Vol. 13, No. 2, Page No. 34–38 (2024)
Received : August, 2024, Accepted : October, 2024

The study in Chandauli district of Uttar Pradesh aimed to achieve a Target Yield for Mustard using Soil Test Crop Response (STCR) Technology

Y.V. Singh* Sanjay Kumar Singh[1] and Ajeet Kumar[2]
*AICRP on STCR, Department of Soil Science and Agricultural Chemistry,
Institute of Agricultural Sciences, Banaras Hindu University, Varanasi 221 005 (U.P.)
[1]Department of Soil Science, Tirhut College of Agriculture, Dholi, Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar, India.
[2]Department of Soil Science, Sugarcane Research Institute. Dr Rajendra Prasad Central Agricultural University, Pusa (Samastipur)-848125, Bihar, India.

Abstract

A field experiment was conducted in Hadahi village, Naugarh block in Chandauli district during 2023–2024 to assess yield, soil, plant and fertilizer nitrogen, phosphorus and potassium (NPK) nutrient relationships and calibrate optimum fertilizer doses for attaining yield targets. The fertilizer adjustment equations are derived by the All India Coordinated Research Project, Institute of Agricultural Science, Banaras Hindu University, Varanasi centre. Results revealed that targeted yield of mustard (20 q ha^{-1}) have been achieved by using the plant nutrients on the basis of targeted yield concept (soil test crop response technology). The percent increase in yield was 27.40 % in first location, 31.53 % in second location and 32.67 % third location over Farmers practice i.e. the fertilizer doses the farmers generally applied in the area which was 16.05, 15.30 and 15.55 q ha^{-1}, respectively. The maximum net returns of mustard first location (Rs.48083.30.00), second location (Rs.50533.30), third location (Rs.51933.36) were obtained in treatment where plant nutrients applied as per soil test value (STCR treatment). This technology also maintained the soil available plant nutrients. Thus, for obtaining maximum gain and sustain the soil fertility, application of plant nutrients as per soil test value (STCR technology) is essential. The fertilizer doses were validated for attaining yield targets of 20 q ha^{-1} in farmer's fields. Mustard yield within 10% deviation was attained, which indicated that soil test based fertilizer dose was superior. This approach could be adopted for regions with similar soil and agro-climatic conditions in other parts of the world to increase Mustard yields.

Key words: Target yield, soil test crop response, economics and B:C ratio etc.

Introduction

The mustard plant is any one of several plant species in the genera *Brassica*, *Rhamphospermum* and *Si napis* in the family Brassicaceae (the mustard family). Mustard seed is used as a spice. Grinding and mixing the seeds with water, vinegar, or other liquids creates the yellow condiment known as prepared mustard. The seeds can also be pressed to make mustard oil, and the edible leaves can be eaten as mustard greens. Mustard is one of the oldest recorded spices, with references dating back to 3000 BC. (Mehra, 1968) [4] It was originally known as a condiment, with the term derived from the Latin *mustum*. Over time, various mustard seed combinations led to a wide range of mustard varieties worldwide. Besides being used as a spice, mustard serves multiple purposes, including as a vegetable, oilseed crop, green manure, and fodder.

The targeted yield approach, first time developed is based on soil testing and crop response (STCR) to optimize fertilizer use and maintain soil fertility[6].

This approach has been widely implemented in India since 1967 through the All India Coordinated Research Project on STCR. By using multiple regression equations, the method helps determine nutrient interactions and ensures sustainable crop productivity. The integration of chemical fertilizers with organic manures (IPNS-based STCR) is recommended for improving soil quality and achieving higher yields.

Materials and Methods

The on farm testing trials were conducted in village–Hadahi, block - Naugarh of Chandauli district, Uttar Pradesh, India during year *Rabi* 2023-24 on alluvial soil (Inceptisol). Soil samples (0-15 cm in depth) were collected, dried and passed through 2 mm sieve and analyzed for physico chemical properties as described (Jachson,1973)[3]. Available nitrogen, by the alkaline permanganate method (Subbiah and Asija, 1956) [11], available phosphorus, by Olsen method (Olsen *et al*, 1954) [5] and available potassium, by the ammonium acetate method (Hanway and Heidal, 1952) [2] as described by (Jackson, 1973)[3]. Five fertilizers treatments viz., Control, Farmers practice, General recommendation dose of fertilizer, Soil test crop response (STCR) for 20 q ha^{-1} in Mustard variety of test crop was Ashirbad, 20 q ha^{-1} targeted yield was taken. The targeted yield of crop was decided as per yield potential of varieties. Pre sowing soil samples were analyszed according to the standard procedures. Soil resource inventory of the study area in given in the table 1. Fertilizer prescription equations developed for mustard under STCR- IPNMS on eastern plain zone of utter Pradesh by (Varma *et al.,* 2017) [14], are given below:

