J. Farm Sci., 36(4): (351-354) 2023

RESEARCH PAPER

Targeted yield approach based site specific nutrient management in Indian mustard (*Brassica juncea* L.) genotypes

A. B. SUSHMITA[1], G. B. SHASHIDHARA[1], B. N. ARAVINDA KUMAR[1] AND B. R. PATIL[2]

[1]Department of Agronomy, [2] Department of Genetics and Plant Breeding
College of Agriculture, University of Agricultural Sciences, Dharwad - 580 005, India
E- mail: sushmitabiradar1999@gmail.com

(Received: November, 2023 ; Accepted: December, 2023)

DOI: 10.61475/JFS.2023.v36i4.05

Abstract: A field experiment was conducted at MARS, University of Agricultural Sciences, Dharwad, Karnataka during *rabi* season 2022-23 on *Vertisols* to evaluate the suitability of site specific nutrient management on growth and yield of Indian mustard (*Brassica juncea* L.) genotypes through targeted yield approach for fertilizer recommendations. The experiment was laid out in strip plot design, horizontal strips with four genotypes *viz*., TDM-304-1, TDM-304-1, TDM-304-1 and NRCHB-101 and vertical strips with three targeted yield levels *viz*., 15, 20 and 25 q ha^{-1}. Genotype TDM-305-1 recorded significantly higher seed yield (1622 kg ha^{-1}) over other genotypes. SSNM based fertilizer application for 20 q ha^{-1}targeted yield recorded significantly higher seed yield (1633 kg ha^{-1}) over 15 and 20 q ha^{-1}. In interaction, genotype TDM-305-1 with a target yield level of 20 q ha^{-1} recorded higher seed yield (1789 kg ha^{-1}) as compared to rest of the treatment combinations. The better yield response of improved genotype TDM-305-1 at 20 q ha^{-1} yield target recoded significantly higher net returns (₹ 49463 ha^{-1}) and B:C ratio (2.59). From the present investigation, it was found that genotype TDM-305-1 at 20 q ha^{-1} yield target recorded significantly higher nutrient uptake of NPK & S and the oil content (39.4%) and oil yield (702.2 kg ha^{-1}).

Key words: Mustard, Nutrient uptake, SSNM, Targeted yield

Introduction

Oilseed crops are the second most important determinants of agricultural economy next only to cereals within the segment of field crops. India is a leading producer of oilseeds. India has the fourth-largest global economy for oilseeds. Among the oilseeds, rapeseed and mustard contribute 28.6 per cent of total area and second in production after China. The family Brassicaceae includes mustard (*Brassica juncea* L.), important winter season *rabi* edible oilseed crop, which is known as *Sasive* in Kannada. The primary oil source in Asia's subtropics is Indian mustard, often known as rai (*Brassica juncea* L.).Canada, China, the European Union, India, Australia and Germany are the top mustard producers. In India, the area, production and productivity of rapeseed-mustard were 7.9 million hectares, 11.9 million tons and 1497 kilogram per hectare, respectively (Anon., 2022).

Fertilizer requirement of different crops vary due to their differential production potential and ability to mine nutrients from native and applied fertilizer sources. Therefore, the quantity of fertilizers to be applied depends upon the initial nutrient status of the soil, nutrient requirement of the crop to produce desired yield and thereby soil test value needs considerable attention. For achieving a definite targeted yield, required quantity of nutrients need to be applied to the crop and this requirement of nutrients can be calculated by taking into consideration the contribution of soil available nutrients and fertilizer nutrients for total uptake. This forms the basis for the fertilizer recommendation for the targeted yield of crops (Subba Rao and Srivastava, 2001).

The existing practice in farmers' fields is application of general dose of fertilizers to mustard crop without considering the soil type and crop response. This needs to be given new dimension. The balanced and adequate nutrition is the most important in achieving the targeted and quality yields. This necessitates the remodelling of our approach to the problem of economic and judicious use of fertilizers based on the soil test crop response approach.

