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Fertilizer prescription equations for targeted yield of hybrid maize under drip fertigation on alfisol

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Abstract
A field experiment was conducted on red non-calcareous, sandy loam soil belonging to Palaviduthi soil series (Typic Rhodustalf) during rabi 2019 to generate fertilizer prescription equations (FPEs) for targeted yield of hybrid maize under drip fertigation. The experiment comprised of eleven treatments *viz*., STCR – NPK alone and STCR –IPNS for yield targets 8, 9, 10 t ha^{-1}, blanket with and without FYM (12.5 t ha^{-1}), FYM alone @ 6.25 and 12.5 t ha^{-1} and absolute control in randomised block design with three replications. From the experimental data, basic parameters *viz*., nutrient requirement (NR), contribution from soil (Cs), contribution from fertilizers (Cf) and contribution from FYM (Cfym) were computed. It has been found that the nutrient requirement for producing one quintal grain of maize was 1.65 kg of N, 0.68 kg of P_2O_5 and 1.41 kg of K_2O. The per cent contribution from soil (Cs) was 35.73, 41.85 and 19.29 for N, P and K respectively and the percent contribution from fertilizer (Cf) and FYM (Cfym) was 52.33 and 35.62 for N, 44.50 and 27.64 for P_2O_5 and 88.87 and 45.32 for K_2O. Using these basic parameters, FPEs were developed through soil test crop response based integrated plant nutrition system (STCR – IPNS) for maize under drip fertigation. Thus developed FPEs were used for formulating monograms for a range of soil test values with desired yield targets.

Keywords: Alfisol, STCR - IPNS, drip fertigation, hybrid maize, fertilizer prescription equations

Introduction
Maize, an important cereal crop contributing about two per cent of the total agricultural output in India is being used as food, feed and raw material for the production of several industrial products like starch, oil, protein, etc. (Majid *et al*., 2017) [10]. The demand for maize is predicted to be 45 million tonnes by 2022. Maize is cultivated in India in an area of 9.18 million hectares. Tamil Nadu is one of the eight states contributing three fourth of the total maize production in India with an area coverage of 0.39 million hectares. India stands only half of the global yield standards (Kumar *et al*., 2013) [8, 19]. Land and water are the two major natural resources needed for successful cultivation of crops. Unfortunately, due to climate change and competition from non-agricultural sectors, prime agricultural lands are dwindling which affect the production and productivity of crops. Further, increasing demands and reduced availability of good water has also added to the misery of cultivation (Li *et al*., 2019). This has prompted to look for alternate method of irrigation, wherein water usage will be channelised and efficiently used in order to enhance water use efficiency and nutrient use efficiency such as drip fertigation (Sinha and Eldho, 2018; Wu *et al*., 2019) [19, 25]. Integration of organic and inorganic sources improves input use efficiency, crop productivity, water use efficiency, soil biology and overall soil health (Yadav *et al*., 2017) [26]. Soil quality is ensured through balanced and integrated use of mineral and organic sources. Fertilizer management using soil test crop response proves to be a significant tool in matching the crop nutrient needs and sustaining the soil fertility status. Adoption of STCR – IPNS based nutrient recommendation helps the farmers to achieve the targeted yield with optimum quantity of fertilizers (Dey and Santhi, 2014) [3]. Hence an attempt was made to develop fertilizer prescription equations for hybrid maize under drip fertigation through STCR - IPNS.

Materials and Methods
Field experiment was carried out with maize hybrid CO 6 in farmer's holding at Thondamuthur block, Coimbatore district. The soil of the experimental field belongs to Palaviduthi soil series (Typic Rhodustalf). Initial composite soil sample was collected, processed and characterised for its physical, physico-chemical and chemical properties.

Results of the initial surface soil analysis showed the soil is red, non-calcareous, sandy loam, slightly alkaline (pH-7.70), non-saline (EC-0.23 dS m^{-1}), low both in organic carbon (4.80 g kg^{-1}) and $KMnO_4$-N (154 kg ha^{-1}), high both in Olsen-P (34.7 kg ha^{-1}) and NH_4OAc-K (340 kg ha^{-1}). With respect to DTPA – extractable micronutrients, the soil was deficient in iron (1.44 mg kg^{-1}) and zinc (0.54 mg kg^{-1}); sufficient in copper (0.89 mg kg^{-1}) and manganese (5.60 mg kg^{-1}).