Nitrogen dose (kg ha^{-1}) =12.27*T-0.56SN-.09*ON

Phosphorus dose (kg ha^{-1}) = 3.03*T- 1.34* SP-0.10*OP

Potassium dose (kg ha^{-1}) = 3.94*T-0.21*K-0.22*OK

Where, FN, FP_2O_5 and FK_2O are fertilizers 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 through soil in kg ha^{-1}, respectively; ON, OP and OK are N, P and K supplied through FYM in kg ha^{-1}. The treatments imposed were as follows: (i) Control, (ii) Farmer's Practices, (iii) General Recommended Dose (iv) STCR based fertilizer dose for an yield target of 20 q $ha^{-1}$with 2 t ha^{-1} FYM. 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 fertilizer doses were calculated and applied for STCR treatments for various yield targets.

Table 1 Physico-chemical properties of the experimental area

Locations	Physico chemical properties			Fertility status		
	pH	EC (dSm^{-1})	OC (%)	Av-N (kg ha^{-1})	Av-P (kg ha^{-1})	Av-K (kg ha^{-1})
Location-I	7.55	0.36	0.45	216.00	13.80	182.00
Location-II	7.66	0.38	0.49	212.00	14.20	185.00
Location-III	7.42	0.39	0.48	213.00	15.00	182.00

* Av = Available

Table 2 Economics of Verification Trails for Mustard crop

Treatments	Fertilizer dose NPK (kg ha^{-1}) and FYM (t ha^{-1})	Actual mean yield (kg ha^{-1})	Additional yield (kg ha^{-1})	Value of additional yield (Rs.)	Cost of fertilizer (Rs.)	Net benefit (Rs.)	B/C ratio
	Location - I: Name – Sri. Ashok S/O. Sri Prem, Village- Hadahi						
T_1-Control	0-0-0	1235	-	-		-	-
T_2-FP	60-30-30	1560	325	22750	3518.7	19231.30	5.47
T_3-GRD	80-40-40	1695	460	32200	4691.6	27508.40	5.86
T_4-20 q ha^{-1}	126-42-50-2	2075	840	58800	6866.6	51933.36	7.56
	Location - II: Name – Sri Ghabhati Singh S/O Sri Udayi, Village- Hadahi						
T_1-Control	0-0-0	1205	-	-		-	-
T_2-FP	60-30-30	1525	320	22400	3518.7	18881.3	5.37
T_3-GRD	80-40-40	1650	705	31150	4691.6	26458.4	5.64
T_4-20 q ha^{-1}	126-42-50-2	2055	850	59500	8366.6	51133.3	6.11

Note: Mustard@Rs.70.00/kg, N@Rs.17.39/kg P_2O_5@Rs.56.25/kg, K_2O@Rs.26.66/kg.
A miner modification was made in the ready reckoner, FP: Farmers practice i.e. the fertilizer doses the farmers generally applied in the area, GRD: General recommendation of agricultural department of the district on the basis of soil test value, B: C ratio: benefit cost ratios

Results and Discussion

Yield targeting of Mustard based on soil test

Experimental data on follow up trails as frontline demonstration, for each location during the period 2023-24 were conducted in farmers field and are given in Table 2. From the field experiment the basic data on nutrient requirement for producing one quintal grain yield of mustard, percent contribution of nutrients from soil (% CS) and fertilizer (% CF) were evaluated. These basic parameters were used for developing the fertilizer prescription equations under NPK alone. The nutrient requirement of N, P_2O_5 and K_2O were 6.22, 0.99 and 4.25 kg q h^{-1} of grain yield, respectively. The percent contribution of nutrients from soil, fertilizers and farm yard manure were found to be 23.94, 42.53 and 4.02 for N, 70.45, 21.44 and 1.24 for P_2O_5 and 22.14, 90.52 and 4.96 for K_2O, respectively. It was noted that contribution of potassium from fertilizer for mustard was higher in comparison to soil. This high value of potassium could be to the interaction effect of higher doses of N, P coupled with priming effect of starter K doses in the treated plots, which might have caused the release of soil potassium form, resulting in the higher uptake from the native soil sources by the crop[7]. Similar type of higher efficiency of potassic fertilizer was also reported for mustard[1] in alluvial soils.