Material and methods

A field experiment was conducted during the *rabi* season 2022-23 at MARS Dharwad on medium to deep black soils (*Vertisol*). The soil was low in available nitrogen (248 kg ha^{-1}), medium in available phosphorus (31 kg ha^{-1}) and potassium (317 kg ha^{-1}) and low in available sulphur (21.6 kg ha^{-1})with neutral to alkaline soil reaction (7.2). The treatments consisted of four genotypes (TDM-304-1, TDM-305-1, TDM-306-1 and NRCHB-101) andthree targeted yield levels of mustard (15, 20 and 25 q ha^{-1}) with three replications in strip plot design. Mustard was sown on October28th 2022 with 45 cm × 10 cm spacing. The fertilizer dose was calculated by using the basic data *viz*., nutrient requirement (NR) in kg q^{-1} of mustard yield, the per cent contribution from soil available nutrients (%CS) and the per cent contribution from applied fertilizer nutrients (%CF) (Table 1). The above mentioned parameters are calculated as follows:

Nutrient requirement (NR) of N, P, K and S for grain production

$$\text{kg of nutrients/q of yield} = \frac{\text{Total uptake of nutrients (kg)}}{\text{Seed yield (q)}}$$

Table 1. The essential basic data required for formulating fertilizer recommendation for targeted yield of mustard are:

Parameters	Nitrogen	Phosphorus	Potassium	Sulphur
NR (kg q^{-1} of produce)	5.3	3.3	2.6	1.5
Uptake value in control plot (kg ha^{-1})	24.94	7.81	42.56	5.9
Uptake value in treated plot (kg ha^{-1})	78.36	26.44	66.11	18.40
Soil test values (kg ha^{-1})	248	31	317	21.6

Contribution of nutrients from soil (% CS)

$$\% CS = \frac{\text{Total uptake in control plots (kg ha}^{-1})}{\text{Soil test values of nutrient (kg ha}^{-1})} \times 100$$

Contribution of nutrients from fertilizer (CF)

CF = Total uptake of nutrients – (Soil test values of nutrients × CS/100)

Contribution (per cent) from fertilizer

CF (per cent) = CF/Fertilizer dose (kg ha^{-1}) × 100

Calculation of fertilizer dose:

The basic data are transformed into workable adjustment equation as follows;

$$i.e., \text{Fertilizer dose} = \frac{NR}{CF} \times 100 \times T - \frac{CS}{CF\ (\%)} \times STV$$

Where, T = Targeted yield, STV= Soil test value

$$\text{Fertilizer N} = \frac{NR}{CF} \times 100 \times T - \frac{CS}{CF\ (\%)} \times STV\ (N)$$

$$\text{Fertilizer P} = \frac{NR}{CF} \times 100 \times T - \frac{CS \times 2.29}{CF\ (\%)} \times STV\ (P)$$

$$\text{Fertilizer K} = \frac{NR}{CF} \times 100 \times T - \frac{CS \times 1.20}{CF\ (\%)} \times STV\ (K)$$

$$\text{Fertilizer S} = \frac{NR}{CF} \times 100 \times T - \frac{CS}{CF\ (\%)} \times STV\ (S)$$

Nitrogen was partly applied in the form of urea and DAP while phosphorus, potassium and sulphur were applied in the

Table 2. Seed yield, stalk yield and harvest index of mustard genotypes as influenced by different levels SSNM practices

