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Validation of Soil Test and Yield Target Based Balanced Fertilizer Prescription Model for Rainfed Maize on Inceptisol

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Soil Test Crop Response based fertilizer prescription equations for desired yield target of rainfed maize were developed under Integrated Plant Nutrition System (STCR-IPNS) on Irugur soil series (Typic Ustropept) of Tamil Nadu. On farm testing of fertilizer prescription equations are essential to demonstrate the effectiveness of technology delivery to the stake holders in need. The present study was undertaken to evaluate the targeted yield model through field experiments at six locations in Dindigul district, Western Zone of Tamil Nadu. The treatments included control, blanket recommendation, soil test crop response (STCR) based fertilizer dose for the yield targets of 4.0 to 6.0 t ha^{-1}, STCR-IPNS based fertilizer dose for the yield targets of 4.0 to 6.0 t ha^{-1} and farmer's practice. In all the six locations, the per cent achievement of the targeted yield was within $\pm$ 10 per cent variation proving the validity of the equations for prescribing integrated fertilizer doses for rainfed maize. The highest mean grain yield was recorded in STCR-IPNS – 6.0 t ha^{-1} (5013 kg ha^{-1}) recording an increase of 52.2 per cent over blanket recommendation. The highest per cent achievement, response ratio and B:C ratio of 97.2,17.47 and 2.28, respectively were recorded in the yield target of 5.0 t ha^{-1} under STCR-IPNS. The post-harvest soil available NPK indicated the build up and maintenance of soil fertility due to soil test based fertilizer recommendation under IPNS. The fertilizer prescription equations developed for rainfed maize under IPNS can be recommended for red non calcareous soils of Tamil Nadu for achieving the yield target of 5.0 t ha^{-1} with sustained soil fertility and it can be extrapolated to other agro-climatic zones of Tamil Nadu on similar and allied soil types.

Key words: Fertilizer prescription, Inceptisols, Rainfed maize, STCR-IPNS

Maize (*Zea mays* L.), noted as "Queen of cereals" is one of the third most important cereals next to wheat and rice in the world. It is one of the most versatile crops grown under diverse environmental conditions with diversified uses such as human food, animal feed and a source of large number of industrial products. In India, maize is cultivated in 8.7 million hectares with a total production of 22.3 million tonnes and an average yield of 2.56 t ha^{-1}. In Tamil Nadu, maize is cultivated in an area of 2.91 lakh hectares with a production of 9.46 lakh tonnes and an average productivity of 3.2 t ha^{-1} (DMR, 2014), which is far ahead of the national average.

Rainfed areas, currently constitute 55 per cent of the net sown area of the country and two thirds of livestock and 40 per cent of human population of the country depend on it. In order to achieve overall development of agriculture in the country, it is essential to bridge the yield gaps, enhance the productivity and profitability, minimize risk and improve the livelihoods of millions of people totally dependent on rainfed agriculture (NRAA, 2012). Erratic rainfall and cultivation of crops without balanced nutrient inputs led to the decline in productivity of rainfed staple cereals such as maize (Rego *et al*., 2007). The productivity of rainfed maize is as low as 0.89 t ha^{-1} to as high as 2.53 t ha^{-1}, indicating large variation and scope for productivity enhancement (NRAA, 2012).

In the rainfed regions of India, negative balance of nitrogen and phosphorus in soils are inevitable (Rego *et al.,* 2003). Use of inorganic, organic or biofertilizers in the rainfed cropping systems is minimum or nil when compared to irrigated production system. Most of the fertilizers used are confined to irrigated production system (Katyal, 2001). At present, an annual net negative balance of about 8-10 million tons of nutrients is reported in India (Tandon, 2007). Further, escalation in cost, non uniform distribution, non availability of fertilizers at times, little amount of organic manures used, poor recycling of crop residues and low use of N and P nutrients cause imbalanced fertilization and the area under deficiency of nutrients are increasing (Tandon, 2002). Sole dependence on either inorganic fertilizers or organic sources is not practically possible. Sustainable crop production can be achieved by efficient utilization of fertilizers. Hence, soil test based precised fertilizer prescription is essential for crop, besides maintaining the soil health.

