RESEARCH ARTICLE

EFFECT OF NUTRIENT MANAGEMENT ON YIELD AND QUALITY IN INDIAN MUSTARD (*BRASSICA JUNCEA* L.)

Chandrabhan Kushwaha[1], K.G. Yadav[1], Kamlesh Kumar Yadav[2], Satendra Kumar[2]* and Nishant[1]

Department of Agronomy[1], Department of Soil Science[2]
Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut-250110 (U.P.)
Email: kamlesh.tanda@gmail.com

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Abstract: A field experiment was conducted during *rabi* season, 2015-16 to study the Effect of nutrient management on yield and quality of Indian mustard (*Brassica juncea* L.) variety Pusa Bold at Crop Research Centre Chirori, Meerut. The experimental results revealed that significantly maximum growth parameters (plant height at harvest, and yield attributes (siliqua length, siliqua plant^{-1}, seeds siliqua^{-1} and test weight), yield (grain and stover), compared to rest of the treatments. The increment in seed yield under application of 100% NPK+40 kg S+1.5 B+20 kg Zn ha^{-1} was 25.32 % over 100% NPK..Maximum gross return, net return and B: C ratio was also recorded with the application of 100% NPK+40 kg S+1.5 kg B+20 kg Zn ha^{-1}. Besides, this combination also improves quality of produce and physico-chemical properties of soil.

Keywords: Nutrient management, Indian mustard, Quality

INTRODUCTION

Mustard (*Brassica juncea* L.) is the third important oilseed crop in the world after soybean (*Glycine max*) and palm (*Elaeis guineensis* Jacq.) oil. Among the seven edible oilseed cultivated in India, mustard contributes 28.6% towards the total oilseed production, being the second most important edible oilseed after groundnut. The share of oilseeds is 14.1% in the total cropped area of India and mustard accounts for 3% of it. The global production of mustard and its oil is around 38-42 and 12-14 mt, respectively. India contributes 28.3 and 19.8% in world acreage and production. India produces around 6.9 mt of rapeseed-mustard next to China (11-12 mt) and EU (10-13 mt) with significant contribution in world mustard industry (Anonymous, 2014). By 2050, India needs to produce 17.84 million tonnes of vegetable oils for its nutritional fat requirement of projected 1685 million populations. This target is difficult to achieve at current status of technology and resources management in Indian agriculture (Hegde, 2012). Thus, enhancing the productivity of oilseeds is imperative for self-reliance. India holds 11.3% of world's arable land and only 4% of the water resources to feed 16% of human population and 18% of animal population of the world. Indian oilseed scenario recently presented a picture of virtual stagnation. The technology mission on oilseed (TMO) launched by government of India in 1986 has impacted to overall production of oilseed significantly. The transformation in mustard scenario is commonly known as "Yellow-Revolution" the quantum jump in production of mustard is to be attributed to the development of improved technology. Mustard is coming up as a new crop in many parts of the country with increase in irrigation facilities. However, productivity of mustard and other oilseed crops is low. Oil seed production often suffers from a high degree of variation in annual production owing to their predominant cultivation under imbalance nutrient situation. The situation is further handicapped by input starved conditions with poor crop management. Oilseeds are energy rich crops and obviously the requirement of major nutrients is very high. Improving efficiency and factor productivity under complexities of diminishing quantity response and increasing eco-awareness is critical for sustainable oilseed production. Nitrogen is the most important nutrient, which determines the growth of the mustard crop and increases the amount of protein and yield. Phosphorus and potash are known to be efficiently utilized in the presence of nitrogen. It promotes flowering, setting of siliquae and increase the size of siliquae and yield (Singh and Meena, 2004).

Phosphorus is second most important major plant nutrient after nitrogen for crop production. It has been called as the "key of life for the plants". It is a structural component of cell membranes, chloroplast and mitochondria. It is necessary for such life process of plant as photosynthesis, development of plant cell as well as synthesis and breakdown of carbohydrates and transfer of energy within the plants. It also strengthens the stem of cereal plants and thus reducing their tendency to lodge. Phosphorous also enhances plant cell division. It also helps in flower and seed production and in the development of a strong root system.