Treatments		Seed yield (kg ha^{-1})	Stalk yield (kg ha^{-1})	Harvest index	Net returns (₹ ha^{-1})	B:C ratio
Horizontal strips (Genotypes) (G)						
G_1	TDM-304-1	1320 ^{b**}	3585 ^{b}	0.269^{b}	28256^{b}	1.90^{b}
G_2	TDM-305-1	1622 ^{a}	4011 ^{a}	0.287^{a}	41861^{a}	2.34^{a}
G_3	TDM-306-1	1605 ^{a}	3998 ^{a}	0.286^{a}	41101^{a}	2.32^{a}
G_4	NRCHB-101	1588 ^{a}	3957 ^{a}	0.286^{a}	40356^{a}	2.29^{a}
S. Em±		25.0	32.2	0.003	1126	0.04
Vertical strips (Targeted yield levels) (T)						
T_1	Target yield 15 q ha^{-1}	1374 ^{b}	3620 ^{c}	0.275^{b}	33114^{c}	2.15^{b}
T_2	Target yield 20 q ha^{-1}	1633 ^{a}	4088 ^{a}	0.285^{a}	42451^{a}	2.37^{a}
T_3	Target yield 25 q ha^{-1}	1594 ^{a}	3956 ^{b}	0.287^{a}	38117^{b}	2.13^{b}
S. Em±		35.0	57.3	0.004	1568	0.05
Horizontal x Vertical (G x T)						
G_1T_1	TDM-304-1+ Target yield 15 q ha^{-1}	1218 ^{d}	3322 ^{g}	0.268^{b}	26053^{g}	1.90^{de}
G_1T_2	TDM-304-1+ Target yield 20 q ha^{-1}	1374 ^{c}	3724 ^{e}	0.270^{b}	30788^{ef}	1.99^{d}
G_1T_3	TDM-304-1+ Target yield 25 q ha^{-1}	1368 ^{c}	3708 ^{ef}	0.269^{b}	27928^{fg}	1.83^{e}
G_2T_1	TDM-305-1+ Target yield 15 q ha^{-1}	1388 ^{c}	3617 ^{f}	0.277^{b}	33733de	2.17^{c}
G_2T_2	TDM-305-1+ Target yield 20 q ha^{-1}	1789 ^{a}	4312 ^{a}	0.293^{a}	49463^{a}	2.59^{a}
G_2T_3	TDM-305-1+ Target yield 25 q ha^{-1}	1689 ^{b}	4106^{bc}	0.291^{a}	42388^{bc}	2.26^{c}
G_3T_1	TDM-306-1+ Target yield 15 q ha^{-1}	1452 ^{c}	3775 ^{e}	0.278^{b}	36598^{d}	2.27^{c}
G_3T_2	TDM-306-1+ Target yield 20 q ha^{-1}	1699 ^{ab}	4195 ^{ab}	0.288^{a}	45368^{ab}	2.46^{ab}
G_3T_3	TDM-306-1+ Target yield 25 q ha^{-1}	1666 ^{b}	4023 ^{cd}	0.291^{a}	41338^{bc}	2.23^{c}
G_4T_1	NRCHB-101+ Target yield 15 q ha^{-1}	1440 ^{c}	3767 ^{e}	0.276^{b}	36073^{d}	2.25^{c}
G_4T_2	NRCHB-101+ Target yield 20 q ha^{-1}	1672 ^{b}	4122^{bc}	0.288^{a}	44183^{bc}	2.42^{b}
G_4T_3	NRCHB-101+ Target yield 25 q ha^{-1}	1654 ^{b}	3938 ^{d}	0.290^{a}	40813^{c}	2.21^{c}
S. Em±		29.3	34.6	0.003	1320	0.04

**: Means followed by same letter (s) within the column did not differ significantly by DMRT (p=0.05)

· The calculated fertilizer dose (kg ha^{-1}) of SSNM treatment for different targeted yield levels of mustard genotypes.

T_1: Targeted yield 15 q ha^{-1} with fertilizer dose 120: 95: 60: 55 NPKS kg ha^{-1}

T_2: Targeted yield 20 q ha^{-1} with fertilizer dose 170: 130: 110: 75 NPKS kg ha^{-1}

T_3: Targeted yield 25 q ha^{-1} with fertilizer dose 220: 170: 155: 95 NPKS kg ha^{-1}

form of diammonium phosphate, muriate of potash and single super phosphate, respectively. Full dose of phosphorus, potassium and sulphur and half the calculated dose of fertilizer (Nitrogen) was applied at the time of sowing and remaining was applied at 45 days after sowing for all the respective treatments. All other agronomic practices were followed as per the package. Observations on growth and yield components of mustard were recorded at 30 days interval from the date of sowing till harvest of the crop. Plant samples collected at harvest were used for estimation of nutrient content. Nitrogen, phosphorus, potassium and sulphur content in plant samples were estimated. Soil samples were collected from each treatment after the harvest of mustard crop to assess the variation in soil properties. Based on the current price of inputs and produce obtained during the year 2022-23, the net profit per hectare and benefit cost (B:C) ratio was worked out by using the formula.

