Original Research Article

Studies on the response of hybrid Maize to IPNSS on productivity, nutrient uptake and post harvest soil status

Abstract

A field study was carried outat farmer's field, Kalappanaickenpatti village, Sendamangalam block, Namakkal district of Tamil Nadu during July - October 2021 to study the effect of Integrated plant nutrient supply system (IPNSS)for sustaining yield ofhybrid maize variety, KAVERI SUPER – 244 in clay loam soil. There are ten different treatments with three replications each were carried out in the plot RBD design. IPNSS practice including inorganic fertilizers, organic manures and biofertilizers in which treatment (T_8) 100 per cent RDF + CPM @ 3 t ha^{-1} + Micronutrient mixture (25 kg ha^{-1}) + Azophos (20 packets) showed its best results with respect tosoil properties and yield parameters like cob length, cob diameter, number of grain cob^{-1}, test weight and harvest index.

Keywords: Maize, IPNSSand composted poultry manure (CPM).

1. INTRODUCTION

Globally, Maize is the third most important food crop after rice and wheat. Maize is one of the most versatile crop and is grown in more than 166 countries across the world, includingtropical, subtropical and temperate regions.India produced30milliontonnesinanareaof9.9millionhectaresin2020-21. Maize is less water demanding andgives higher yield per hectare. By growing maize farmers can save 90 per cent of water, 70 per centofpowercompared to Paddy.

Inadditiontostaplefoodforhumanbeingandqualityfeedforanimals,maizeservesasabasic raw material to thousands of industrial products that includes starch, oil, protein, alcoholicbeverages,foodsweeteners,pharmaceutical,cosmetic,film,textile,gum,package,paperindustries*etc*.However, over application of inorganic fertilizers causes inefficient use, large losses and imbalances of nutrients. It also leads to environmental contamination in a number of areas in developed world.

Hence, it is important to reduce the usage of chemical fertilizers and supplementing the nutrient need same through organic manures such as CPM, FYM, pressmud compost, vermicompost and biofertilizers have become necessary to attain sustainable productivity, profitability and to maintain soil health.

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Furthermore, the fertilizer management is one of the most important factors that influence the growth and yield of maize crop. Maize is considered as most exhaustive crop after sugar cane 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. The micronutrients content in organic manure may be sufficient enough to meet the crop production requirement.

2. MATERIAL AND METHODS

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.

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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 wasgiven 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 ℃ during the cropping year of 2021. The weekly minimum temperature mean is about 24.4 ℃ during the cropping year of 2021. The average relative humidity was 80 per cent during 2021.

3. RESULTS AND DISCUSSION

3.1 YIELD PARAMETERS

The yield potential of maize is determined by the resultant values of yield components which are greatly influenced by the growth parameters. This is well reflected in the present investigation also. Almost all yield attributing characters *viz*., cob length, cob diameter, number of grains cob^{-1}, test weight and harvest index were remarkably influenced by the practice of integrated plant nutrient supply system.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 in yield parameters.

The number of grains cob^{-1} of maize obtained from plants that received poultry manure was because of more nutrients were released which mineralized rapidly for plant uptake and utilization. It could also be attributed to reduction in plant diseases or other soil-borne diseases which decrease yield, or to increased microbial activities which favour yield increases as reported by Olanikan, 2006 and Enujeke*et al.*, 2013. These reports are generally in harmony with the work and recommendations of Directorate of Information and Publications of Agriculture. (2006) and Fagimi and Odebode. (2007).The higher yield attributes under combined application of organics and inorganics was due to higher levels of inorganic fertilizer that have increased the activity of photosynthesis and enzymes which is responsible for transformation of energy, carbohydrates, fat metabolism and respiration of the plant. Number of grains cob^{-1} and test weight increased linearly with the application of poultry manure. Similar results are reported by SudhagarRao*et al.* (2017).

Table 1. Effect of IPNSS on cob length (cm), cob diameter (cm), number of grain cob-1, test weight (g) and harvest index of hybrid maize

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3.2 NUTRIENT UPTAKE AND POST HARVEST SOIL STATUS

It was quite clear from the data that the application of 100 percent RDF + CPM @ 3 t ha^{-1} + Micronutrient mixture + Azophos (T_8) recorded the maximum nitrogen, phosphorous and potassium in uptake by the plant and post harvest available soil nutrient status after harvest.

The uptake of phosphorus might be attributed to the reason of the positive effect of organic sources *viz.*, poultry manure and Azophos which chelates micronutrients (Ca and Mg)

