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Effect of Graded Levels of Fertilisers with FYM on Yield and NPK Uptake by Hybrid Maize in *Vertic ustropept*

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A B S T R A C T

The field experiment was conducted to evaluate yield and N, P and K uptake for hybrid maize on Inceptisol. The soil of experimental field was sandy clay loam with alkaline pH and non-saline in nature. The soil was low in organic carbon and available N, medium in available P and high in available K. The available Zn, Cu, Fe, and Mn were in sufficient status. Among the STCR-IPNS treatments, the highest and significant grain and stover yield of 12,032 kg ha^{-1} and 13125 kg ha^{-1} respectively was recorded inSTCR-IPNS-200% of FD for 5 t ha^{-1} + FYM @ 12.5 t ha^{-1} (T10). The highest N, P and K uptake of 241.82 kg ha^{-1}, 33.57 kg ha^{-1} and 149.36 kg ha^{-1} was recorded in STCR-IPNS-200% of FD for 5 t ha^{-1} + FYM @ 12.5 t ha^{-1} (T10).

Introduction

Maize (*Zea mays* L.) is a dominant crop in the farming system belongs to family Poaceae and is an annual, determinate crop ranks third most important cereal crop after rice and wheat in India. Hybrids play a vital role in successful maize husbandry.

Among the various factors of crop production, improved hybrids play key role in boosting production of maize. Achieving high maize yield requires adequate and balanced supply of plant nutrients (Barbieri *et al.*, 2008) as declining soil fertility is a prominent constraint for maize production (Okoko and Makworo, 2012). So, that integrated use of organic manure and chemical fertilizers is beneficial in improving crop yield and uptake by maize hybrid.

Materials and Methods

The experiment was conducted during *Rabi* season in Allapalayam village, Annur block, Coimbatore District, Western Zone of Tamil Nadu, Southern India during in the year 2015 to 2016. The experimental soil was Periyanaickenpalayam soil series -*Vertic Ustropept*) (mixed black calcareous soil). The

Maize Hybrid TNAU CO 6 was sown in experimental plot having thirteen treatments with three replications. The experiment was laid out in Randmozied block design with the treatments are T_1-STCR-NPK alone- 100 % of FD for 5 t ha^{-1}, T_2-STCR-NPK alone- 125 % of FD for 5 t ha^{-1}, T_3-STCR-NPK alone- 150 % of FD for 5 t ha^{-1}, T_4-STCR-NPK alone- 175 % of FD for 5 t ha^{-1}, T_5-STCR-NPK alone- 200 % of FD for 5 t ha^{-1}, T_6-STCR-IPNS - 100 % of FD for 5 t ha^{-1}+ FYM @ 12.5 t ha^{-1}, T_7-STCR-IPNS - 125 % of FD for 5 t ha^{-1}+ FYM @ 12.5 t ha^{-1}, T_8-STCR-IPNS - 150 % of FD for 5 t ha^{-1}+ FYM @ 12.5 t ha^{-1}, T_9 -STCR-IPNS - 175 % of FD for 5 t ha^{-1}+ FYM @ 12.5 t ha^{-1}, T_{10}-STCR-IPNS - 200 % of FD for 5 t ha^{-1}+ FYM @ 12.5 t ha^{-1}, T_{11}-FYM @ 6.25 t ha^{-1} alone, T_{12}-FYM @ 12.5 t ha^{-1} alone, T_{13}-Absolute control.

Uptake of nutrients (N, P and K) was calculated by multiplying the dry matter production (kg ha^{-1}) with the corresponding nutrient content of the plant parts at harvest stage. The sum of nutrient uptake of straw and grain was expressed as the total nutrients uptake (kg ha^{-1}) at harvest stage of the crop.

Results and Discussion

Grain and stover yield

Maize yield with complementary alliance of inorganic and organic manures and with sole inorganic fertilizer treatment in the present study is comparable with the organic fertiliser because nutrients are readily released from the inorganic fertilizer and maize, being an exhaustive crop, is able to utilize it for its growth and yield. The purpose of all cultural operations is to manipulate these parameters there by to attain maximum yield. The highest mean grain weight (12032 Kg ha^{-1}) (Table 1) was recorded in the plot treated 200% STCR NPK recommended feriliser dose along with 5 t ha^{-1} of FYM. Among the treatments, STCR-IPNS – 200% FD for 5 t ha^{-1} + FYM @ 12.5 t ha^{-1} (T10) recorded significantly higher grain yield followed by STCR-IPNS – 175% FD for 5 t ha^{-1} + FYM @ 12.5 t ha^{-1} (T9). Similar results were also recorded by Sanjivkumar (2014); Endris and David (2015). An increase in the grain yield with FYM and vermicompost application along with NPK fertilizers may be due to the fact that added FYM and vermicompost served as store house of several macro and micro-nutrients which are released during the process of mineralization Shilpa shree *et al.,* (2012). Application of organic manures either alone or integrated with chemical amendments for maize, performed better than all amendments tested in laboratory trails studied by Mujeeb *et al.,* (2010). Recommendation of organic matter alone with synthetic fertilizers could be helpful for enhancing stagnant wheat grain yield was reported by Tahir *et al.,* (2011). The lowest (5313 Kg ha^{-1}) was recorded in absolute control plot.