Net profit (₹ ha^{-1}) = Gross income (₹ ha^{-1}) – Cost of cultivation (₹ ha^{-1})

$$\textbf{Benefit:Cost ratio} = \frac{\text{Gross income (₹ ha}^{-1}\text{)}}{\text{Cost of cultivation (₹ ha}^{-1}\text{)}}$$

Results and discussion

The application of optimum doses of fertilizers as per the calculated dose for targeted yield level treatment significantly influenced the yield of mustard. The genotype TDM-305-1 at 20 q ha^{-1} targeted yield level recorded significantly higher seed yield (1789 kg ha^{-1}), stalk yield (4312 kg ha^{-1}), harvest index (0.293) than rest of the treatment combinations. However, seed yield was on par TDM-306-1 with 20 q ha^{-1} (1699 kg ha^{-1}) target yield level. The next best treatment combinations were TDM-305-1 at 25 q ha^{-1} target yield and TDM-306-1 at 25 q ha^{-1} and NRCHB-101 at 20 and 25 q ha^{-1}. However, the TDM-304-1 at 20 q ha^{-1} target yield recorded higher yield (1374 kg ha^{-1}) compared to 15 (1218 kg ha^{-1}) and 25 q ha^{-1} (1368 kg ha^{-1}) target yield level treatment combinations and remains lower values as compare to all other combinations of genotypes with different targeted levels (Table 2). The better yield response in the improved genotype TDM-305-1 genotype with 20 q ha^{-1} targeted yield level is due to better expression of yield attributing parameters like pod length (5.09 cm), number of siliquae per plant (210), number of seeds per siliqua (13.08), and 1000 seed weight (5.97 g) and higher dry matter production at all stages of crop growth (5.7, 27.0 and 48.2 g of dry matter at 30, 60 DAS and harvest, respectively). The morphological characters like plant height, number of primary and secondary branches, leaf area and leaf area index were higher with the TDM-305-1 with 20 q ha^{-1} target yield levels. The better yield is also attributed to significantly higher uptake of all nutrients (139.0, 40.1, 53.2 & 32.2 kg of NPK&S) (Table 3). The same trend was followed with respect net returns and B:C ratio, highest was recorded in the targeted yield level treatment of 20 q ha^{-1} (₹ 49463 ha^{-1} and 2.59) (Table 2). From the present investigation it can be concluded that, significantly higher targeted yield and higher B:C ratio could be achieved upto the targeted yield levels of 20 q ha^{-1}in northern transitional zone of Karnataka. Similar findings are shown by Milap-Chand *et al*. (2006) in mustard, Abhilash *et al.* 2010 and Singh 2020.

Table 3. Nutrient uptake of N, P_2O_5, K_2O and S at harvest of mustard genotypes as influenced bydifferent levels SSNM practices