The experiment comprised of eleven treatments *viz.*, T_1 - STCR-NPK alone - 8 t ha^{-1}, T_2 - STCR-NPK alone - 9 t ha^{-1}, T_3 - STCR-NPK alone - 10 t ha^{-1}, T_4 - STCR-IPNS - 8 t ha^{-1}, T_5 - STCR-IPNS - 9 t ha^{-1}, T_6 - STCR-IPNS - 10 t ha^{-1}, T_7 - FYM alone - 6.25 t ha^{-1}, T_8 - FYM alone - 12.5 t ha^{-1}, T_9 - Blanket (100 % RDF), T_{10} - Blanket + FYM 12.5 t ha^{-1} and T_{11} - Absolute control. The experiment was laid in Randomised Block Design with three replications. The fertiliser dosage for STCR treatments were computed using the FPEs available for hybrid maize developed based on inductive cum targeted yield model (Ramamoorthy *et al.*, 1967) [14] for soil application of fertilizers and surface irrigation on Palaviduthi soil series. Before the application of fertilisers and manures, plot wise pre sowing soil samples were collected, processed and analysed for soil available N, P and K. The calculated dose of nutrients was applied as urea (46 % N), single super phosphate (16% P_2O_5) and muriate of potash (60 % K_2O). Entire dose of P_2O_5 was applied basally; micronutrient deficiencies were corrected in the experimental field by applying recommended dose, 50 kg ferrous sulphate and 25 kg zinc sulphate per hectare basally. Fertiliser N and K_2O were applied through drip fertigation at an interval of six days and the entire quantities of fertiliser N and K_2O were split up into 13 fertigation with 25 % supplied during 6 to 30 DAS, 50 % during 31 to 60 DAS and 25 % during 61 to 78 DAS (Sampathkumar and Pandian, 2010) [17] for STCR and blanket treatments. A composite FYM sample was collected and analysed for its moisture (18 %), N (0.57 %), P (0.32 %) and K (0.52%). For IPNS treatments, FYM was applied basally @ 12.5 t ha^{-1}. The nutrient contribution from FYM in terms of fertiliser N, P_2O_5 and K_2O was computed on dry weight basis (40:20:26 kg ha^{-1} respectively) and subtracted for IPNS treatments.

The test crop maize hybrid CO 6 was sown on October, 2019 (rabi) and all the package of practices were followed as per TNAU crop production guide 2020 and the crop was harvested on January, 2020. During harvest, grain and stover yields from each plot were recorded and soil, plant and grain samples were collected, processed and analysed for soil available N, P and K and N, P and K content in plant and grain. Standard analytical procedures for available N (Subbiah and Asija, 1956) [22] P (Olsen *et al.*, 1954) [13] and K (Stanford and English (1949) [21]; plant and grain N (Humphries, 1956) [5], P and K (Jackson, 1973) [6] were used. Using dry matter yield and N, P and K content in plant and grain of maize, total N, P and K uptake was computed.

For comparison of growth and yield attributes, soil available N, P and K, uptake of N, P and K by maize and other computed parameters, experimental data of all the treatments were made use of. Statistical analysis of the experimental data was carried out using SPSS statistical software to explicate the impact of the treatments imposed on yield and uptake (Nie *et al.*, 1975) [12]. For developing FPEs, the experimental data of the treatments T_1 to T_8 and T_{11} were used. Response in terms of grain yield of the treatments was computed by deducting the yield in control treatment from yield obtained in the respective fertilised treatments. The basic parameters *viz.*, NR, Cs, Cf and Cfym were calculated using formulae given below (Ramamoorthy *et al.*, (1967) [14] and Santhi *et al.*, (1999) [3, 4, 7, 5, 18, 20, 23] and fertilizer prescription equations were developed.

1. Nutrient requirement (NR) kg q^{-1}

$$\text{Kg N required per quintal of grain production} = \frac{\text{Total uptake of N (kg ha}^{-1}\text{)}}{\text{Grain yield (q ha}^{-1}\text{)}}$$

$$\text{Kg P}_2\text{O}_5\text{ required per quintal of grain production} = \frac{\text{Total uptake of P}_2\text{O}_5\text{ (kg ha}^{-1}\text{)}}{\text{Grain yield (q ha}^{-1}\text{)}}$$

$$\text{Kg K}_2\text{O required per quintal of grain production} = \frac{\text{Total uptake of K}_2\text{O (kg ha}^{-1}\text{)}}{\text{Grain yield (q ha}^{-1}\text{)}}$$

