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Soil Test - Crop Response Correlation with Maize under IPNS System in *Inceptisols* of Surguja Hills Zone of Chhattisgarh, India

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A B S T R A C T

A field experiment was conducted during *kharif* 2012 in *Inceptisols* of Northern hills zone of Chhattisgarh to estimate the nutritional requirement, efficiencies of fertilizer, soil test and organic source (FYM) to estimate the fertilizer requirement for varying yield goals of maize crop based on soil test levels using INM approach. Maize crop required 1.59 kg N, 0.32 kg P and 1.84 kg K for one quintal grain production. Fertilizer and soil test efficiencies estimated were 41.84 and 22.53 percent, respectively for N, 28.28 and 52.67 percent, respectively for P and 140.33 and 26.40 percent, respectively for K. The FYM contribution in terms of N, P and K were estimated 21.76, 4.70 and 12.81 per cent, respectively. Based on these basic parameters, fertilizer adjustment equation for N, P and K were evolved for different yield targets of maize based on soil nutrients level using FYM as organic component in INM.

Introduction

Maize (*Zea mays* L.) is one of the important crop among cereals and it occupies third position in production next to rice and wheat in the world.

In Northern region, maize is gaining popularly and improving climate the livelihood due to favourable climate with limited irrigation facility. The effective fertilizer recommendation should consider crop needs and nutrient already available in the soil. Continuous use of inorganic nutrients may adversely affect the physico - chemical properties of soil and thereby affect the crop yields. In order to sustain the yield and reduce the dependency on inorganic fertilizer use, conjunctive use of organic manures and fertilizers is very much essential. Targeted yield concept strikes a balance between fertilizing the crop and fertilizing the soil. In the view of above facts, a study on refining the integrated plant nutrient supply on STCR basis was conducted as advocated by Ramamoorthy *et al.*, (1967).

Materials and Methods

A field experiment on soil test crop response correlation study was conducted with maize (var. Hisheal) during *kharif* season 2012 in *Inceptisols* at Rajmohini Devi College of Agriculture and Research Station, Ajirma, Ambikapur (Chhattisgarh). A special field technique developed by Ramamoorthy *et al.*, (1967) was used for this study. The field was divided in to three long strips and was denoted as L_0, L_1 and L_2. These fertility strips had fertility gradient with respect to available P which was created during previous crop season. Each strip (treated as block) was divided in to 24 equal size plot. The fertilizer treatments constituted of different combinations of various levels of N (0, 60, 120 and 180 kg ha^{-1}), P_2O_5 (0, 30, 60 and 90 kg ha^{-1}) and K_2O (0, 30, 60 and 90 kg ha^{-1}) and FYM (0, 5 and 10 t ha^{-1}) were randomly distributed in each strip. The fertilizer materials used were urea, single super phosphate and muraite of potash. Full dose of P_2O_5 and K_2O were applied as basal. The N was applied in three equal splits applied at basal, full length and tasseling stages. Before application of fertilizer, FYM @ 0, 5 and 10 t ha^{-1} as per treatments structure was applied and thoroughly mixed in soil. Plot-wise soil samples were collected before application of fertilizer and FYM treatments. Soil samples were analyzed for available N (Subhiah and Asija, 1956), P (Bray, 1948) and K (Hanway and Heidal, 1952). The Hisheal variety of maize crop was sown during the third week of July, 2012 and harvested in fourth week of October, 2012. The yield data for grain and straw for all the plots were recorded at the end of the experiment. Grain and straw samples were analyzed for N, P and K content (Piper, 1966) and total nutrient uptake was computed using grain and straw yield data.

The basic parameter, *viz*. nutrient requirement (kg q^{-1}), contribution of nutrients from soil, fertilizer and organic sources were calculated as described by Ramamoorthy *et al.*, (1967). These parameters were used for the formulation of fertilizer adjustment equations for deriving fertilizer doses and the soil test based fertilizer recommendations with organic source were prescribed in the form of ready reckoner for desired yield goal of maize.

Results and Discussion

Soil available nutrients

The range and mean values of available nutrients (N, P & K) (Table 1) indicate that soil test N, P and K varied with different fertility strips although soil test N and K variations with respect to fertility strip were marginal however, soil P variation in different strips were quite marked and it increased across the fertility strips.