The highest and significant stover yield of 13125 kg ha^{-1} was recorded in STCR-IPNS-200% of FD for 5 t ha^{-1} + FYM @ 12.5 t ha^{-1} (T10) followed by STCR-IPNS -175% of FD for 5 t ha^{-1}+ FYM @ 12.5 t ha^{-1}(T9) (12705 kg ha^{-1}). Dry matter production by maize in response to fertlisers and manure could be attributed to the fact that maize depends on fertiliser P at its early stages of growth; this might have stimulated root proliferation and acquisition of nutrients for growth (Ademba *et al.,* 2014).

The beneficial effects of farm yard manure in increasing the stover yield might be due to its contribution in supplying additional plant nutrients, improvement of favourable soil conditions and biological process in soil, Joshi *et al.,* (2013) also reported the enhancement of maize productivity with combined application of nutrients through organic and inorganic sources.

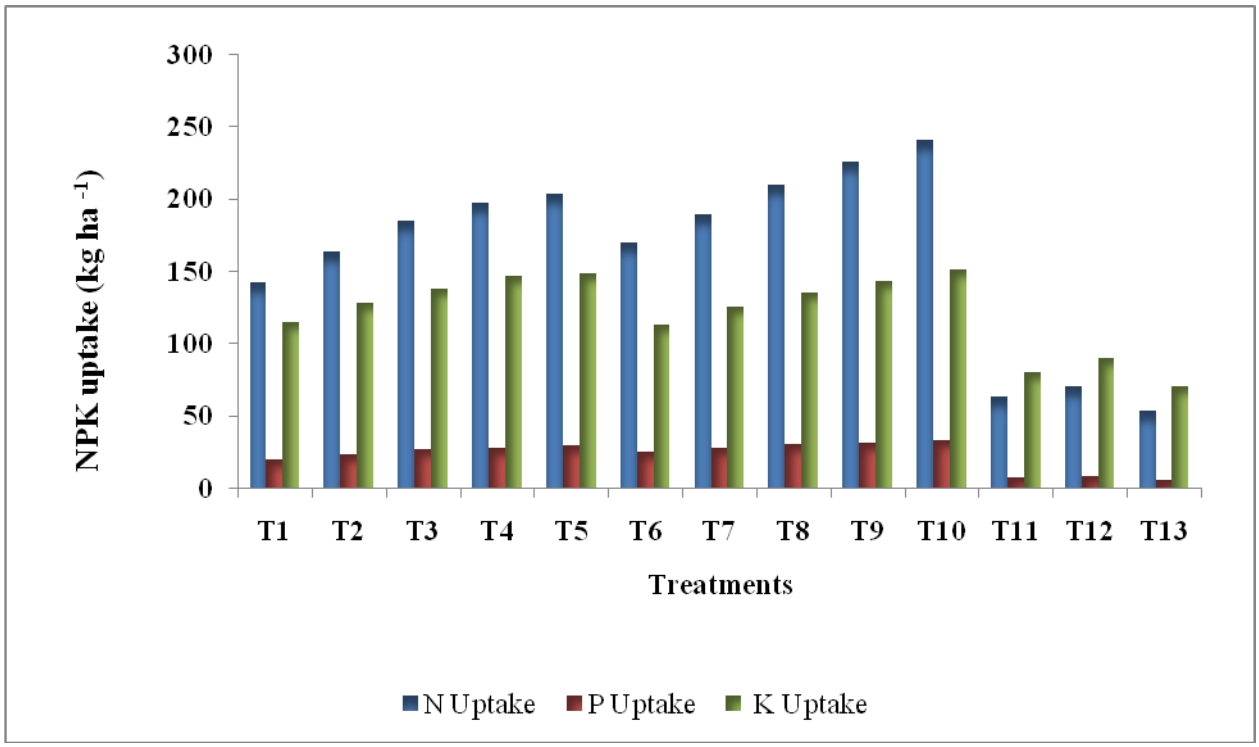
Table.1 Effect of varying fertiliser doses of NPK and IPNS on yield (kg ha^{-1}) of maize