2. Per cent contribution of nutrients from soil to total nutrient uptake (Cs)

$$\text{Per cent contribution of N from soil} = \frac{\text{Total uptake of N in control plot (kg ha}^{-1}\text{)}}{\text{Soil test value for available N in control plot (kg ha}^{-1}\text{)}} \times 100$$

$$\text{Per cent contribution of P}_2\text{O}_5\text{ from soil} = \frac{\text{Total uptake of P}_2\text{O}_5\text{ in control plot (kg ha}^{-1}\text{)}}{\text{Soil test value for available P}_2\text{O}_5\text{ in control plot (kg ha}^{-1}\text{)}} \times 100$$

$$\text{Per cent contribution of K}_2\text{O from soil} = \frac{\text{Total uptake of K}_2\text{O in control plot (kg ha}^{-}\text{)}}{\text{Soil test value for available K}_2\text{O in control plot (kg ha}^{-1}\text{)}} \times 100$$

3. Per cent contribution of nutrients from fertilisers to total uptake (Cf)

$$\text{Per cent contribution of N from fertiliser} = \frac{\text{Total uptake of N in treated plot (kg ha}^{-1}\text{)} - \left(\text{Soil test value for available N in treated plot (kg ha}^{-1}\text{)} \times \text{Average Cs}\right)}{\text{Fertilizer N applied (kg ha}^{-1}\text{)}} \times 100$$

$$\text{Per cent contribution of } P_2O_5 \text{ from fertiliser} = \frac{\text{Total uptake of } P_2O_5 \text{ in treated plot (kg ha}^{-1}\text{)} - \left(\text{Soil test value for available } P_2O_5 \text{ in treated plot (kg ha}^{-1}\text{)} \times \text{Average Cs}\right)}{\text{Fertilizer } P_2O_5 \text{ applied (kg ha}^{-1}\text{)}} \times 100$$

$$\text{Per cent contribution of } K_2O \text{ from fertiliser} = \frac{\text{Total uptake of } K_2O \text{ in treated plot (kg ha}^{-1}\text{)} - \left(\text{Soil test value for available } K_2O \text{ in treated plot (kg ha}^{-1}\text{)} \times \text{Average Cs}\right)}{\text{Fertilizer } K_2O \text{ applied (kg ha}^{-1}\text{)}} \times 100$$

4. Per cent nutrient contribution of nutrients from organics to total uptake (Co)

i) Per cent contribution from FYM (Cfym)

$$\text{Cfym} = \frac{\text{Total uptake of N/P/K in FYM treated plot (kg ha}^{-1}\text{)} - \left(\text{Soil test value for available N/P/K in FYM treated plot (kg ha}^{-1}\text{)} \times \text{Average Cs}\right)}{\text{Nutrient N/P/K added through FYM (kg ha}^{-1}\text{)}} \times 100$$

Fertilizer prescription equations

Making use of these parameters, the Fertilizer Prescription Equations (FPEs) were developed for maize as furnished below.

i) Fertilizer nitrogen (FNs)

$$FN = \frac{NR}{Cf/100}\,T - \frac{Cs}{Cf}\,SN$$

$$FN = \frac{NR}{Cf/100}\,T - \frac{Cs}{Cf}\,SN - \frac{Cfym}{Cf} \times ON$$

ii) Fertilizer phosphorus (FP_2O_5)

$$FP_2O_5 = \frac{NR}{Cf/100}\,T - \frac{Cs}{Cf} \times 2.29 \times SP$$

$$FP_2O_5 = \frac{NR}{Cf/100}\,T - \frac{Cs}{Cf} \times 2.29 \times SP - \frac{Cfym}{Cf} \times 2.29 \times OP$$

iii) Fertilizer potassium (FK_2O)

$$FK_2O = \frac{NR}{Cf/100}\,T - \frac{Cs}{Cf} \times 1.21 \times SK$$

$$FK_2O = \frac{NR}{Cf/100}\,T - \frac{Cs}{Cf} \times 1.21 \times SK - \frac{Cfym}{Cf} \times 1.21 \times OK$$

Where, FN: Fertiliser N (kg ha^{-1}); FP_2O_5: Fertiliser P_2O_5 (kg ha^{-1}); FK_2O: Fertiliser K_2O (kg ha^{-1}); NR: Nutrient requirement of N or P_2O_5 or K_2O (kg q^{-1}); Cs: Per cent contribution of nutrients from soil; Cf: Per cent contribution of nutrients from fertiliser; SN: Soil test value for available N (kg ha^{-1}); SP: Soil test value for available P (kg ha^{-1}); SK: Soil test value for available K (kg ha^{-1}); Cfym: Per cent contribution of nutrients from FYM; ON: Quantity of N applied through FYM (kg ha^{-1}); OP: Quantity of P applied through FYM (kg ha^{-1}); OK: Quantity of K applied through FYM (kg ha^{-1}).