Crop yield

Table 2 gives the range and averages of maize yield in relation to different fertility strips. It was observed from the results that there was increasing trends in maize yields from L_0 to L_2 fertility strip due to increasing P level.

Highest yield of 84.14 q/ha was observed in L_2 strip with a good response to the application of highest dose of fertilizer and 20.86 q/ha was observed in the L_0 strip without fertilizer (Control).

Estimation of basic parameters

Results presented in Table 3 show the nutrient requirement (NR) for N, P and K (kg q^{-1}), efficiencies of fertilizer (Ef), soil test (Es) and FYM estimated based on the basic formula. The maize required about 1.59 kg N, 0.32 kg P and 1.84 kg K to produce one quintal of grain. Fertilizer efficiencies for P were less than soil test efficiencies.

Table.1 Range and mean value of available N, P and K (kg/ha)

Soil Nutrients	L_0	L_1	L_2	SD	CV %
Alkaline $KMnO_4$-N	197 – 229 (209)	192 – 217 (206)	197 – 229 (211)	9.12	4.37
Bray's	10.37 – 20.52 (14.15)	19.22 – 38.70 (29.98)	30.05 – 44.21 (37.56)	10.70	39.92
Amm. acetate extractable K	183 – 289 (219)	172 – 324 (233)	181 – 349 (244)	42.31	18.24

Values in parenthesis are average data

Table.2 Range and mean values of maize (Var. Hisheal) yield (q/ha)

Locations	Fertility strips			SD	CV (%)
	L_0	L_1	L_2		
Ambikapur	20.86 - 78.43 (55.97)	26.71- 82.81 (58.51)	33.52 - 84.14 (60.14)	17.52	30.10

Table.3 Nutrient requirement, fertilizer, soil and FYM efficiencies

Nutrient	NR (kg q^{-1})	Fertilizer efficiency (%)	Soil test efficiency (%)	FYM efficiency (%)
N	1.59	41.84	22.53	21.76
P	0.32	28.28	52.67	4.70
K	1.84	140.33	26.40	12.81

Table.4 Fertilizer adjustment equation estimated based on response data (Ambikapur)

Fertilizer adjustment equations
FN = 3.81 Y - 0.54 SN - 0.52 FYM
FP = 1.13 Y- 1.86 SP - 0.17 FYM
FK = 1.31 Y - 0.19 SK - 0.09 FYM

Where, FN, FP and FK are fertilizer N, P_2O_5 and K_2O (Kg ha^{-1})respectively. FYM is Farm Yard Manure (t ha^{-1}). SN, SP and SK are soil test values (kg ha^{-1}) for $KMnO_4$ N, Bray 's P and ammonium acetate extractable K and Y is targeted yield in q $ha^{-1.}$

Table.5 Ready Reckoners for soil test based fertilizer N P_2O_5 and K_2O recommendation of hybrid maize (Hisheal) in *Inceptisols* with 5 tonnes of FYM

Soil Test values (kg/ha)			Yield Target of maize (q/ha)								
			60			70			80		
N	P	K	FN	FP	FK	FN	FP	FK	FN	FP	FK
150	4	200	145	60	50	183	71	63	221	82	76
175	6	225	132	56	45	170	67	58	208	78	71
200	8	250	118	52	40	156	63	53	194	75	66
225	10	275	105	48	35	143	60	49	181	71	62
250	12	300	91	45	31	129	56	44	167	67	57
275	14	325	78	41	26	116	52	39	154	64	52
300	16	350	64	37	21	102	48	34	140	60	47
325	18	375	51	33	16	89	45	30	127	56	43
350	20	400	37	30	12	75	41	25	113	52	38
375	22	450	24	26	7	62	37	20	100	49	33
400	24	500	10	22	2	48	34	15	86	45	28

Contrary to this, fertilizer efficiencies for nitrogen and potash were observed higher than soil test efficiencies. The efficiency of FYM for N was found to be higher and minimum value was observed with phosphorous.

The fertilizer adjustment equations for N, P and K with FYM have been presented in Table 4. The ready reckoners for fertilizer N, P_2O_5 and K_2O along with 5 tonnes of FYM for specific yield targets of maize (var. Hisheal) is presented in Table 5. The ready reckoners show that the fertilizer requirements decrease with increase in soil test values. Therefore a slightly lower yield target may be considered for poor farmers.

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