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THE TARGET YIELD FOR CHILLI IN *VERTISOL* OF C.G. BASED ON BALANCE FERTILIZER PRESCRIPTION

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Abstract

A field experiments were carried out in chilli crop under soil test crop response correlation studies in *Vertisol* during *Rabi* season 2014-15 at Instructional Farm of Indira Gandhi Agricultural University, Raipur, Chhattisgarh, India. Based on the basic parameters, fertilizer adjustment equations were evolved for chilli crop to achieve a definite goal. The nutrient requirements (kg q^{-1}) of N, P_2O_5 and K_2O for producing one quintal of chilli fruit yield in *Vertisol* were found to be 1.04, 0.12 and 1.27 kg, respectively. The per cent contributions of nutrient from soil, fertilizers and FYM were 24.71, 41.85 and 12.79 ; 51.12, 23.19 and 186 and 10.99, 3.83 and 17.17 of N, P and K nutrients, respectively.

Key words : Available NPK, fertilizer equation, nutrient requirement, soil test values.

Introduction

Chilli belongs to the family solanaceae and two main species are *Capsicum annuum* L. and *Capsicum frutescens* L. Chillies are classified as pungent and nonpungent varieties. Most of the Indian chillies belong to the *Capsicum annuum* species and thus constitute the major commercial variety used in food flavourings. In India, chilli occupies an area of 8.01 lakh ha with an annual production of 13.06 lakh tones with an average productivity of 1.6 ton/ha. Chilli is mainly grown in Andhra Pradesh (49%), Karnataka (15%), Orissa (8%), Maharashtra (6%), West Bengal (5%), Rajasthan (4%) and Tamil Nadu (3%), which together contributes about 75 per cent of the total cultivated area (Kumar *et al*., 2011). India is the leading producer, but the average yield of chilli is very low (1.11 t/ha dry chilli) as compared to developed countries like USA, China, South Korea, Taiwan etc, where the average yield ranges from 3 – 4 t/ha. In India, the quantitative refinements in the fertilizer recommendations based on the soil and plant analysis were made (1967-68) through the All India Coordinated Research Project for soil test crop response correlation used the targeted yield approach to develop relationship between crop yields on the one hand and soil test values and fertilizer inputs on the other. This approach can be used not only for individual field situations, but also a better approximation for planning the requirement of fertilizers on an area basis for a given level of crop production.

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Materials and Methods

Field experiments were carried out at Instructional Farm of Indira Gandhi Agricultural University, Raipur, Chhattisgarh (India) during *Rabi* season 2014-15 in *Vertisol*. Soil is represented as typical *fine montmorillonitic, hyperthermic, Udic Chromustert*. The experimental field was divided into three equal long fertility strips having gradient already created previously and named as L_0, L_1 and L_2. The experimental design was set in a re-enforced resolvable block design with three across FYM (0, 5 and 10 t ha^{-1}) strips. Twenty one selected treatment and three control combinations from four levels of each N (0, 50, 100 and 150 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}) were superimposed over each fertility strip. Initial soil samples were collected from each sub-plot (0-15cm) before superimposition of 21 fertilizer treatments and three controls were analyzed for available nitrogen by alkaline potassium permanganate method as proposed by Subbiah and Asija (1956), available phosphorus by Olsen's method (Olsen *et al*., 1954) and available potassium by ammonium acetate method (Hanway and Heidal, 1952) as described by Jackson (1973). The plant samples fruit

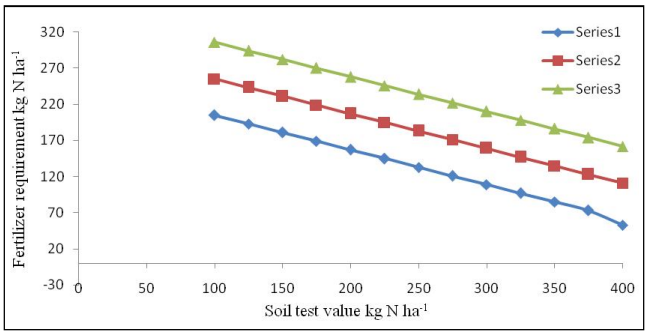

Fig. 1 : Fertilizer (N) requirement (kg ha^{-1}) for the targeted yield (150, 200 and 250 qu ha^{-1}) of chilli.