Potassium plays an important role in the maintenance of cellular organization by regulating the permeability of cellular membranes and keeping the protoplasm in a proper degree of hydration by stabilizing the emulsion of high colloidal properties. Potassium has a great buffering action and stabilize various enzymes system. It plays role in

*Corresponding Author

photosynthesis and translocation of food from source to sink. It also enhance the plants ability to resist pest attack, moisture stress and cold condition. Adequate supply of this nutrient promotes the formation of fully developed grains with a high starch contents. Sulphur is a crucial element for rapeseed-mustard in determining its seed yield, oil content, quality and resistance to various biotic and abiotic stresses. Besides promoting chlorophyll formation and oil synthesis, it is an important constituent of seed protein, amino acids, various enzymes and glucosinolate. Sulphur increases the seed yield of mustard by 12 to 48% under irrigated and 17 to 124% under rainfed conditions. (Rathore *et. al.*, 2015).

MATERIAL AND METHOD

The experiment was conducted during *Rabi* season of 2015-2016 in the field at the Crop Research Centre, Chirori of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.). The experiment consists of twelve treatments viz., (T_1) Control, (T_2) 100% NPK, (T_3) 100% NPK+20 kg S ha^{-1}, (T_4) 100% NPK+40 kg S ha^{-1}, (T_5) 100% NPK+1.5 kg B ha^{-1}, (T_6) 100% NPK+20 kg Zn ha^{-1}, (T_7) 100% NPK+20 kg S ha^{-1}+1.5 kg B ha^{-1}, (T_8) 100% NPK+20 kg S ha^{-1}+20 kg Zn ha^{-1}, (T_9) 100% NPK+40 Kg S ha^{-1}+1.5 kg B ha^{-1}, (T_{10}) 100% NPK+40 kg S ha^{-1}+20 kg Zn ha^{-1}, (T_{11}) 100% NPK+20 kg S ha^{-1}+1.5 kg B ha^{-1}+20 kg Zn $ha^{-1}$and (T_{12}) 100% NPK+40 kg S ha^{-1}+1.5 kg B ha^{-1}+20 kg Zn ha^{-1}. The experiment was laid out in randomized block design with three replications, P, K, S, Zn and B per plot was applied in the reported treatment from urea (46% N), di ammonium phosphate (46%P_2O_5), muriate of potash(60% K_2O), bentonite sulphur (90% S), zinc chelate (99% Zn) and borex (11% B). The half dose of nitrogen and full dose of phosphorus, potassium, sulphur, zinc and boron was applied as basal and rest half amount of nitrogen was applied as top dressing at 35 DAS. The various plant growth studies were carried out at 30, 60, 90 DAS and finally at harvest as per procedure are given below. The various plant growth studies were carried out at 30, 60, 90 DAS and finally at harvest as per procedure are given below. Five plants selected randomly from each plot were tagged. The height was measured in cm with the help of meter scale from the base of the plant to the top of the plant and mean values were presented. Five plants uprooted plant for dry matter accumulation were also used. The total number of primary and secondary branches of plant was counted and mean values per plant have been presented. Plants were uprooted from per plot at 30, 60, 90 DAS and at harvesting. The plants were sun dried separately and then oven dried at 72 ± 0.5^0C till the constant weight is obtained. The dry matter accumulation was expressed in g $plant^{-1}$.

Soil and plant Analysis

The processed plant samples were analyzed by micro-Kjeldahl method (Jackson, 1967) to determine nitrogen content. Wet digestion (di-acid) method (Jackson, 1973) was used for preparation of aliquot to determine P, K, S, Zn and B content in plant. The protein content (percent) was determined 'as is' via the standard Kjeldahl method using the nitrogen-protein conversion factor of 6.25, the accepted standard. (Kjeldahl, 1883) were as follows: Grain protein content (%) = Nitrogen content (%) X 6.25.Seed samples were collected from each number of plot and analysed for oil content (%) in seeds with the help of Soxhlet apparatus method taking petroleum ether as a solvent (Licitra *et al*., 1996).

Soil analysis

Soil samples were collected from 0-15 cm. depth from each plot. These samples were processed and analyzed for various physico-chemical properties in the laboratory of department of soil science, in Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut. Available nitrogen in soil was determined by alkaline potassium permanganate method (Subbiah and Asija, 1956).Available phosphorus was determined by Ascorbic acid method (Olsen *et al.,* 1954).Available K in the soil was determined by Extraction Method (Hanway and Heidal, 1952). Available sulphur was determined by the turbidimetric procedure (Williams, C.H. and Steinberg, A. 1969) after extraction with calcium chloride reagent. Available zinc was determined by the DTPA extractant method. The soil could be extracted by boiling with water directly on a hot plate.