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A blanket recommendation of 60:30:30 kg ha^{-1} of N, P_2O_5 and K_2O is followed for Alfisols of rainfed maize in Tamil Nadu. Soil testing becomes one of the vital tool in increasing the yield of crops by optimising the prescription of fertilizers to crops and maintenance of soil fertility. Soil test based fertilizer prescription eliminates over or under usage of fertilizer inputs thereby, increases the fertilizer use efficiency and yield of crops. A unique field experimental approach (Inductive methodology) on Soil Test Crop Response Correlation studies was evolved by Ramamoorthy *et al*. (1967) by applying graded doses of fertilizers, which provides a scientific basis for balanced fertilization not only with fertilizer nutrients but also, with the soil available nutrients. Law of optimum, provides a basis for soil fertility maintenance consistent with high productivity and efficient nutrient management in "Precision farming" for sustainable and enduring agriculture (Ramamoorthy and Velayutham, 2011).

To reap the maximum benefit, enhanced nutrient use efficiency and reduced nutrient losses, fertilizers must be applied in the right quantity, from the right sources and in the right combination at the right time using the right methods (Dey, 2015; Singh, 2016). Hence, the present study was undertaken for rainfed maize on Irugur soil series (Typic Ustropept) in Western Zone of Tamil Nadu with an aim to validate the developed equation for maximising the productivity of rainfed maize.

Materials and Methods

Six verification trails were conducted during 2013-15 at K.N.Patti, Kendayagoundanur, Nalroadu, Viralipatti-I, Asaripudur and Viralipatti-II of Dindigul district with TNAU maize hybrid CO6. Initial soil samples were collected from each location and analyzed for pH, E.C, alkaline $KMnO_4$-N (Subbiah and Asija, 1956), Olsen-P (Olsen *et al*., 1954), NH_4OAc-K (Stanford and English, 1949) and DTPA extractable micronutrients (Lindsay and Norwell, 1978). The initial soil fertility status for different locations is shown in Table 1. Fertilizer prescription equations developed for rainfed maize under IPNS on Irugur soil series are furnished below:

$$FN = 3.23\ T - 0.42\ SN - 0.52\ ON$$

$$FP_2O_5 = 1.51\ T - 1.98\ SP - 0.94\ OP$$

$$FK_2O = 1.73\ T - 0.21\ SK - 0.48\ OK$$

where, FN, FP_2O_5 and FK_2O are fertilizer N, P_2O_5 and K_2O in kg ha^{-1}, respectively;

T = Grain yield target in q ha^{-1}; SN, SP and SK are available N, P and K in kg ha^{-1}, respectively; ON, OP and OK are N, P and K supplied through FYM in kg ha^{-1}

The treatments imposed are control, blanket fertilizer dose, STCR based fertilizer dose for an yield target of 4.0 to 6.0 t ha^{-1}, STCR-IPNS based fertilizer dose for an yield target of 4.0 to 6.0 t ha^{-1}, and farmers practice. Based on the initial soil test values of available N, P and K and the quantities of N, P_2O_5 and K_2O supplied through FYM, fertilizer doses were calculated and applied for STCR treatments for various yield targets. STCR-NPK alone treatments received only inorganic fertilizers based on STCR equations developed, whereas for IPNS treatments receiving (NPK+ FYM @ 12.5 t ha^{-1}), fertilizers were applied after adjusting the nutrients supplied through FYM based on STCR-IPNS equations (Table 2). Fifty per cent of N and full dose of P_2O_5 and K_2O were applied basally and the remaining 50 per cent N was applied on 20 days after sowing and all other packages of practices were carried out periodically. Using the data on grain yield and fertilizer doses applied, the parameters *viz*., per cent achievement {(yield obtained / yield target aimed) x 100} and response ratio (RR) were worked out (Response Ratio = Response in kg ha^{-1} / Quantities of fertilizer N, P_2O_5 and K_2O applied in kg ha^{-1}). B:C ratio was worked out based on the price of the produce and cost incurred for the cultivation as per the standard procedure. Statistical analysis was carried out using Agres package considering each location as one replication with randomised block design. Post-harvest soil samples were collected and analyzed for available N, P and K status.