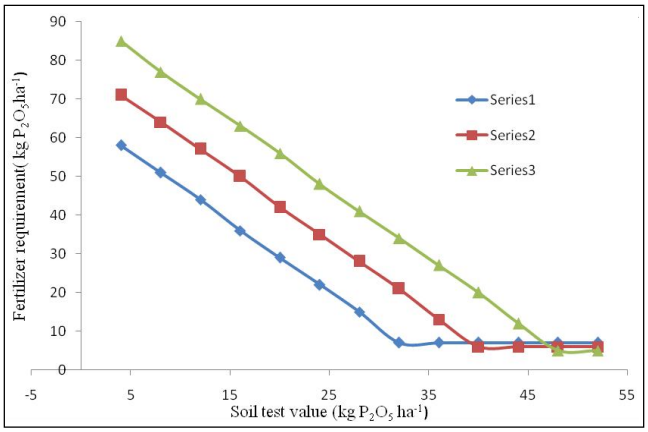

Fig. 2 : Fertilizer (P) requirement (kg ha^{-1}) for the targeted yield (150, 200 and 250 qu ha^{-1}) of chilli.

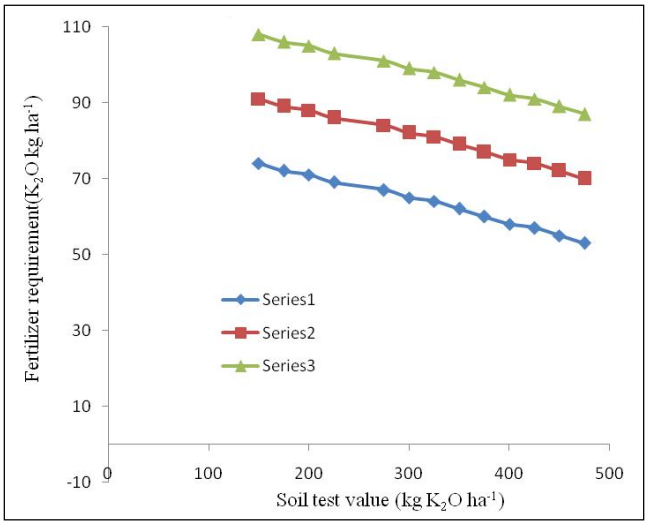

Fig. 3 : Fertilizer (K) requirement (kg ha^{-1}) for the targeted yield (150, 200 and 250 qu ha^{-1}) of chilli.

Table 2 : Range and mean of fruit yields of chilli during rabi season 2014-15 in relation to fertility.

Fertility strips	Strips			SD	CV %
	Fruit yield (q/ha)				
	Minimum	Maximum	Average		
L_0	19.81	182.87	103.72	46.36	44.70
L_1	38.41	182.90	110.38	42.94	38.90
L_2	46.06	183.30	115.48	41.67	36.08
All strips	19.81	183.30	109.86	43.35	39.46

as well as straw sample collected at harvesting stage has been analyzed for N, P, K and the plant uptake of nutrients was calibrated by using fruit and straw yield data. Using the fruit yield and nutrient uptake data, soil test values and applied fertilizer does of treated and control plots, the basic data *viz*. nutrient requirement (kg q^{-1}), soil, fertilizer and organic manure efficiencies (%) for making fertilizer recommendation have been estimated by following the conventional procedure as discussed by Ramamoorthy *et al*. (1967).

Results and Discussion

Table 1 showed that the range and mean values of available nutrients (N, P and K) before *Rabi* season, 2014-15. Mean values on available soil N ranged from 214–270 kg ha^{-1}. The level of soil N showed increasing trend marginally. The level of soil P increased with respect to fertility strips from L_0 to L_2. Average soil P ranged from 10.42 – 31.24 kg ha^{-1} during *Rabi* season before taking the test crops. Similarly, the mean values of available K status were recorded in the range from 489–593 kg K ha^{-1} before *Rabi* season, respectively.