Treatments	Cob length	Cob diameter	Number of grain cob^{-1}	Test weight	Harvest index
T_1 - Control	13.28	5.18	175.10	24.83	31.06
T_2 - 100% RDF	15.75	5.42	295.63	25.27	38.05
T_3 - 100% RDF + Vermicompost @ 3 t ha^{-1}	19.64	6.06	370.01	25.79	39.99
T_4 - 100% RDF +CPM @ 3 t ha^{-1}	20.47	6.28	410.24	25.91	41.39
T_5 -100%RDF+ Pressmud compost @ 3 t ha^{-1}	19.13	5.97	360.66	25.48	39.67
T_6 -100% RDF + FYM @ 10 t ha^{-1}	17.64	5.73	330.44	25.34	38.48
T_7- 100%RDF + Vermicompost @ 3 t ha^{-1} + Micronutrient mixture + Azophos	23.17	6.9	438.99	26.23	42.87
T_8 -100% RDF +CPM @ 3 t ha^{-1} + Micronutrient mixture +Azophos	24.29	7.20	454.11	26.34	43.30
T_9 -100% RDF+ Pressmud compost @ 3 t ha^{-1} + Micronutrient mixture + Azophos	22.72	6.78	431.48	26.15	42.63
T_{10}-100% RDF+ FYM@ 10 t ha^{-1} + Micronutrient mixture + Azophos	21.83	6.53	418.35	26.02	41.79
SEm±	0.18	0.06	3.90	0.005	0.12
CD (P=0.05)	0.55	0.16	11.93	NS	0.34

and preventing them from fixing phosphorus in insoluble compounds and thereby increased the phosphorus uptake.

The potassium uptake in all fertilizers and manurial treatments increased significantly over control plot. This might be due to more availability of the nutrient potassium from added fertilizers and to the solublizing action on potassium by organic acids produced during degradation of organic manures. Similar findings were quoted by Altaf*et al.* (2019).

The presence of nitrogen fertilizer and poultry manure helps the soil to maintain higher rate of applied urea intact or in the form of ammonium ions for a longer time, resulting in higher nitrogen uptake efficiency. The above results are in accordance with the earlier findings of Naiji*et al.* (2018).

Application of inorganic fertilizers and poultry manure increased the nutrient uptake over control or in combination improves the availability of major nutrients to the maize. This was due to the addition of organic manure which improved the soil properties, hence,

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enhancing nitrogen, phosphorus and potassium uptake. This result is in agreement with Vidyavathi*et al*. (2012).

Combined application of inorganic mineral fertilizer and poultry manure has significantly higher nitrogen, phosphorus and potassium uptake values of maize than the sole organic and inorganic fertilizers. A similar result was also documented by Quansah (2010).

The increased nitrogen content in this treatment could attribute to the addition of organic material *viz.*, poultry manure with balanced chemical fertilizers. These results are in close conformity with the findings of Sarangthem*et al*. (2011).

An increase in soil available phosphorus in poultry manure treatments may be due to mineralisation of organic phosphorus and production of organic acids that makes soil phosphorus more available and reduces phosphorus fixation. This result corroborates the findings of Islam *et al*. (2018), who explained that soils treated with either organic fertilisers or, inorganic fertilisers or combination of these fertilizers have higher values of available phosphorus will be obtained compared to the control treatments.

Table 2. Effect of IPNSS on nutrient uptake and Post harvest nutrient status of soil (kg ha^{-1}) of hybrid maize

Treatments	Nutrient uptake			Post harvest nutrient status of soil		
	N	P	K	N	P	K
T_1 - Control	99.80	23.70	101.70	156.40	15.90	210.15
T_2 - 100% RDF	122.47	29.96	125.63	164.66	17.66	215.50
T_3 - 100% RDF + Vermicompost @ 3 t ha^{-1}	157.03	41.45	145.03	170.94	19.65	224.33
T_4 - 100% RDF +CPM @ 3 t ha^{-1}	169.64	44.85	152.43	173.64	20.39	228.43
T_5 -100%RDF+ Pressmud compost @ 3 t ha^{-1}	151.63	40.13	141.23	170.14	19.36	223.52
T_6 -100% RDF + FYM @ 10 t ha^{-1}	137.47	34.73	134.33	166.99	18.50	219.31
T_7- 100%RDF + Vermicompost @ 3 t ha^{-1} + Micronutrient mixture + Azophos	198..99	54.47	171.40	180.21	21.84	237.14
T_8 -100% RDF +CPM @ 3 t ha^{-1} + Micronutrient mixture +Azophos	210.12	57.80	178.50	183.12	22.50	240.00
T_9 -100% RDF+ Pressmud compost @ 3 t ha^{-1} + Micronutrient mixture + Azophos	194.89	53.45	168.29	179.31	21.65	236.13
T_{10}-100% RDF+ FYM@ 10 t ha^{-1} + Micronutrient mixture + Azophos	182.67	49.35	160.63	176.30	20.98	233.04
SEm±	2.76	0.62	1.83	0.50	0.14	0.66
CD (P=0.05)	8.24	1.86	5.47	1.51	0.44	1.98

The increase in soil exchangeable potassium in combined application of inorganic and organic fertilizer treatments may be due to the direct supplementation of potassium to soil which increases the potassium pool in the soil. This result is supported by Islam *et al*. (2018) who reported that soil exchangeable potassium increased when organic or both organic and chemical fertilizers were applied. Ahmad *et al*. (2013) also reported that the highest soil OM, total nitrogen, available phosphorus and exchangeable potassium, after maize was harvested.

4. CONCLUSION

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Based on the results the integration of composted poultry manure, inorganic fertilizer and biofertilizer (T_8) 100% RDF + CPM @ 3 t ha^{-1} + Micronutrient mixture + Azophos improved all the yield parameters and soil properties. The combined uses of organic and inorganic source of nutrients have the improvement of crop yield parameters and soil physio-chemical properties. This kind of nutrients integration will produce the crop in sustainable manner. Whereas, the lowest values were recorded in the treatment (T_1) which is control.

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