Results and Discussion

Grain yield of rainfed maize

The data on pooled mean of grain yield for six locations revealed that the highest grain yield was recorded in the treatment STCR-IPNS-6.0 t ha^{-1} (5013 kg ha^{-1}) followed by STCR-IPNS -5.0 t ha^{-1} (4861 kg ha^{-1}), STCR-NPK alone -6.0 t ha^{-1} (4814 kg ha^{-1}) and STCR-NPK alone – 5.0 t ha^{-1} (4656 kg ha^{-1}) indicating that the STCR -IPNS treatments recorded relatively higher yield over STCR -NPK alone treatments (Table 3 and Fig. 1). STCR -IPNS-6.0 t ha^{-1} recorded an yield

Table 1. Initial soil fertility status of the field experiments

Locations	pH	E.C (dSm^{-1})	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})	Zn (mg kg^{-1})	Fe (mg kg^{-1})	Mn (mg kg^{-1})	Cu (mg kg^{-1})
K.N.Patti	8.37	0.25	145	13.0	185	0.50	3.24	6.25	0.73
Kendayagoundanur	6.89	0.03	162	21.0	123	0.55	4.63	9.31	0.28
Naroadu	7.80	0.20	149	20.0	161	0.44	3.28	4.42	0.37
Viralipatti-I	7.46	0.32	159	16.2	285	1.28	4.28	4.85	0.87
Asaripudur	8.83	0.12	164	16.6	285	0.68	4.26	4.58	0.50
Viralipatti II	7.45	0.35	156	15.6	247	1.04	3.58	4.24	1.09

increase of 52.22 per cent over blanket recommendation (3293 kg ha^{-1}) followed by STCR -IPNS-5.0 t ha^{-1} (47.60 per cent). Statistical scrutiny of yield data from the six locations revealed that STCR -IPNS-6.0 t ha^{-1} had recorded significantly higher grain yield and it was on par with STCR -IPNS-5.0 t ha^{-1} and STCR-NPK alone-6.0 t ha^{-1}; whereas, blanket recommendation recorded significantly lower yield over STCR treatments.

Table 2.Fertilizer doses (kg ha^{-1}) imposed in six locations based on fertilizer prescription equation

Treatments	K.N.Patti 2013-14			Kendayagoundanur 2014-15			Nalroadu 2014-15			Viralipatti-I 2014-15			Asaripudur 2014-15			Viralipatti- II 2014-15		
	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
Blanket	60	30	30	60	30	30	60	30	30	60	30	30	60	30	30	60	30	30
STCR - NPK alone - 4.0 t ha^{-1}	68	35	30	61	19	43	67	21	35	62	28	15*	60	28	15*	64	30	17
STCR - NPK alone - 5.0 t ha^{-1}	101	50	48	93	34	60**	99	36	53	95	43	27	93	43	27	96	45	35
STCR - NPK alone - 6.0 t ha^{-1}	120**	60**	60**	120**	49	60**	120**	51	60**	120**	59	44	120*	58	44	120**	60**	52
STCR - IPNS - 4.0 t ha^{-1}	46	18	15*	39	15*	23	45	15*	15*	40	15*	15*	38	15*	15*	42	15*	15*
STCR - IPNS - 5.0 t ha^{-1}	79	33	28	71	17	41	77	19	33	73	26	15*	71	26	15*	74	28	15*
STCR - IPNS - 6.0 t ha^{-1}	111	48	45	104	32	58	109	34	50	105	42	24	103	41	24	106	43	32
Farmers Practice	38	23	19	32	23	23	32	23	23	38	23	30	35	20	15	38	23	30
Control	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