Soil test based fertilizer calibrations for attaining targeted yields

The basic data *viz*., the nutrient requirement (kg q^{-1}) for producing one quintal of chilli fruit yield, soil, fertilizer and organic manure efficiencies or the per cent contribution from soil fertilizer nitrogen, phosphorus, potassium and FYM have been calculated from each plot based on the data of whole field. The estimates of nutrient requirement (kg q^{-1}) values of fertilizer nitrogen, phosphorus and potassium based on whole field method were 1.04, 0.12 and 1.27, respectively. The per cent

Table 1 : Range and mean values of available N, P and K (kg/ha) before *Rabi* season, 2014 -15 with chilli.

Soil nutrients	L_0	L_1	L_2	SD	CV (%)
Alkaline $KMnO_4$-N	214 -246 (231)	219 -269 (242)	234 - 270 (250)	13.19	5.47
Olsen's P	10.42-15.68 (12.49)	16.41-22.88 (19.99)	22.10 - 31.24 (27.15)	6.35	31.69
Ammonium acetate Extractable–K	489 - 569 (525)	500 – 572 (530)	501 - 593 (533)	24.73	4.67

Table 3 : Basic data and fertilizer equation for chilli in *Vertisol*.

Nutrients	NR (kg/q^{-1})	CS (%)	CF (%)	CFYM (%)	Fertilizer adjustment equations
N	1.04	24.71	51.12	10.99	FN = 2.03Y-0.48SN-0.21FYM
P	0.12	41.85	23.19	3.83	FN = 0.53Y-1.81SP-0.17FYM
K	1.27	12.79	186	17.17	FN = 0.68Y-0.07SK-0.09FYM

Table 4 : Ready reckoners for fertilizer N P and K recommendations based on soil test levels with 5 tons of FYM for chilli crop (Indira chilli - 3) in *Vertisol* of Chhattisgarh.

Soil test levels (kgha^{-1})			Yield target of chilli (q ha^{-1})								
			150			200			250		
SN	SP	SK	FN	FP	FK	FN	FP	FK	FN	FP	FK
100	4	150	205	58	74	255	71	91	306	85	108
125	8	175	193	51	72	243	64	89	294	77	106
150	12	200	181	44	71	231	57	88	282	70	105
175	16	225	169	36	69	219	50	86	270	63	103
200	20	275	157	29	67	207	42	84	258	56	101
225	24	300	145	22	65	195	35	82	246	48	99
250	28	325	133	15	64	183	28	81	234	41	98
275	32	350	121	7	62	171	21	79	222	34	96
300	36	375	109	7	60	159	13	77	210	27	94
325	40	400	97	7	58	147	6	75	198	20	92
350	44	425	85	7	57	135	6	74	186	12	91
375	48	450	73	7	55	123	6	72	174	5	89
400	52	475	61	7	53	111	6	70	162	5	87

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; Olsen's P and ammonium acetate extractable K and Y is crop yield in q ha^{-1}.

nutrient contribution from soil, fertilizer and FYM in *Vertisol* were found to be 24.71, 41.85 and 12.79, 51.12, 23.19 and 186 and 10.99, 3.83 and 17.17% for nitrogen, phosphorus and potassium, respectively under whole field method, which is given in table 3. The available N, P and K varied with different fertility strips although available N and K variations with respect to fertility strip were marginal however, available P variation in different strips were quite marked and it increased across the fertility strips.

The overall chilli fruit yields were recorded in the range of 19.81-183.30 q ha^{-1} with an average value of 109.86 q ha^{-1}. The average of chilli fruit yields were recorded as 103.72 q ha^{-1} in L_0 strip, 110.38 q ha^{-1} in L_1 strip and 115.48 q ha^{-1} in L_2 strip. There was an increasing trend in the fruit yields from L_0 to L_2 strip. The increase in chilli fruit yields with respect to fertility strips may be due to fertility gradient in soil N and P status from L_0 to L_2. Using fertilizer adjustment equations derived under whole field method, a ready reckoner showing optimum N, P and K fertilizer doses at varying soil test values for attaining yield targets of 150, 200 and 250 q ha^{-1} fruit yield of chilli is given in table 4.

Conclusion

It can be concluded from the results that chilli responded to the application of fertilizer P markedly however, responses to applied N and K applications were marginal. Poor crops response to FYM application was noticed. The fertilizer adjustment equations were evolved for chilli to achieve a definite yield target of the crop based on the soil nutrient level and application of FYM. Yield targeting equations can be used for similar soils situation with chosen appropriate yield target within yield range of the main complex experiment. Ready reckoners were prepared based on which a balanced nutrition for chilli crop can be suggested to the farmers through state soil testing laboratory.