	Treatments	Nitrogen (kg ha^{-1})	Phosphorus (kg ha^{-1})	Potassium (kg ha^{-1})	Sulphur (kg ha^{-1})
Horizontal strips (Genotypes) (G)					
G_1	TDM-304-1	102.5^{b**}	29.7^{b}	39.6^{b}	23.8^{b}
G_2	TDM-305-1	126.0^{a}	36.4^{a}	48.3^{a}	29.2^{a}
G_3	TDM-306-1	124.6^{a}	36.0^{a}	48.1^{a}	28.9^{a}
G_4	NRCHB-101	123.5^{a}	35.7^{a}	47.7^{a}	28.6^{a}
S. Em±		2.0	0.6	0.8	0.5
Vertical strips (Targeted yield levels) (T)					
T_1	Target yield 15 q ha^{-1}	106.6^{b}	30.9^{b}	41.2^{b}	24.7^{b}
T_2	Target yield 20 q ha^{-1}	126.8^{a}	36.7^{a}	48.8^{a}	29.4^{a}
T_3	Target yield 25 q ha^{-1}	124.0^{a}	35.8^{a}	47.6^{a}	28.7^{a}
S. Em±		2.7	0.8	1.1	0.6
Horizontal x Vertical (G x T)					
G_1T_1	TDM-304-1+ Target yield 15 q ha^{-1}	94.4^{d}	27.4^{d}	36.5^{d}	21.9^{d}
G_1T_2	TDM-304-1+ Target yield 20 q ha^{-1}	106.7^{c}	30.8^{c}	41.2^{c}	24.7^{c}
G_1T_3	TDM-304-1+ Target yield 25 q ha^{-1}	106.5^{c}	30.8^{c}	41.0^{c}	24.6^{c}
G_2T_1	TDM-305-1+ Target yield 15 q ha^{-1}	107.7^{c}	31.2^{c}	41.7^{c}	25.0^{c}
G_2T_2	TDM-305-1+ Target yield 20 q ha^{-1}	139.0^{a}	40.1^{a}	53.2^{a}	32.2^{a}
G_2T_3	TDM-305-1+ Target yield 25 q ha^{-1}	131.3^{b}	38.0^{b}	49.9^{b}	30.3^{b}
G_3T_1	TDM-306-1+ Target yield 15 q ha^{-1}	112.7^{c}	32.7^{c}	43.6^{c}	26.1^{c}
G_3T_2	TDM-306-1+ Target yield 20 q ha^{-1}	131.7^{ab}	38.2^{ab}	50.7^{ab}	30.6^{ab}
G_3T_3	TDM-306-1+ Target yield 25 q ha^{-1}	129.3^{b}	37.3^{b}	49.9^{b}	30.0^{b}
G_4T_1	NRCHB-101+ Target yield 15 q ha^{-1}	111.7^{c}	32.4^{c}	43.2^{c}	25.9^{c}
G_4T_2	NRCHB-101+ Target yield 20 q ha^{-1}	130.0^{b}	37.6^{b}	50.1^{b}	30.1^{b}
G_4T_3	NRCHB-101+ Target yield 25 q ha^{-1}	128.9^{b}	37.2^{b}	49.6^{b}	29.8^{b}
S. Em±		2.4	0.6	0.8	0.5

Conclusion

Among the genotypes the newly bred genotype TDM-305-1 responded well to SSNM at 15 and 20 q ha^{-1} target yield with a deviation of 8.0 to 12.8 per cent. Whereas TDM-306-1 genotype varied 3.3 to 17.7 per cent at above said targeted levels. So, for Northern Karnataka Zone-VIII the TDM-305-1 and TDM- 306-1 may be selected for further fine tuning of yields as compare to NRCHB-101. Application of fertilizer (170:130:110:75 N, P_2O_5, K_2O & S kg ha^{-1}) based on SSNM approach for the target yield up to 20 q ha^{-1} for the all the genotypes is found to be beneficial.

References

Anonymous, 2022, Area, production and productivity of mustard, Ministry of Agriculture and Farmers welfare. *www.indiastat.com*.

Abhilash K D, Shashidhara G B and Bidari B I, 2010, Effect of site specific nutrient management (SSNM) through targeted yield approach on quality parameters of chilli (*Capsicum annuum* L.). M.Sc. (Agri.) Thesis, University of Agricultural Sciences, Dharwad (India).

Milap-Chand, Benbi D and Benipal D S, 2006, Fertilizer recommendations based on soil tests for yield targets of mustard and rapeseed and their validations under farmers field conditions in Punjab. *Journal of the Indian Society of Soil Science*, 54(3): 316-321.

Singh O, 2020, Evaluation of soil-test based fertilizer prescription evolved for mustard (*Brassica juncea*) crop in *Vertisol*, *https://krishikosh.egranth.ac.in/handle/1/5810152742*.

Subba Rao A and Srivastava S, 2001, Soil-test based fertilizer recommendations for targeted yield of crops. Indian institute of soil science Bhopal, Proceedings of national seminar on soil testing for balanced and integrated use of fertilizer and manure.