Himachal Journal of Agricultural Research 34(2):22-24, 2008

Evaluation of prescription based fertilizer recommendations in toria (*Brassica rapa* cv DK-1) in low hills of Himachal Pradesh

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Abstract

Twenty demonstrations on toria (*Brassica rapa* cv DK-1) were conducted in low hills of Himachal Pradesh to validate and popularize prescription based fertilizer recommendations during *zaid* 2002, 2003, 2004 and 2005. The treatments in each demonstrations comprised of Farmers' Practice (FP), State Level Dose (SLD), Soil Test Based (STB) and two yield targets viz., 10 q/ha (T_{10}) and 15q/ ha (T_{15}). Yield targets showed superiority over SLD and STB in terms of both seed yields and benefit cost ratio. The per cent deviation between pre-fixed and actual yield target was quite satisfactory.

Key words: Prescription based fertilizer recommendations, toria, per cent deviation, B.C ratio.

Introduction

Among many methods and approaches for fertilizer recommendations, prescription based fertilizer recommendations approach is unique because the nutrient doses are calculated from fertilizer adjustment equations developed by conducting soil test crop response experiments (Ramamoorthy *et al.*, 1967). This approach takes into account three basic parameters viz., nutrient requirements of crops, efficiency of soil available nutrients and efficiency of nutrients added through fertilizers. Also, it provides a scientific basis for balanced fertilization not only between the soil and fertilizer nutrients but also amongst the soil available nutrients themselves, compared to general soil test recommendations. The fertilizer adjustment equations so developed for different agro-climatic zones are verified for their usefulness on farmers' fields by conducting validation trials. Present demonstrations were also conducted on farmer's fields with the objective of evaluating prescription based fertilizer adjustment equations developed for toria grown in low hills of Himachal Pradesh for their popularization among farmers.

Material and Methods

Twenty demonstrations on toria (*Brassica rapa* cv DK-1) comprising of five each during 2002, 2003, 2004 and 2005 were conducted on farmers' fields in low hills of Himachal Pradesh. The treatments in each demonstration comprised of Farmers' Practice (FP), State Level Dose (SLD), Soil Test Based (STB) and two yield targets viz., 10q/ ha (T_{10}) and 15 q/ ha (T_{15}).

The area under each treatment was kept 500 m^2 at each location. The fertilizer adjustment equations developed earlier were used for calculation of nutrient doses for yield target treatments. These were, FN = 5.33 T- 0.06 SN, FP_2O_5 = 3.67 T- 0.27 SP and FK_2O = 5.63 T-0.69 SK where FN, FP_2O_5 and K_2O are the fertilizer nutrient doses for N, P_2O_5 and K_2O, in kg ha^{-1}, respectively; T is the yield target in q ha^{-1}; SN, SP and SK are the soil test values in kg ha^{-1} for available N, P and K, respectively. Initial soil samples before sowing of toria were collected from different locations. The soil samples were processed in the laboratory and analyzed for determination of available N,P and K by alkaline $KMnO_4$,Olsen-P and ammonium acetate methods, respectively. The nutrient doses using above mentioned fertilizer adjustment equations were calculated for yield target treatments (T_{10} and T_{15}). Whole of N, P and K were applied at sowing time through urea, SSP and muraite of potash. All standard cultural practices were followed in raising toria crop upto maturity. The seed yield was recorded treatment wise.

Results and Discussion

Nutrient Doses

The average initial soil test values of N, P and K for selected locations on which these demonstrations were conducted indicated average N and K status in low range and average P in medium range (Table 1). The average initial soil