Results and Discussion

Grain yield

The grain yield recorded due to imposition of different treatments ranged from 3569 to 11353 kg ha^{-1} (Table 1). The highest grain yield of 11353 kg ha^{-1} was recorded in T_6 (STCR-IPNS - 10 t ha^{-1}) which was on par with the grain yield 11160 kg ha^{-1} recorded in T_3 - STCR-NPK alone - 10 t ha^{-1}. Following treatments T_6 and T_3, T_5 - STCR-IPNS - 9 t ha^{-1} recorded grain yield of 10578 kg ha^{-1}, comparable to the grain yield of T_2 - STCR-NPK alone - 9 t ha^{-1} (10239 kg ha^{-1}) and T_{10} - Blanket + FYM 12.5 t ha^{-1} (10142 kg ha^{-1}). These treatments were superior to T_4 - STCR-IPNS - 8 t ha^{-1}, T_1 - STCR-NPK alone – 8 t ha^{-1} and T_9 - Blanket (100 % RDF) which recorded grain yields of 9674, 9415 and 9351 kg ha^{-1} respectively. All the fertilised treatments were superior to T8 - FYM alone @ 12.5 t ha^{-1} and T_7 - FYM alone @ 6.25 t ha^{-1} which recorded grain yields of 5233 and 4264 kg ha^{-1} respectively. Absolute control (T_{11}) recorded the lowest yield of 3569 kg ha^{-1}. The percentage increase in yield of STCR – NPK alone over blanket alone were 9 and 19 per cent for 9 and 10 t ha^{-1} targets respectively. The percentage increase in yield of STCR- IPNS treatments over blanket alone were 13 and 21 per cent for yield targets 9 and 10 t ha^{-1} respectively.

The positive and encouraging effect of FYM in combination with NPK on maize yield could be due to creation of favourable and conducive physico- chemical environment around the maize root zone, which enabled the maize crop to have greater absorption and utilization of macro and micro nutrients at appropriate time and led to overall improvement in crop growth reflected from source-sink relationship, which in turn produced higher crop yield (Meena *et al.*, 2019) [11, 15]. The higher maize yield obtained under drip fertigation could be possibly due to existence of synchrony between the supply of nutrients from drip fertigation and nutrient demand by maize crop at critical stages and further less moisture stress resulting in enhanced transfer of photosynthates from source to the sink (Reddy and Murthy, 2017) [16, 24]. The present result noticed was similarly echoed by Coumaravel (2012) [1, 2] and Suresh and Santhi (2018) [3, 4, 7, 5, 18, 20, 23] in maize and Ravikiran *et al.*, (2018) [15] in pearl millet.

Table 1: Mean and range of grain yield, pre-sowing soil test values uptake of NPK, response and % achievement of maize under drip fertigation

Tr. No.	Treatment details	Grain yield	UN	UP	UK	SN	SP	SK	FN	FP$_2$O$_5$	FK$_2$O	FYM	Response	% Achievement
		(kg ha^{-1})										(t ha^{-1})	(kg ha^{-1})	
T$_1$	STCR-NPK alone - 8 t ha^{-1}	9415	153.2	22.71	83.6	155	33.2	336	222	58	41	0	5846	118
T$_2$	STCR-NPK alone 9 t ha^{-1}	10239	186.8	26.52	95.3	153	32.8	342	262	73	58	0	6670	114
T$_3$	STCR-NPK alone 10 t ha^{-1}	11160	197.2	29.93	101.4	153	33.9	339	301	89	74	0	7591	112
T$_4$	STCR-IPNS - 8 t ha^{-1}	9674	158.5	22.77	83.9	156	34.9	342	182	38	15	12.5	6105	121
T$_5$	STCR-IPNS - 9 t ha^{-1}	10578	189.1	26.89	95.8	156	35.2	340	221	54	32	12.5	7009	118
T$_6$	STCR-IPNS - 10 t ha^{-1}	11353	198.6	30.08	104.8	152	35.0	342	261	69	48	12.5	7784	114
T$_7$	FYM alone - 6.25 t ha^{-1}	4264	63.5	16.96	71.6	156	34.9	339	0	0	0	6.25	694	
T$_8$	FYM alone - 12.5 t ha^{-1}	5233	72.6	19.48	78.5	156	34.4	341	0	0	0	12.5	1663	
T$_9$	Blanket (100% RDF)	9351	152.9	21.84	83.5	152	35.2	338	250	75	75	0	5782	
T$_{10}$	Blanket + FYM 12.5 t ha^{-1}	10142	183.0	26.25	94.4	152	35.2	341	250	75	75	12.5	6573	
T$_{11}$	Absolute control	3569	56.1	13.77	66.0	157	32.9	342	0	0	0	0	-	
	SEd	212.0	3.29	1.00	1.8									
	CD (P = 0.05)	442.3	6.9	2.09	3.8									
	Range	3569-11353	56.1-198.6	13.77-30.08	66-104.8	152-157	32.8-35.2	336-342						