IPNS=NPK+FYM @ 12.5 t ha^{-1} *maintenance dose **maximum dose

Similar findings indicated that application of inorganic fertilizer along with organic manures recorded higher grain and straw yield (Kaleeswari *et al.*, 2011). This could also be due to the integrated use of organic manures with chemical fertilizers, which could have resulted in increased available nutrient status over sole use of chemical fertilizers (Kaleeswari *et al.*, 2011; Shah *et al*., 2013) ultimately resulting in higher uptake (Sathish *et al.* 2011) and increased use efficiency of nutrients (Jat *et al*., 2014).

Per cent achievement, RR and Cost benefit ratio

The highest per cent achievement of the yield target was recorded with STCR-IPNS-5.0 t ha^{-1} (97.2) followed by STCR-IPNS-4.0 t ha^{-1} (94.1) and STCR-NPK alone-5.0 t ha^{-1} (93.1) (Table 3). Yield targeting with IPNS recorded relatively higher per cent achievement than that aimed under their respective

Table 3. Grain yield, RR , % achievement and B:C ratio of rainfed maize

Treatments	Grain Yield (kg ha^{-1})							* % Yield increase over blanket	*RR (kg kg^{-1})	*Per cent Achieve-ment	*B:C Ratio
	K.N.Patti 2013-14	Kendaya goundanur 2014-15	Nalroadu 2014-15	Viralipatti-I 2014-15	Asaripudur 2014-15	Viralipatti- II 2014-15	Pooled Mean				
Blanket	3141	3460	3420	3026	3296	3416	3293	-	12.68	-	1.66
STCR - NPK alone 4.0 t ha^{-1}	3788	3590	3580	3250	3365	3586	3527	7.09	15.20	88.2	1.82
STCR - NPK alone 5.0 t ha^{-1}	3953	4765	4896	4747	4820	4755	4656	41.38	16.31	93.1	2.25
STCR - NPK alone 6.0 t ha^{-1}	4022	4896	5012	4950	5010	4995	4814	46.19	13.33	80.2	2.24
STCR - IPNS 4.0 t ha^{-1}	3899	3750	3810	3680	3660	3780	3763	14.27	17.32	94.1	1.87
STCR - IPNS 5.0 t ha^{-1}	4032	4996	5110	4970	4960	5096	4861	47.60	17.47	97.2	2.28
STCR - IPNS 6.0 t ha^{-1}	4080	5140	5285	5122	5196	5255	5013	52.22	14.20	83.6	2.25
Farmers Practice	2738	2590	2650	2586	2630	2680	2646	-	10.87	-	1.39
Control	2274	1620	1706	1695	1679	1652	1771	-	-	-	1.01
SEd				159.7				-	-	-	-
CD(p=0.05)				322.8							

*Mean values for six field experiments

NPK alone treatments. Sujatha *et al.* (2008) reported similar results of positive effects of combination of sunhemp green manuring, use of biofertilizers and compost with inorganic fertilizers on growth and yield of rainfed maize. In all the six verification trials, the per cent achievement of the targeted yield was within ±10 per cent variation proving the validity of the equations for prescribing integrated fertilizer doses for rainfed maize. STCR-IPNS technology ensures sustainable crop production with economical use of fertilizer inputs (Mahajan *et al*., 2013).

