clay loam with pH of 7.1, Electrical conductivity 0.38 dS m^{-1}, medium in organic carbon (0.57 per cent), low in available nitrogen (181 kg ha^{-1}) and medium in phosphorus (18.5 kg ha^{-1}) and medium in potassium (230 kg ha^{-1}).

The experiment was laid out in a randomized block design for maize during *kharif* 2021 with 10 treatments consisting of T_1 - Control (No application), T_2 - 100% Recommended Dose of Fertilizer (RDF), T_3 - 100% RDF + Vermicompost @ 3 t ha^{-1}, T_4 - 100% RDF + CPM @ 3 t ha^{-1}, T_5 - 100% RDF + Pressmud compost @ 3 t ha^{-1}, T_6 - 100% RDF + Farm yard manure @ 10 t ha^{-1}, T_7 - 100% RDF + Vermicompost @ 3 t ha^{-1} + Micronutrient mixture + Azophos, T_8 - 100% RDF + CPM @ 3 t ha^{-1} + Micronutrient mixture + Azophos, T_9 - 100% RDF + Pressmud compost @ 3 t ha^{-1} + Micronutrient mixture + Azophos, T_{10} - 100% RDF + Farm yard manure @ 10 t ha^{-1} + Micronutrient mixture + Azophos.

The hybrid maize Kaveri super - 244 was sown at spacing of 60 cm × 25 cm. Organic manures were applied as per the treatment and incorporated into the soil two weeks before sowing. The fertilizers were applied to the experimental field as per the recommended fertilizer schedule of 250:75:75 kg N, P_2O_5 and K_2O ha^{-1}. The nitrogen source was given in three splits in the form of urea, phosphorous as single super phosphate and potassium as muriate of potash. A half dose of N and full dose of P_2O_5 and K_2O were applied basally and the remaining half doses of N were applied as two splits on 25 and 45 days after sowing. In addition, as per the treatment schedule the 20 packets of Azophos were applied initially in the soil.

The weather at Kalappanaickenpatti village, Namakkal is moderately warm with hot summer months. Namakkal district comes under north western agro climatic zone and western agro climatic zone. The weekly maximum temperature mean is about 32.6 °C during the cropping year of 2021. The weekly minimum temperature mean is about 24.4 °C during the cropping year of 2021. The average relative humidity was 80 per cent during 2021.

Table-1. Effect of IPNSS on plant height (cm) at different growth stages of hybrid maize

Treatments	30 DAS	60 DAS	At harvest
T_1 - Control	28.11	98.41	139.16
T_2 - 100% RDF	38.94	106.09	146.14
T_3 - 100% RDF + Vermicompost @ 3 t ha^{-1}	50.44	124.55	163.81
T_4 - 100% RDF + CPM @ 3 t ha^{-1}	53.86	131.88	170.50
T_5 - 100%RDF + Pressmud compost @ 3 t ha^{-1}	48.59	121.10	160.26
T_6 - 100% RDF + FYM @ 10 t ha^{-1}	44.04	114.00	152.45
T_7 - 100%RDF + Vermicompost @ 3 t ha^{-1} + Micronutrient mixture + Azophos	62.92	149.31	189.07
T_8 - 100% RDF +CPM @ 3 t ha^{-1} + Micronutrient mixture +Azophos	66.14	155.42	196.93
T_9 - 100% RDF+ Pressmud compost @ 3 t ha^{-1} + Micronutrient mixture + Azophos	60.97	145.13	184.95
T_{10} - 100% RDF+ FYM @ 10 t ha^{-1} + Micronutrient mixture + Azophos	57.98	138.58	177.96
SEm±	0.93	1.83	2.34
CD (P=0.05)	2.79	5.46	7.02

Growth parameters :

The combined application of organic manures and biofertilizers along with inorganic fertilizer reflected desirable effect on crop growth because of its complementary and synergistic effects. The results of this study on integrated application of inorganic fertilizer, organic manure and biofertilizer on maize crop revealed that the growth characters were markedly influenced by the application of 100 per cent RDF + CPM @ 3 t ha^{-1} + Micronutrient mixture + Azophos (T_8).

Plant height :

During the study, there is a significant difference was observed with plant height due to different treatments at 30, 60 and harvest days after sowing (DAS) was recorded. The increased plant height of 66.14, 155.42 and 196.93 cm over control was observed in the field trial respectively.