Nutrient uptake

The nutrient uptake ranged from 56.1 - 198.6 kg ha^{-1} for N, 13.77 - 30.08 kg ha^{-1} for P and 66.0 - 104.8 kg ha^{-1} for K (Table 1). The maximum uptake of nutrients were observed in T$_6$ (STCR-IPNS - 10 t ha^{-1}) which was comparable with T$_3$ (STCR-NPK alone - 10 t ha^{-1}) with N uptake of 198.6 and 197.2 kg ha^{-1}, P uptake of 30.08 and 29.93 kg ha^{-1} and 104.8 and K uptake of 101.4 kg ha^{-1} respectively. Next to T$_6$ and T$_3$, T$_5$ (STCR-IPNS - 9 t ha^{-1}), T$_2$ (STCR-NPK alone - 9 t ha^{-1}) and T$_{10}$ (Blanket + FYM 12.5 t ha^{-1}) recorded N uptake of 189.1, 186.8 and 183.0 kg ha^{-1}, P uptake of 26.89, 26.52 and 26.25 kg ha^{-1} and K uptake of 95.8, 95.3 and 94.4 kg ha^{-1} respectively and were comparable among them. These treatments recorded significantly higher uptake than T$_4$ - STCR-IPNS - 8 t ha^{-1}, T$_1$ - STCR-NPK alone – 8 t ha^{-1} and T$_9$ - Blanket (100 % RDF) which recorded an uptake of 158.5, 153.2 and 152.9 kg N ha^{-1}, 22.77, 22.71 and 21.84 kg P ha^{-1} and 83.9, 83.6 and 83.5 kg K ha^{-1} respectively. FYM alone - 12.5 t ha^{-1}and T$_7$ - FYM alone - 6.25 t ha^{-1} recorded 72.6 and 63.5 kg N uptake ha^{-1}, 19.48 and 16.96 kg P uptake ha^{-1} and 78.5 and 71.6 kg K uptake ha^{-1} respectively. Absolute control recorded the lowest NPK uptake of 56.1, 13.77 and 66.0 kg per ha^{-1} respectively. The uptake pattern observed among the treatments was similar to those observed by Ravikiran *et al.*, (2018) [15] and Kanchana *et al.*, (2020) [7]. Application of nutrients through drip fertigation delivered nutrients at optimum rate, duration and frequency, maximizing water and nutrient uptake by crop, while minimizing leaching of nutrients from the root zone (Fanish *et al.*, 2011) [4].

Response of maize

The response of maize to various STCR - NPK and STCR - IPNS treatments applied through drip fertigation was assessed. The maximum response of 7784 kg ha^{-1} was found in T$_6$ (STCR-IPNS - 10 t ha^{-1}) and minimum of 694 was found in T$_7$ (FYM alone - 6.25 t ha^{-1}) (Table 1). The response was found to be greater in STCR-IPNS treatments comparing STCR-NPK alone treatments of the corresponding yield targets. The achievement of yield targets in the present investigation exceeded 110 per cent at all target levels and therefore the existing FPEs have to be refined as put forth by Velayutham *et al.*, (1985) [24]. This formed the basis for refining the existing FPEs to suit for drip fertigation in maize.

Basic parameters

Utilising the pre-sowing soil available NPK, applied fertiliser doses, grain yield and NPK uptake obtained from the experiment, the basic parameters *viz*., nutrient requirement (NR), contribution from soil (Cs), fertilizers (Cf) and FYM (Cfym) were computed (Table 2). The results disclose, maize requires 1.65, 0.68 and 1.41 kg N, P$_2$O$_5$ and K$_2$O respectively to generate one quintal of grain yield when the fertilizers were supplied through drip fertigation. The per cent contribution of soil and fertilizers were 35.73 and 52.33 for N, 41.85 and 44.50 for P$_2$O$_5$ and 19.29 and 88.87 for K$_2$O. The per cent contribution of N, P and K from FYM were 35.62, 27.64 and 45.32 respectively (Table 2).