Table 4. Effect of treatments on the uptake of NPK (kg ha^{-1}) in rainfed maize

Treatments	K.N.Patti 2013-14			Kendayagoundanur 2014-15			Nalroadu 2014-15			Viralipatti-I 2014-15			Asaripudur 2014-15			Viralipatti- II 2014-15			Mean uptake		
	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
Blanket	42.6	10.9	39.6	48.3	11.6	41.5	42.3	11.7	42.1	43.2	10.8	42.8	42.6	11.5	39.7	46.2	11.5	42.3	44.2	11.3	41.3
STCR - NPK alone 4.0 t ha^{-1}	59.2	13.6	49.3	56.4	12.8	48.6	56.2	12.9	46.8	54.2	12.0	44.6	52.6	11.8	44.8	53.7	13.4	46.2	55.4	12.8	46.7
STCR - NPK alone 5.0 t ha^{-1}	68.2	15.9	50.9	68.7	16.4	53.4	70.6	17.3	56.7	70.6	16.8	56.4	73.6	18.6	54.3	72.6	18.0	56.8	70.7	17.2	54.7
STCR - NPK alone 6.0 t ha^{-1}	76.8	17.1	54.6	77.0	17.6	56.9	78.2	18.3	59.2	77.0	18.0	60.1	80.6	20.1	61.2	78.6	19.6	60.8	78.0	18.5	58.8
STCR - IPNS 4.0 t ha^{-1}	64.6	14.8	49.2	63.4	13.8	48.5	64.6	14.0	48.6	62.6	13.6	47.5	63.0	13.8	48.2	65.8	14.0	49.2	64.0	14.0	48.5
STCR - IPNS 5.0 t ha^{-1}	86.0	17.8	58.3	84.3	19.8	55.7	87.2	21.1	60.4	84.6	20.2	59.4	86.8	20.2	58.2	86.4	20.6	58.6	85.9	19.9	58.4
STCR - IPNS 6.0 t ha^{-1}	97.1	18.4	62.4	98.6	20.8	62.0	102.0	22.6	64.2	98.2	21.0	61.8	96.7	21.2	62.6	102.8	22.7	64.6	99.2	21.1	62.9
Farmers Practice	40.6	9.8	36.4	38.9	9.6	35.8	40.6	10.2	38.3	39.6	10.2	35.4	39.8	10.0	36.4	44.3	10.6	38.2	40.6	10.1	36.7
Control	30.8	8.8	25.9	28.6	8.6	23.7	26.8	8.8	24.9	26.2	8.2	24.2	26.4	8.0	24.6	27.0	8.6	26.2	24.8	8.5	24.9
SEd																			1.09	0.45	1.05
CD(.05)																			2.22	0.92	2.12

The mean RR recorded for various treatments ranged from 12.68 kg kg^{-1} in blanket to 17.47 kg kg^{-1} in STCR-IPNS-5.0 t ha^{-1} (Table 3). Among the STCR treatments, IPNS recorded relatively higher RR than NPK alone due to the better use efficiency of applied fertilizers under IPNS. Balanced supply of nutrients from fertilizer, efficient utilization of applied fertilizer nutrients in the presence of organic sources and the synergistic effect of the conjoint addition of various sources of nutrients resulted in relatively higher RR recorded under STCR and STCR-IPNS treatments, when compared to blanket recommendation. The results are corroborated with the findings of Muralidharudu *et al.* (2011) and Dey