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test values of N, P and K for all four years varied from 125 to 205, 10 to 22 and 71 to 112 kg/ha, respectively. The fertilizer nutrient doses applied as per Farmer's Practice, SLD and STB along with calculated nutrient doses as per fertilizer adjustment equations for yield target of 10 and 15 q/ha of toria are given in Table 2. As is evident from the data in table 2 that the N, P_2O_5 and K_2O doses were substantially higher under SLD and STB treatments as compared to yield targets of 10 q/ha for all four years. However, for yield target of 15 q/ha, the N doses was almost same (68 – 73 kg/ha) as it was for STB (75 kg/ha) treatments for all four years. As far as P_2O_5 doses were concerned, they were somewhat higher (49-52 kg/ha) and K_2O were quite low (7-28 kg/ha) for yield target of 15 q/ha when compared with P_2O_5 (42-45 kg/ha) and K_2O (45-50 kg/ha) doses for STB treatment. The variations in fertilizer doses for 15 q/ha yield target and STB were due to difference in methodologies of fertilizer doses calculations based on initial soil test values. As initial soil test values of P were in medium category of soil fertility class, the SLD dose of P was not changed for STB but was increased for yield target of 15 q/ha as per calculations from fertilizer adjustment equations. The initial soil test values of K however were in low range of soil fertility class; hence the SLD dose of K was increased by 25 per cent for STB. K dose calculated as per fertilizer adjustment equations for yield target of 15 q/ha were almost less than half to half of that applied in STB. This clearly indicated the importance of balanced nutrition as per crop need on the basis of initial soil test values under prescription based fertilizer recommendations.

Table 1. Initial soil test values for available N, P and K of different demonstrations

Year	Initial Soil test values (kg/ha)					
	N		P		K	
	Range	Mean	Range	Mean	Range	Mean
2002	140-174	157	7-13	10	61-102	81
2003	162-248	205	11-31	21	91-132	112
2004	102-148	125	14-29	22	52-89	71
2005	141-176	159	8-16	12	62-102	82

Table 2. Nutrient doses applied at sowing in toria (cv DK-1) demonstration plots*

Treatments	Nutrient doses (kg/ ha)											
	2002			2003			2004			2005		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
FP	30	0	0	30	0	0	30	0	0	30	0	0
SLD	60	40	40	60	40	40	60	40	40	60	40	40
STB	75	44	50	75	44	45	75	42	45	71	45	50
T_{10}	44	34	1	41	31	0	46	31	8	43	33	2
T_{15}	71	52	21	68	49	7	73	49	22	70	51	28

*Average of 5 locations

Seed yields and economic aspects

The data with respect to seed yield of toria, per cent deviation and economic aspects are given in Table 3. The minimum mean seed yield (5.1 to 6.8 q/ha) was obtained under farmers' practice treatment during four years of experimentation. The yield obtained under SLD ranged from 9.0 to 10.7 q/ha followed by 9.4 to 12.1 under STB treatment from 2002 to 2005 which clearly indicated the importance of soil test based fertilizer application in toria. However, under yield targeting treatments of 10 and 15 q/ha, in spite of applying almost same dose of N, increasing slightly P doses and reducing K doses, the yield level obtained were much higher, viz.11.3

Table 3. Seed yields (q/ha), Per cent deviation and B:C ratio in toria (cv DK-1) in demonstration plots*

Treatments	Seed yield (q/ ha)				Per cent deviation (%)				B: C Ratio			
	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005
FP	5.1	5.0	6.2	6.8	-	-	-		-	-	-	-
SLD	9.0	9.2	10.5	10.7	-	-	-		8.6	8.4	8.6	8.8
STB	9.4	9.6	11.9	12.1	-	-	-		7.7	8.4	8.7	8.6
T_{10}	11.3	11.6	13.1	12.6	+12.8	+12.9	+31.2	+25.6	13.3	17.3	15.9	15.6
T_{15}	14.2	14.6	16.4	17.3	-1.3	-2.8	+9.5	+15.5	11.8	13.6	12.2	12.5

*Average of 5 locations

to 13.1 q/ha for 10 q/ha yield target and 14.2 to 17.3 q/ha for yield target of 15 q/ha, respectively. This supported the usefulness of soil test based fertilizer recommendations on one hand and concept of fertilizing crop as per its need.

The per cent deviation for two yield targets were +12.8 to +31.2 for 10 q/ha yield target and -1.3 to +15.5 for yield target of 15 q/ha. The benefit: cost ratio was much higher under yield target treatments as compared to either SLD or STB. The benefit: cost varied from 13.3 to 17.3 for 10 q/ha yield target and from 11.8 to 13.6 for yield target of 15 q/ha. Similar results have also been reported earlier by Verma and Bhagat (1996), Suri *et al.* (2002) and Sandal *et al.* (2006) on toria under farmers' field conditions.

Conclusion

The results of the present study indicated that toria yield in Sub-montane and low hills Sub-tropical Zone could be targeted successfully up to 15 q/ha with much higher benefit: cost ratio.

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