RESULT AND DISCUSSION

Yield and Yield attributes

Increase in plant height with inorganic sources might be due to higher nutrient supply, rapid conversion of carbohydrates in to protein which in turn elaborated in to protoplasm. The highest plant heights of 198.9 cm at harvest were recorded in T_{12} (100% NPK+ 40 kg S + 1.5 kg B + 20 kg Zn ha^{-1}) crop growth respectively. However the shortest plant height was recorded in control plot (T_1). Nitrogen increased in size of cell, which expressed morphologically increased in plant height. The yield of *Brassica species* is a function of yield attributes like length of siliqua, number of siliquae $plant^{-1}$, number of seeds $siliqua^{-1}$, 1000-seed weight. For these again a good mustard crop is required, which in turn depends upon optimum growth of photosynthetic organs, translocation of nutrients and photosynthesis to developing plant parts and finally larger frame to accommodate more number of yield attributes. The length of siliqua, number of siliquae $plant^{-1}$, number of seeds $siliqua^{-1}$ and 1000-seed weight, g respectively found in T_{12} (100% NPK + 40 kg S + 1.5 kg B + 20 kg Zn ha^{-1}). However the minimum number recorded in control plot (T_1) which was significantly lower than other treatments at all the stages. The balanced nutrient management practices contributed to a great extent influencing the seed yield of mustard. The seed yield increased with the increasing fertility levels and recorded highest grain, Stover and biological yield 22.32, 73.52 and 95.84, q ha^{-1} respectively in $T_{12,}$ where 100% NPK + 40 kg S ha^{-1} + 1.5 kg B ha^{-1} + 20 kg Zn ha^{-1} was applied. However the minimum yield was recorded in control plot (T_1) which was significantly lower than other treatments.

Economics

The total variable cost of cultivation increased slightly with different sources of fertilizer. The highest cost of cultivation (Rs.25726), gross income (Rs.87140), net income (Rs.61414) and benefit cost ratio (2.39) was noted in $T_{12,}$ while the lowest cost of cultivation (Rs.17456), gross income (Rs.39992), net income (Rs.22536) and benefit cost ratio (1.29) was observed in T_1 (control) plot. The highest net income (Rs.61414) of mustard was recorded in T_{12} (100% NPK + 40 kg S ha^{-1} + 1.5 kg B ha^{-1} + 20 kg Zn ha^{-1}) because of highest quantity of seed and stover yield and rates of respective yields. Similar trends were also observed by Singh and Meena (2004).

Table 1. Effect of nutrient management on plant height (cm) at harvest and B: C ratio.

Treatment	At harvest	B:C ratio
Control	128.2	1.29
100% NPK	154.1	2.12
100% NPK + 20 kg ha^{-1} S	167.1	2.26
100% NPK + 40 kg ha^{-1}S	176.6	2.24
100% NPK+ 1.5 kg ha^{-1}B	160.0	2.18
100% NPK+ 20 kg ha^{-1} Zn	165.0	2.05
100% NPK + 20 kg ha^{-1} S + 1.5 kg ha^{-1} B	174.1	2.31
100% NPK + 20 kg ha^{-1} S + 20 kg ha^{-1}Zn	186.7	2.19
100% NPK + 40 Kg ha^{-1} S + 1.5 kg ha^{-1} B	184.4	2.34
100% NPK+ 40 kg ha^{-1} S + 20 kg ha^{-1} Zn	196.3	2.23
100% NPK + 20 kg ha^{-1} S + 1.5 kg ha^{-1} B + 20 kg ha^{-1} Zn	192.1	2.16
100% NPK + 40 kg ha^{-1} S + 1.5 kg ha^{-1} B + 20 kg ha^{-1} Zn	198.9	2.39
SEM(±)	1.0	
C.D. (P=0.05)	3.0	

Table 2. Effect of nutrient management on length of siliqua (cm), number of siliquae $plant^{-1}$, number of seeds $siliqua^{-1}$ and 1000- seed weight of mustard**.**

Treatment	Length of siliqua (cm)	Siliquae $plant^{-1}$	Seeds $siliqua^{-1}$	1000-Seed weight (gm)
Control	4.2	121.3	8.7	4.1
100% NPK	4.9	219.3	12.5	4.4
100% NPK + 20 kg ha^{-1} S	5.5	253.5	14.5	4.8
100% NPK + 40 kg ha^{-1} S	5.7	267.0	14.9	4.9
100% NPK + 1.5 kg ha^{-1} B	5.4	230.7	13.7	4.7
100% NPK + 20 kg ha^{-1}Zn	5.2	239.7	13.7	4.5
100% NPK + 20 kg ha^{-1} S + 1.5 kg ha^{-1} B	5.7	276.0	15.1	5.1