Table 5. Post- harvest soil fertility as influenced by various treatments

Treatments	K.N.Patti 2013-14			Kendayagoundanur 2014-15			Nalroadu 2014-15			Viralipatti-I 2014-15			Asaripudur 2014-15			Viralipatti- II 2014-15		
	SN	SP	SK	SN	SP	SK	SN	SP	SK	SN	SP	SK	SN	SP	SK	SN	SP	SK
	(kg ha^{-1})																	
Blanket	142	14.5	184	156	22.6	122	148	21.2	162	156	17.4	279	160	17.9	286	154	17.0	242
STCR - NPK alone 4.0 t ha^{-1}	152	16.6	197	172	26.2	130	164	24.4	169	169	20.2	286	176	20.8	297	168	19.6	251
STCR - NPK alone 5.0 t ha^{-1}	161	18.9	205	183	28.4	132	170	27.2	174	175	21.8	292	185	22.4	306	178	21.2	258
STCR - NPK alone 6.0 t ha^{-1}	170	19.6	214	190	29.4	135	174	28.6	177	178	22.6	304	190	23.2	307	183	21.8	261
STCR - IPNS 4.0 t ha^{-1}	160	18.2	204	181	26.6	129	167	25.2	173	174	20.4	296	182	20.8	297	175	19.6	257
STCR - IPNS 5.0 t ha^{-1}	170	20.3	210	186	31.2	138	174	29.0	182	178	23.2	304	187	23.8	308	182	23.0	267
STCR - IPNS 6.0 t ha^{-1}	178	21.4	218	190	33.6	142	179	32.0	188	182	25.8	314	192	25.8	316	186	25.2	276
Farmers Practice	136	13.8	190	160	22.4	125	146	20.4	163	158	17.0	290	160	17.6	286	153	15.8	249
Control	128	12.6	182	154	20.0	121	142	19.6	158	156	16.0	282	157	15.8	274	148	15.2	242
Initial values	145	13.0	185	162	21.0	123	149	20.0	161	159	16.2	285.0	164	16.6	285	156	15.6	247

and Das (2014). STCR-IPNS-5.0 t ha^{-1} was found to record the highest B:C ratio of 2.28. (Table 3) which was in close conformity with the findings reported by Sujatha *et al*. (2008) and Kalhapure *et al*. (2013).

N, P and K uptake

The mean N uptake ranged from 24.8 to 99.2 kg ha^{-1}. The highest and significant N uptake was recorded in the treatment receiving STCR-IPNS-6.0 t ha^{-1} (99.2 kg ha^{-1}) (Table 4, Fig. 2). The mean P uptake ranged from 8.5 to 21.1 kg ha^{-1}. The highest and significant mean P uptake was recorded in the treatment receiving STCR-IPNS-6.0 t ha^{-1} (21.1 kg ha^{-1}). The mean K uptake ranged from 24.9 to 62.9 kg ha^{-1}. The highest mean K uptake (62.9 kg ha-1) was recorded in the treatment receiving STCR-IPNS-6.0 t ha^{-1}.

The increase in nitrogen uptake might be due to the enhanced availability of nitrogen in soil due to the adequacy of nitrogen. 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). The improved nutrient uptake in FYM amended plots could be attributed to enhanced organic matter decomposition-mineralization process, better root development and higher nutrient availability (Khan *et al*., 2009). Blanket and farmers practice recorded the lower nutrient uptake and the least in control emphasizing continuous cropping without addition of mineral fertilisers or manures retard the yield of maize due to the poor dry matter production and degrade soil quality in long run. Among the treatments imposed, STCR-IPNS treatments found to enhance the uptake of nutrients when compared to STCR-NPK treatments. The combined effect of FYM and NPK fertlizers could have reduced the nutrient losses and improved physical, chemical and biological properties of soil and addition of organic manures exerts multiple benefits of crop productivity and soil fertility (Zhang, 2016).

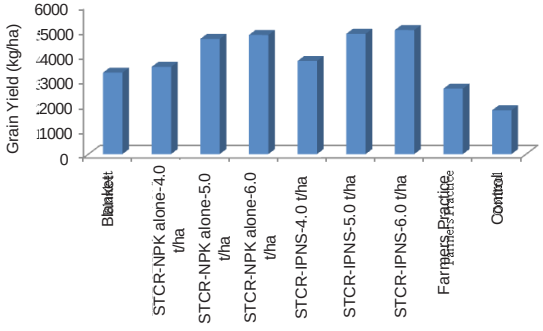

Fig. 1. Effect of treatments on grain yield of maize

Post harvest soil fertility

Soil available N ranged from 128 to178 kg ha^{-1} at K.N. Patti, 154 to 190 kg ha^{-1} at Kendayagoundanur, 142 to 179 kg ha^{-1} at Nalroadu, 148 to182 kg ha^{-1} at Viralipatti – I, 157 to 192 kg ha^{-1} at Asaripudur and 153 to 186 kg ha^{-1} at Viralipatti-II (Table 5). In all the locations, the higher available N was recorded in STCR-IPNS treatments followed by STCR-NPK alone. When compared with the initial soil fertility, control, farmers practice and blanket, recorded reduction in available N but the degree of reduction was less in blanket.