Table 2: Basic parameters for maize under drip fertigation

	Basic parameters			
	NR	Cs	Cf	Cfym
N	1.65	35.73	52.33	35.62
P$_2$O$_5$	0.68	41.85	44.50	27.64
K$_2$O	1.41	19.29	88.87	45.32

The basic parameters *viz*., NR, Cs, Cf and Cfym exposed that comparatively greater quantity of N was indispensable to produce one quintal of maize under drip fertigation followed by K_2O and P_2O_5. Phosphorous contribution from soil was relatively higher than N and K contribution. The P contribution from soil augmented to the degree of 1.17 times of N and 2.17 times of K. Contribution from fertilizers was superior in K followed by N and P. The trend observed in the contribution of nutrients from fertilizer in the present study was in harmony with observations made by Coumaravel (2012) [1, 2] and Sivaranjani *et al.*, (2018) [20].

Refined fertiliser prescription equations for maize under drip fertigation

The basic parameters *viz.*, NR, Cs, Cf and Cfym, are used to establish fertilizer prescription equations under STCR - NPK alone and STCR - IPNS for hybrid under drip fertigation and is given below.

STCR – NPK alone	STCR – IPNS (NPK + FYM)
FN = 3.15 T – 0.68 SN	FN = 3.15 T – 0.68 SN – 0.68 ON
FP_2O_5 = 1.53 T – 2.15 SP	FP_2O_5 = 1.53 T – 2.15 SP – 0.62 OP
FK_2O = 1.58 T – 0.26 SK	FK_2O = 1.58 T – 0.26 SK – 0.51 OK

Where FN, FP_2O_5 and FK_2O are fertiliser N, P_2O_5 and K_2O in kg ha^{-1} respectively; T is the targeted yield in q ha^{-1}; SN, SP and SK are alkaline KMnO4 – N, Olsen – P and NH_4OAc – K in kg ha^{-1} respectively and ON, OP and OK are amount of N, P and K in kg ha^{-1} supplied through FYM.

Fertilizer prescription for maize under drip fertigation

The FPEs constructed were used to derive fertilizer prescription for maize grown under drip fertigation for a range of soil test values and desired yield targets of 8, 9 and 10 t ha^{-1}. The fertilizer prescriptions for both NPK alone and IPNS were computed and presented in table 3. When FYM (with 18.2 % moisture, 0.57 % N, 0.32 % P and 0.52 % K content) is applied @ 12.5 t ha^{-1}, the quantity of fertiliser saved corresponds to 39, 21 and 27 kg N, P_2O_5 and K_2O. The fertilizer dosage increased when yield targets were high and decreased with soils of high available nutrients. Similar trends were observed by Ravikiran *et al.*, (2018) [15]. The fertilizer prescription equations developed for maize under drip fertigation can be recommended for large scale adoption after validation.

Table 3: Soil test based fertilizer doses for desired yield targets of maize under STCR – NPK alone and STCR – IPNS

STV			STCR - NPK ALONE									STCR - IPNS								
			8			9			10			8			9			10		
N	P	K	FN	FP_2O_5	FK_2O	FN	FP_2O_5	FK_2O	FN	FP_2O_5	FK_2O	FN	FP_2O_5	FK_2O	FN	FP_2O_5	FK_2O	FN	FP_2O_5	FK_2O
150	22	260	150	75	58	181	91	74	213	106	90	125*	55	38*	142	70	47	173	85	63
160	24	280	143	71	53	174	86	69	206	102	85	125*	50	38*	135	66	42	166	81	58
170	26	300	136	67	48	168	82	64	199	97	79	125*	46	38*	128	61	38*	160	77	52
180	28	320	129	62	42	161	78	58	192	93	74	125*	42	38*	125*	57	38*	153	72	47
190	30	340	125*	58	38*	154	73	53	185	89	69	125*	38*	38*	125*	53	38*	146	68	42
200	32	360	125*	54	38*	147	69	48	179	84	64	125*	38*	38*	125*	48	38*	139	64	38*

*Maintenance dose – 50 per cent of blanket dose; Blanket: 250:75:75 kg N, P_2O_5, K_2O ha^{-1}

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