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Effect of levels of phosphorus and molybdenum on yield, quality and economics of mustard (*Brassica juncea* L.)

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Abstract

A field experiment was conducted during *Rabi* 2019 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, (U.P). The experiment was laid out in a Randomized Block Design, comprising of two factors and each replicated thrice *viz.*, soil application of Phosphorus (P₁: 40, P₂: 50, P₃: 60 Kg/ha) at the time of sowing and two application methods of Molybdenum as soil (M₁: 0kg/ha, M₂: 2 kg/ha, M₃: 2kg/ha) at time of sowing and (5ppm) as foliar application before the flowering stage and effect was observed on growth and yield of Mustard. Application of Phosphorus and Molybdenum significantly influenced the yield, oil content and economics. Treatment T₉ (60 kg/ha P₂ O₅+ 2 kg/ha + 5ppm Mo) recorded highest seed yield (2715.00) & oil content (41.80%) respectively. Whereas, gross return (₹113749.65), net return (₹75296.32) & b:c ratio (1.96) recorded highest with the treatment T₉ (60 kg/ha P₂ O₅+ 2 kg/ha + 5ppm Mo).

Keywords: Mustard, phosphorus, molybdenum, soil application, foliar application, seed yield

Introduction

Mustard (*Brassica juncea* L.) is an important *Rabi* season oil seed crop growing mainly in Rajasthan, Haryana, Uttar Pradesh, Maharashtra, Karnataka, Madhya Pradesh, and West Bengal, Tamil Nadu., occupying a prominent place being next in importance to groundnut, both in area and production. It is also called as rai, raya or laha. The oil content of mustard seed ranges from 30 - 47% and 20 - 40% protein. Present production of oilseeds in India is around 32.3 million tons from 25.5 million hectare with average productivity 1265 Kg/ha. In India, mustard is cultivated over an area of 6.2 million hectare with production of 9.3 million tons of seeds. The average yield of mustard in country is 1499 Kg/ha. In India, Rajasthan ranks first in production 4.08 million tons and Haryana State has the second highest production of 1.25 million tons of mustard. In U.P. mustard is grown with production of 1.12 million tons and percent share of production to all India 11.96 (Directorate of Economics & Statistics, Department of Agriculture, Cooperation & Farmers Welfare. 2018-2019)^[2].

There may be a number of factors responsible for low yield of mustard in India but poor soil fertility status and sub optimal use of fertilizer nutrients, particularly, phosphorus appears to be most important (Premi and Kumar, 2004)^[5]. Phosphorous plays a vital role as a structural component of cell constituent and metabolically active compounds *i.e.* chloroplasts, mitochondria, phyton, nucleic acid, protein, flavin nucleotides and several enzymes. Phosphorus influences the vigour of plants and root growth. It also encourages the development of nitrogen fixing bacteria, pod formation and hastens the maturity of pods (Tisdale *et al.* 1984)^[7].

Molybdenum is one of the most recognized nutrient elements considered to be essential for the growth of plant also playing important role in structural building of cell wall and cell membrane and synthesis of protein. Mustard is very susceptible to molybdenum deficiency. Growth is markedly reduced and plants develop foliar symptoms like cupping, marginal scorching and loss of lamina. Molybdenum is an essential micronutrient for plants, bacteria, and animals. Mo-deficient plants exhibit poor growth and low chlorophyll and ascorbic acid content (Marschner, 1995)^[4].

Materials and Methods

The experiment was conducted during the *Rabi* season 2019, at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj (U.P.). The soil of the experiment plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.10), low in organic carbon (0.51%), available N (247 kg ha), available P (15.22 kg ha), available K (235 kg ha). The treatments consist of soil application of Phosphorus (P₁: 40, P₂: 50, P₃: 60 Kg/ha) at the time of sowing and Molybdenum (M₁:0kg ha, M₂: 2 kg ha, M₃: 2kg ha+ 5ppm) at the time of sowing and 5ppm as foliar spray at flowering stage respectively.

Results and Discussion

Seed yield (Kg/ha)

The data related to seed yield is presented in Table. 1, which revealed that the seed yield (2715.00 Kg/ha) was found to be significantly higher with the treatment T₉ (60 kg/ha P₂ O₅+ 2 kg/ha + 5ppm Mo) whereas treatments T₈ (60 kg/ha P₂ O₅+ 2 kg/ha Mo) and T₅ (50 kg/ha P₂ O₅+ 2 kg/ha Mo) were found to be statistically at par with treatment T₉. The reason for higher seed yield was that, cumulative effect on improvement in all growth and yield attributing characters under P application might have contributed to the increase in seed yield (Solanki *et al.* 2016)^[6]. Phosphorus with the increasing rates of molybdenum, the percentage of shoot phosphorus increases as well. The results confirm that Mo might affect positively with some nutrients to be available to the plants (Chatterjee *et al.*, 1978)^[1].