100% NPK + 20 kg ha^{-1} S + 20 kg ha^{-1}Zn	5.6	260.8	14.6	4.9
100% NPK + 40 Kg ha^{-1} S + 1.5 kg ha^{-1} B	6.0	299.3	16.1	5.7
100% NPK + 40 kg ha^{-1} S + 20 kg ha^{-1}Zn	5.9	289.0	15.4	5.7
100% NPK + 20 kg ha^{-1} S + 1.5 kg ha^{-1} B + 20 kg ha^{-1}Zn	5.8	283.3	15.1	5.6
100% NPK + 40 kg ha^{-1} S + 1.5 kg ha^{-1} B + 20 kg ha^{-1}Zn	6.1	311.4	16.6	5.8
SEm(±)	0.1	4.5	0.3	0.1
C.D. (P=0.05)	0.3	13.2	1.0	0.2

Table 3. Effect of nutrient management on seed, stover and biological yield (q ha^{-1}) of mustard, oil content and protein content (%) of mustard

Treatment	**Seed yield q ha^{-1}**	**Stover yield q ha^{-1}**	**Biological yield q ha^{-1}**
Control	10.32	35.87	46.19
100% NPK	17.81	61.88	79.69
100% NPK + 20 kg ha^{-1} S	19.40	66.43	85.84
100% NPK + 40 kg ha^{-1} S	20.09	67.92	88.01
100% NPK + 1.5 kg ha^{-1} B	18.75	64.50	83.25
100% NPK + 20 kg ha^{-1}Zn	18.25	62.95	81.20
100% NPK + 20 kg ha^{-1} S + 1.5 kg ha^{-1} B	20.48	68.61	89.09
100% NPK + 20 kg ha^{-1} S + 20 kg ha^{-1}Zn	19.85	67.49	87.34
100% NPK + 40 Kg ha^{-1} S + 1.5 kg ha^{-1} B	21.44	70.97	92.41
100% NPK + 40 kg ha^{-1} S + 20 kg ha^{-1}Zn	20.91	69.42	90.33
100% NPK + 20 kg ha^{-1} S + 1.5 kg ha^{-1} B + 20 kg ha^{-1}Zn	20.35	68.58	88.93
100% NPK + 40 kg ha^{-1} S + 1.5 kg ha^{-1} B + 20 kg ha^{-1}Zn	22.32	73.52	95.84
SEm(±)	0.34	1.14	1.47
C.D. (P=0.05)	0.99	3.36	4.35

REFERENCES

Anonymous (2014). 3rd advance estimate, Government of India.

Hegde, D.M. (2012). Carrying capacity of Indian agriculture oil seeds. *Current Science* **102**(6): 867-873.

Hegde, D.M. (2012). Carrying capacity of Indian agriculture oil seeds. *Current Science* **102**(6): 867-873.

Hanway, J.J. and Hedal, H. (1952). Soil analysis method used in lowa state soil testing laboratory. *lowa agriculture*. **57**: 1-31.

Jackson, M.L. (1967). Soil Chemical Analysis. *Prentice Hall of Index Pvt. Ltd. New Delhi, India* **498**

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

Olsen, S.R., Cole, C.V., Watanabe, F.S. and Dean, L.A. (1954). Estimation of available phosphorus in soils by extraction with sodium bicarbonate. *Washington, D.C., U.S. Government Printing Office.*

Subbiah, B.V. and Asija, G.L. (1956). A rapid procedure for the estimation of available nitrogen in soils. *Curr. Science*, **25**: 259-260.

Singh, A. and Meena, N.L. (2004). Effect of nitrogen and sulphur on growth, yield attributes and seed yield of mustard (*Brassica juncea* L.) in Eastern plains of Rajasthan. *Indian Journal of Agronomy* **49**(3): 186-188.

Tripathi, M.K., Chaturvedi, S., Shukla, D.K. and Saini, S.K. (2011). Influence of integrated nutrient management on growth, yield and quality of Indian mustard *(Brassica juncea* L.) in tarai region of northern India**.** *Journal of Crop and Weed* **7**(2): 104-107.

Williams, C.H. and Steinberg, A. (1979). Soil sulphure fraction as chemical indices of available sulphure in some Australian soil. *Australian Journal Of Agricultural Research* **10**: 340-352.