Soil available P ranged from 12.6 to 21.4 kg ha^{-1} at K.N. Patti, 20.0 to 33.6 kg ha^{-1} at Kendayagoundanur, 19.6 to 32.0 kg ha^{-1} at Nalroadu, 16.0 to 25.8 kg ha^{-1} at Viralipatti – I, 15.8 to 25.8 kg ha^{-1} at Asaripudur and 15.2 to 25.2 kg ha^{-1} at Viralipatti-II (Table 5). STCR-IPNS treatments recorded higher available P in all the locations followed by STCR-NPK alone treatments and blanket while control and farmers practice recorded lower available P.

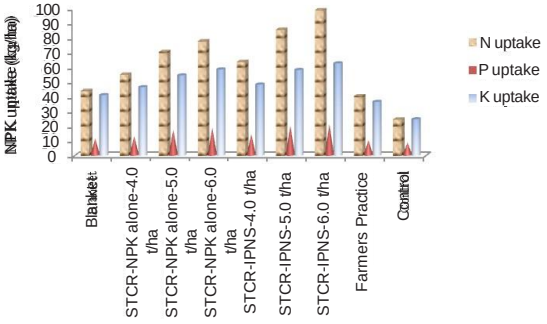

Fig. 2. Effect of treatments on NPK uptake in maize

Soil available K ranged from 182 to 218 kg ha^{-1}, 121 to 142 kg ha^{-1}, 158 to 188 kg ha^{-1}, 282 to 314 kg ha^{-1}, 274 to 316 kg ha^{-1}, 242 to 276 kg ha^{-1} at K.N. Patti, Kendayagoundanur, Nalroadu, Viralipatti–I, Asaripudur and Viralipatti-II (Table 5). Higher available K was recorded in STCR-IPNS treatments in all the locations followed by STCR-NPK alone treatments while control and farmers practice recorded lower available K. The degree of reduction was higher in control and farmers practice when compared to the initial soil fertility while in blanket reduction in available K was less.

Post harvest soil fertility values of $KMnO_4$-N, Olsen-P and NH_4OAc-K indicated the build up and maintenance of soil fertility due to soil test based fertilizer recommendation under IPNS. Despite higher removal of nutrients, the fertility status was maintained in STCR-IPNS as compared to STCR-NPK alone (Table 5). This could be due to the prevention of losses of nutrients under IPNS, even after meeting the crop needs. Application of FYM in conjunction with chemical fertilizers not only increases the productivity but also improve the soil fertility (Jaga and Upadhyay, 2013). The targeted yield concept provides rational and increased use of fertilizer and reduce its requirements if, combined with FYM (Velayutham *et al*., 2016).

Conclusion

The per cent achievement of the targeted yield of all the six verification trials was within ±10 per

cent variation proving the validity of the equations for prescribing balanced fertilizer doses for rainfed maize to achieve the grain yield target of 5.0 t ha^{-1} under rainfed conditions with higher RR, per cent achievement and benefit cost ratio. The post-harvest soil available N, P and K status indicated the build up and maintenance of soil fertility due to soil test based fertilizer prescription under IPNS. Hence, the fertilizer prescription equations developed for rainfed maize under IPNS can be recommended for red non calcareous soils of Irugur soil series (Typic Ustropept) of Tamil Nadu for achieving yield target of 5.0 t ha^{-1} with sustained soil health.

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