Treatments		Grain yield	Stover yield
T_1	STCR-NPK alone- 100 % of FD for 5 t ha^{-1}	8148	9030
T_2	STCR-NPK alone-125 % of FD for 5 t ha^{-1}	8704	10137
T_3	STCR-NPK alone-150 % of FD for 5 t ha^{-1}	9683	10713
T_4	STCR-NPK alone -175 % of FD for 5 t ha^{-1}	10278	11040
T_5	STCR-NPK alone- 200 % of FD for 5 t ha^{-1}	10486	11144
T_6	STCR-IPNS - 100 % of FD for 5 t ha^{-1}+ FYM @ 12.5 t ha^{-1}	9245	10381
T_7	STCR-IPNS -125 % of FD for 5 t ha^{-1}+ FYM @ 12.5 t ha^{-1}	10203	11377
T_8	STCR-IPNS -150 % of FD for 5 t ha^{-1}+ FYM @ 12.5 t ha^{-1}	10992	12317
T_9	STCR-IPNS -175 % of FD for 5 t ha^{-1}+ FYM @ 12.5 t ha^{-1}	11393	12705
T_{10}	STCR-IPNS -200 % of FD for 5 t ha^{-1}+ FYM @ 12.5 t ha^{-1}	12032	13125
T_{11}	FYM @ 6.25 t ha^{-1} alone	6234	7193
T_{12}	FYM @ 12.5 t ha^{-1} alone	6625	7525
T_{13}	Absolute Control.	5313	6507
Mean		9180	10245
SEd		174.40	93.57
CD (P=0.05)		359.95	193.13

Table.2 Effect of varying fertiliser doses of NPK and IPNS on total N, P and K uptake (kg ha^{-1}) by maize at harvest stage

Treatments		N	P	K
T_1	STCR-NPK alone- 100 % of FD for 5 t ha^{-1}	142.63	20.90	115.76
T_2	STCR-NPK alone-125 % of FD for 5 t ha^{-1}	164.04	24.09	128.48
T_3	STCR-NPK alone-150 % of FD for 5 t ha^{-1}	185.85	27.49	138.27
T_4	STCR-NPK alone -175 % of FD for 5 t ha^{-1}	197.57	28.88	147.65
T_5	STCR-NPK alone- 200 % of FD for 5 t ha^{-1}	204.34	30.20	151.52
T_6	STCR-IPNS - 100 % of FD for 5 t ha^{-1}+ FYM @ 12.5 t ha^{-1}	170.29	25.54	113.79
T_7	STCR-IPNS -125 % of FD for 5 t ha^{-1}+ FYM @ 12.5 t ha^{-1}	190.31	28.20	125.68
T_8	STCR-IPNS -150 % of FD for 5 t ha^{-1}+ FYM @ 12.5 t ha^{-1}	210.20	30.82	135.85
T_9	STCR-IPNS -175 % of FD for 5 t ha^{-1}+ FYM @ 12.5 t ha^{-1}	226.50	32.35	143.63
T_{10}	STCR-IPNS -200 % of FD for 5 t ha^{-1}+ FYM @ 12.5 t ha^{-1}	241.82	33.57	149.36
T_{11}	FYM @ 6.25 t ha^{-1} alone	64.03	7.84	81.05
T_{12}	FYM @ 12.5 t ha^{-1} alone	71.20	8.63	90.39
T_{13}	Absolute Control.	54.39	6.30	71.10
Mean		163.31	23.44	122.50
SEd		4.54	0.90	3.40
CD (P=0.05)		9.37	1.86	7.01

Fig.1 Effect of varying fertiliser doses of NPK and IPNS on total N, P and K uptake (kg ha^{-1}) at harvest stage of maize



Total N, P and K uptake at harvest

The amount of fertiliser applied is responsible for the amount of nitrogen, phosphorus and potassium uptake in maize. The increase in P and K uptake was due to the fact that nitrogen promotes phosphorus and potassium uptake by increasing top and root growth, altering plant metabolism and increasing P and K solubility and availability Kafle *et al.*, (2016). Among the treatments, STCR-IPNS treatment with STCR-IPNS- 200 % FD for 5 t ha-1 +FYM @ 12.5 t ha^{-1} (T10) recorded significant and the highest total uptake of N 241.82 kg ha^{-1} (Table 2). Whereas, the total uptake of P (33.57 kg ha^{-1}) and K (149.36 kg ha^{-1}) (Table 2) was found to be the highest in STCR-IPNS- 200 % FD for 5 t ha^{-1} +FYM @ 12.5 t ha^{-1} (T10) followed by STCR-IPNS- 175 % FD for 5 t ha-1 +FYM @ 12.5 t ha^{-1} (T9) which were on par with each other. The uptake of N, P and K found to have significant and positive correlation with grain (R^2 = 0.9798**, 0.9596**, 0.8870**) and stover yield of maize (R^2 = 0.9734**, 0.9523**, 0.8458**), respectively. Among the treatments imposed, STCR-IPNS treatments found to enhance uptake of nutrients when compared to STCR-NPK treatments due to the combined effect of FYM and NPK fertlisers. Numerous studies have shown that addition of organic manures exerts multiple benefits of crop productivity and soil fertility (Zhang, 2016) and sustainable cropping (Fig. 1).

The present study concluded that FYM along with inorganic fertilizers were efficiently used by maize crop for their growth and development and also maintained soil fertility and increased yield of the crop. The uptake of N, P and K found to have significant and positive correlation with grain and stover yield of maize. Addition of organic manures

plays multiple roles in crop productivity and maintaining soil fertility which sustains cropping and enhances profitability of farmers.

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