References

Bhargava, G. P. (2001). Nutrient management for rice, based on targeted yield concept in mediam black soil of Satpura and Kaymore plateau in Madhya Pradesh. *JNKVV Research Journal*, **35(1/2)** : 8-11.

Bokkisam, H. B., H. T. Channal, B. I. Bidari and G. B. Shashidhara (2010). Effect of nutrient ratios on yield and economics of chilli (*Capsicum annuum* L.) cv. BYADGI DABBI in a vertisol of northern transitional zone of Karnataka. *Asian Journal of Soil Science*, **4(2)** : 198-200.

Deshmuka, K. K., N. K. Bisen and N. K. Singh (2012). Effect of soil test crop response technology on productivity and economics of major crops of Seoni district of Madhya Pradesh. *Journal of Soils and Crops*, **22(1)** : 54-57.

Hanway, T. J. and H. Heidal (1952). Soil analysis methods as used in Iowa state soil testing laboratory. *Iowa Agriculture*, **57** : 1-31.

Jackson, M. L. (1973). *Soil Chemical Analysis*. Prentice Hall of India Pvt. Ltd, New Delhi.

Kimetu, M., D. N. Mugendi, C. A. Palm, P. K. Mutuo, C. N. Gachengo, S. Nandwa and B. Ungu (2004). *African network on soil biology and fertility*. p. 207-224.

Olsen, S. R., C. V. Cole, F. S. Watanabe and L. A. Dean (1954). Estimation of available phosphorous in soils by extraction with sodium bicarbonate. *USDA Circular*. **1**, p. 939.

Ramamoorthy, B., R. L. Narasimham and R. S. Dinesh (1967). Fertilizer application for specific yield target of sonara-64 wheat. *Indian Farming*, **17(5)** : 43-45.

Rao, B. R. B. and M. V. Shantaram (2001). Soil test based fertilizer recommendation for rice (*Oryza sativa*) for alfisols of Karimnagar district of Andra Pradesh. *Indian Journal of Dryland Agricultural Research and Development*, **16(2)** : 97-103.

Reddy, K. C. and S. R. Ahmed (2000). Soil test based fertilizer recommendation for maize grown in inceptisols of Jagtiyal in Andhra Pradesh. *Journal of Indian Society of Soil Science*, **48(1)** : 84-89.

Regar, K. and Y. V. Singh (2014). Fertilizer recommendation based on soil testing for the testing for targeted yield on rice in eastern plain zone of U.P. An Ineternational Quarterly Journal of Life Science. *The Bioscan*, **9(2)** : 531-534.

Sridevi, V., V. Chellamuthu and S. Jeyaraman (2011). System of rice intensification - A review. *Agri. Review*, **32** : 120-126.

Srinivas, A., B. R. C. P. Rao, K. C. K. Reddy and G. R. M. Sankar (2001). Soil test based fertilizer recommendations for attaining different yield targets of rice under rice-rice crop sequence in Vertisols. *Journal of Research ANGRAU*, **29** : 69-74.

Srinivasan, S. and A. Angayarkanni (2010). Fertilizer recommendation based on soil test crop response for high targeted yield. *Oryza – An International Journal on Rice*, **47(4)** : 287-290.

Subbiah, B. V. and G. L. Asija (1956). A rapid procedure for assessment of available nitrogen to rice plots. *Current Science*, **31** : 196-200.

Troug, E. (1960). *Fifty years of soil testing*. Transactions of 7th International Congress of Soil Science, Vol. **3**, Commission **IV**, Paper No. **7**, 46-53.

Walkley, A. and I. A. Black (1934). An examination of the Degtijariff method for determining soil organic matter and a proposed modification of the chromic acid titration method. *Soil Science*, **37** : 29-38.

Xalxo, A., L. K. Srivastava, T. Patel and V. N. Mishra (2015). Soil Test Crop Response Correlation with Potato Under IPNS System In Inceptisols of Surguja Hills Zone of Chhattisgarh. Department of Soil Science and Agricultural Chemistry.