Target yield of 20 q ha^{-1} has been achieved with comparatively lower application of N and P_2O_5 fertilizers but

higher application of K_2O, in comparison to doses applied in farmer's practice and soil based recommendations. As for example in the alluvial soil of West Bengal, In the winter season highest mustard yield was 6.0 t/ha^{-1} regardless of the N level used but could be raised to 7.4 t/ha^{-1} with increased application of K fertilizers[12]. This is probably due to the higher N use efficiency as well as increased N recovery by crop under increased K application[4]. Yield targets of 20 q ha^{-1} for Mustard Ashirbad were achieved in table.2 from the expected yield targets in all the cases. In all sites, grain yields of mustard through general recommendation (GRD) of fertilizers lagged behind the yield obtained at 20 q ha^{-1} fixed target. These results accorded with the findings of (Singh *et al.,* 2014,a)[8] and(Singh *et al.,* 2015)[9]. Targets tried, targeting for 20 q ha^{-1} recorded relatively higher response ratio it has also recorded higher yields. This might be due to the better use efficiency of applied NPK fertilizers at low yield target levels [10, 11].

However for efficient utilization of applied fertilizer some other parameters like soil pH, organic carbon status etc. should also be considered, since these are the major determining factors of soil nutrient retention. This is for the development of an effective fertilizer schedule as well as nutrient supply source in view of the better nutrient absorption and assimilation by the plants.

Conclusion

The study will help to make guidelines for the amount of fertilizer used in mustard cultivation. The specific yield equation based on soil health will not only ensure sustainable crop production but will also steer the farmers towards economic use of costly fertilizer inputs depending on their financial status and prevailing market price of the crop under consideration.

Acknowledgements

The authors are grateful to Indian Institute of Soil Sciences, Bhopal for providing financial assistance through AICRP on STCR project during the course of investigation.

References

1. Ahmed, S., Raizuddin, M. and Krishna Reddy, P.V. (2002). Optimizing fertilizer doses for rice in alluvial soils through chemical fertilizers, farm yard manure and green manure using soil test values. Agropedology, 12:133-140.
2. Hanway, J.J. and Heidal, H. (1952). Soil analysis methods asused in Iowa state college soil testing laboratory. Lowa State College of Agriculture Bulletin, 57:1-31.
3. Jackson, M.L. (1973). Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd, New Delhi.
4. Marschner, H. (1995). Mineral nutrition of higher plants. Academic Press. London.
5. Olsen, S.R., Cole, C.V., Frank, S.W. and Dean, L.A. (1954) Estimation of available phosphorus by extraction with sodium bicarbonate. United States Department of Agriculture Circular number, 939.

6. Ramamoorthy, B., Narasimham, R.L. and Dinesh, R.S. (1967). Fertilizer application for specific yield targets of sonora - 64 wheat. Indian Farming, 17: 43-45.
7. Ray, P. K., Jana, A. K., Maitra, D. N., Saha, M. N., Chaudhury, J., Saha, S. and Saha, A. R. (2000). Fertilizer prescriptions on soil test basis for jute, rice and wheat in a typic ustochrept. Journal of Indian Society of Soil Science, 48:79-84.
8. Singh, Y.V. and Singh, S.K. (2014,a). Fertilizer prescription for targated yield of rice (Oryaza Sativa L var. Saryu-52) in and Inceptisol of Varanasi. Indian Journal of Ecology, 41(2): 282-285.
9. Singh, Y.V., Dey, Pradip., Singh, S.K. and Kumar, Mukesh. (2015). Impact of soil test crop response technology on yield and economics of wheat in Chandauli district of Uttar Pradesh. Technofame - a journal of multidisciplinary advance research, 1: 52 - 56.
10. Singh, Y.V., Sharma P.K. and Meena, R. (2014). Effect of Soil Test Crop Response Technology on Productivity and Economics of Rice crop of Varanasi district of Uttar Pradesh. Journal of Rural and Agricultural Research, 14(01): 77-80.
11. Subbiah, B.V. and Asija, G.I. (1956). A rapid procedure for determination of available nitrogen in soils. Current Science, 31: 196-198
12. Tiwari, K.N. (2002). Nutrient management for sustainable agriculture. Journal of Indian Society Agriculture Statistics, 50: 374-397.