The reports of Adekiya *et al.*,[1] are kept as an evidence for the application of poultry manure and inorganic fertilizers had a greater influence on plant height. This was due to application of poultry manure which increased the soil pH, organic matter, macro and micro nutrients. These nutrients were released into the soil over the decomposition of poultry manure which increased the plant height of maize. The increased plant height was also due to the application of poultry manure which contains high nitrogen content which was made available to the plants through mineralization to stimulate the plant growth and also increased

the uptake of primary nutrients and faster movement of photosynthates within the plant system. The research work supports by the findings of Vimera *et al.*[13]. The enhancement of shoot apical meristem was the reason behind the achievement of better height. It seemed that the application of poultry manure and biofertilizer enhanced the activities of apical meristem, which in turn led to an increase in plant height. This was in accordance with the finding of Kareem *et al.*[9]. (Table-1).

Leaf area index :

The application of 100 per cent RDF + CPM @ 3 t ha^{-1} + Micronutrient mixture + Azophos (T_8) significantly registered the highest leaf area index values of 3.81 and 7.75 respectively at 30 and 60 DAS.

The leaf area index was increased due to light interception and DMP to support plant growth and yield[3]. The leaves are important organs which have an active role in photo-synthesis. The application of 6 t ha^{-1} poultry manure + 100% RDF registered the highest leaf area index of 3.8 and 7.4 at 30 and 60 DAS respectively. This interaction excelled superiorly over other treatment combinations and control plots[12].

Aziz *et al.*,[2] found poultry manure enhanced the leaf area index (LAI). The increasing trend of LAI with integrated nutrient application can be attributed to the positive effect of nitrogen on both leaf development and leaf area duration of the crop[7]. (Table-2).

Table-2. Effect of IPNSS on leaf area index at different growth stages of hybrid maize

Treatments	30 DAS	60 DAS
T_1 - Control	1.71	5.04
T_2 - 100% RDF	1.95	5.49
T_3 - 100% RDF + Vermicompost @ 3 t ha^{-1}	2.69	6.32
T_4 - 100% RDF + CPM @ 3 t ha^{-1}	2.97	6.61
T_5 - 100%RDF + Pressmud compost @ 3 t ha^{-1}	2.55	6.19
T_6 - 100% RDF + FYM @ 10 t ha^{-1}	2.24	5.85
T_7 - 100%RDF + Vermicompost @ 3 t ha^{-1} + Micronutrient mixture + Azophos	3.60	7.44
T_8 - 100% RDF +CPM @ 3 t ha^{-1} + Micronutrient mixture +Azophos	3.81	7.75
T_9 - 100% RDF+ Pressmud compost @ 3 t ha^{-1} + Micronutrient mixture + Azophos	3.49	7.29
T_{10} - 100% RDF+ FYM @ 10 t ha^{-1} + Micronutrient mixture + Azophos	3.24	6.93
SEm±	0.046	0.09
CD (P=0.05)	0.14	0.28

Dry matter production :

Dry matter production increased with the fertilizer levels. The treatment (T_8) recorded the highest dry matter production of 3911.21, 7312.53 and 10733.25 kg ha^{-1} at 30 DAS, 60 DAS and at harvest respectively. The lowest dry matter production was recorded with the treatment (T_1) control.

The increase in DMP was the cumulative effect of increase in various growth characters such as, plant height, LAI, RGR and NAR. The drymatter accumulation is considered to be the reliable index of the crop growth[12].

Boateng *et al.*[4] reported that application of poultry manure associated with the increase of photosynthetic efficiency which promotes more vigorous growth, improved meristamatic and physiological activities in the plant , as well as improve the soil properties.

Ibeawuchi *et al.*[8] reported that 8 t ha^{-1} of poultry manure resulted in significantly higher dry matter of maize. The increase in DMP can be due to the synergistic effect of combination of both organic manures and inorganic fertilizer that enhanced nutrient release and availability improve the absorbtion of nitrogen and other macro and micro elements by the maize plant. (Table-3).