Stover yield

The data related to seed yield is presented in Table. 1, which revealed that the stover yield (5149.65 Kg/ha) was found to be significantly higher with the treatment T₉ (60 kg/ha P₂ O₅+ 2 kg/ha + 5ppm Mo) whereas treatments T₈, T₆, T₅, T₄ & T₃ were found to be statistically at par with treatment T₉. Phosphorus is commonly lacking in many soils. Although abundant amount of phosphorus is absorbed and accumulated by rapeseed-mustard group of crops, the actual amount of phosphorus needed in metabolic reactions and structural components of cells are relatively small, (Tisdale *et al.*, 1984)^[7]. May be of importance on Sulphur deficient soils. Under unfavorable conditions for molybdenum uptake, high Sulphur application rates may lead to Mo deficiency and yield responses to Mo fertilization can be expected, (Schnug and Haneklaus, 1990).

Oil content (%)

The data related to the oil content (%) is presented in the Table.1, which revealed that the oil percentage (41.80%) was found to be significantly higher with the treatment T₉ (60 kg/ha P₂ O₅+ 2 kg/ha + 5ppm Mo). The oil content was found to be maximum with phosphorus application @ 60 Kg/ha in mustard related to the findings of (Kundu and Dhaka, 1996)^[3].

Economics

Gross returns (₹113749.65), Net return (₹75296.32) & benefit cost ratio (1.96) were found to be significantly superior in treatment T₉ (60 kg /ha of Phosphorus + 2kg/ha+5ppm).

Table 1: Effect of Phosphorus and Molybdenum Levels on Yield and Quality of Mustard

Treatments	Seed yield (Kg/ha)	Stover yield (Kg/ha)	Oil content (%)
T ₁ : 40 Kg/ha P ₂ O ₅ + 0 Kg/ha Mo	1921.78	4161.39	34.57
T ₂ : 40 Kg/ha P ₂ O ₅ + 2 Kg/ha Mo	2203.11	4545.51	36.24
T ₃ : 40 Kg/ha P ₂ O ₅ + 2 Kg/ha + 5ppm Mo	2304.89	5031.56	35.84
T ₄ : 50 Kg/ha P ₂ O ₅ + 0 Kg/ha Mo	2165.44	4871.12	36.50
T ₅ : 50 Kg/ha P ₂ O ₅ + 2 Kg/ha Mo	2447.33	5101.03	36.10
T ₆ : 50 Kg/ha P ₂ O ₅ + 2 Kg/ha + 5ppm Mo	2153.22	5142.64	36.80
T ₇ : 60 Kg/ha P ₂ O ₅ + 0 Kg/ha Mo	2301.56	4387.83	35.37
T ₈ : 60 Kg/ha P ₂ O ₅ + 2 Kg/ha Mo	2578.89	5087.32	39.57
T ₉ : 60 Kg/ha P ₂ O ₅ + 2 Kg/ha + 5ppm Mo	2715.00	5149.65	41.80
F test	S	S	S
S.Em ±	80.99	94.26	0.69
CD (P = 0.05)	242.82	282.58	2.07

Table 2: Effect of Phosphorus and Molybdenum Levels on Economics of Mustard

Treatments	Cost of cultivation(₹/ha)	Gross Returns(₹/ha)	Net Returns(₹/ha)	B:C Ratio
T ₁ : 40 Kg/ha P ₂ O ₅ + 0 Kg/ha Mo	32915.00	81032.46	48117.46	1.46
T ₂ : 40 Kg/ha P ₂ O ₅ + 2 Kg/ha Mo	38265.00	92669.91	54404.91	1.42
T ₃ : 40 Kg/ha P ₂ O ₅ + 2 Kg/ha + 5ppm Mo	38273.33	97227.16	58953.83	1.54
T ₄ : 50 Kg/ha P ₂ O ₅ + 0 Kg/ha Mo	33005.00	91488.85	58483.85	1.77
T ₅ : 50 Kg/ha P ₂ O ₅ + 2 Kg/ha Mo	38355.00	102994.36	64639.36	1.69
T ₆ : 50 Kg/ha P ₂ O ₅ + 2 Kg/ha + 5ppm Mo	38363.33	91271.58	52908.24	1.38
T ₇ : 60 Kg/ha P ₂ O ₅ + 0 Kg/ha Mo	33095.00	96450.10	63355.10	1.91
T ₈ : 60 Kg/ha P ₂ O ₅ + 2 Kg/ha Mo	38445.00	108242.92	69797.92	1.82
T ₉ : 60 Kg/ha P ₂ O ₅ + 2 Kg/ha + 5ppm Mo	38453.33	113749.65	75296.32	1.96

Conclusion

On the basis of the research findings we can conclude that application of 60kg/ha of Phosphorus along with 2kg/ha+5ppm molybdenum were found beneficial for farmers.

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