Table-3. Efeect of IPNSS on dry matter production (kg ha^{-1}) at different stages of hybrid maize

Treatments	30 DAS	60 DAS	At harvest
T_1 - Control	2673.42	5672.11	8480.19
T_2 - 100% RDF	2817.80	5879.40	9088.91
T_3 - 100% RDF + Vermicompost @ 3 t ha^{-1}	3209.90	6581.87	9602.78
T_4 - 100% RDF + CPM @ 3 t ha^{-1}	3400.21	6771.20	9832.89
T_5 - 100%RDF + Pressmud compost @ 3 t ha^{-1}	3138.50	6510.75	9459.77
T_6 - 100% RDF + FYM @ 10 t ha^{-1}	2948.10	6110.19	9269.37
T_7 - 100%RDF + Vermicompost @ 3 t ha^{-1} + Micronutrient mixture + Azophos	3761.11	7171.74	10524.14
T_8 - 100% RDF +CPM @ 3 t ha^{-1} + Micronutrient mixture +Azophos	3911.21	7312.53	10733.25
T_9 - 100% RDF+ Pressmud compost @ 3 t ha^{-1} + Micronutrient mixture + Azophos	3700.60	7091.28	10403.63
T_{10} - 100% RDF+ FYM @ 10 t ha^{-1} + Micronutrient mixture + Azophos	3560.48	6939.64	10123.22
SEm±	36.51	44.74	60.31
CD (P=0.05)	109.31	133.99	180.56

Grain yield and stover yield :

Among the various treatments imposed in the study of integrated application of 100 percent RDF+CPM @ 3 t ha^{-1} + Micronutrient mixture + Azophos (T_8) registered an increased grain yield and stover yield.

Chandrashekar *et al.*,[5] observed that the application of poultry manure @ 10 t ha^{-1} along with 150: 75: 37.5 kg N, P and K ha^{-1} (100% recommended dose of fertilizer) recorded significantly higher grain (50.8 q ha^{-1}) and fodder yields (74.4 q ha^{-1}) than application of vermicompost, FYM @ 2.5 t ha^{-1} each and RDF alone.

The increased grain yield of 7028 kg ha^{-1}, over control was observed in the field trial respectively. The research work supports by the findings of Dinka *et al.*,[6] and Naiji *et al.*,[10] that integrated nutrient application gave higher crop yield. The authors also reported that an integrated application of organic and inorganic fertilizer would build up soil productivity and quality on a long-term basis.

Stover yield was found to be highly significant among different treatments due to the effect of 100 per cent RDF + CPM @ 3 t ha^{-1} + Micronutrient mixture + Azophos (T_8). This significant result was obtained owing to continues release of essential micro and macro soil nutrients by the poultry manure throughout growing period in the field due to integration of organic sources as well as inorganic source which sustain and increase the crop productivity, the results are in line with the findings of Wailare and Kesarwani.,[14], (Table-4).

Table-4. Effect of IPNSS on grain yield and stover yield (kg ha^{-1}) of hybrid maize

Treatments	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})
T_1 - Control	2527	5610.00
T_2 - 100% RDF	4344	6969.87
T_3 - 100% RDF + Vermicompost @ 3 t ha^{-1}	5502	8156.32
T_4 - 100% RDF + CPM @ 3 t ha^{-1}	5912	8370.54
T_5 - 100%RDF + Pressmud compost @ 3 t ha^{-1}	5302	8060.89
T_6 - 100% RDF + FYM @ 10 t ha^{-1}	4824	7709.98
T_7 - 100%RDF + Vermicompost @ 3 t ha^{-1} + Micronutrient mixture + Azophos	6718	8952.05
T_8 - 100% RDF +CPM @ 3 t ha^{-1} + Micronutrient mixture +Azophos	7028	9202.21
T_9 - 100% RDF+ Pressmud compost @ 3 t ha^{-1} + Micronutrient mixture + Azophos	6577	8850.95
T_{10} - 100% RDF+ FYM @ 10 t ha^{-1} + Micronutrient mixture + Azophos	6203	8640.85
SEm±	74.86	58.85
CD (P=0.05)	224.13	176.19

From the above discussion we can conclude that application of 100 per cent RDF + CPM @ 3 t ha^{-1} + Micronutrient mixture 25 kg ha^{-1} + Azophos 20 packets (T_8) results higher in growth and yield can be achieved by appropriate combine application of organic and inorganic sources of nutrient application in maize. The results also proved that integrated use of nutrient sources have the improvement of soil fertility and crop productivity in the sustainable manners. The lowest growth parameters and yield was reported in the treatment (T_1).

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