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Influence of Potassium and Spacing Yield and Economics of Mustard (*Brassica juncea* L.)

ABSTRACT

A field experiment was conducted during *Rabi* of 2022-23 at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology And Sciences, Prayagraj (U.P.) India. To study the Response of potassium and spacing on growth and yield of Mustard. The treatments consist of potassium 30,40,50 kg/ha and spacing 25 x 10 cm, 35 x 10 cm, and 45 x 10 cm. There were 9 treatments each replicated thrice. The soil of experimental plot was sandy loamy in texture, nearly neutral in soil reaction (pH 7.8), low in organic carbon (0.35%) available N (163.42 kg/ha), available P (21.96 kg/ha) and available K (256.48 kg/ha). Results revealed that the significantly higher number of siliqua per plant (276), higher seeds/siliqua (16.54), higher oil content (44.03%), higher seed yield (2.33 t/ha) and higher stover yield (3.53 t/ha) were significantly influenced with application of potassium 50 kg/ha +spacing 45 x 10 cm. Higher gross returns (INR 116616/ha), higher net returns (INR 85013/ha) and higher B:C ratio (2.69) were also recorded in treatment-9 (Potassium 50 kg/ha +Spacing 45 x 10 cm).

Keywords: *Mustard, Potassium, Spacing, yield attributes, and Economics.*

INTRODUCTION

Among the Brassica family, Indian mustard (*Brassica juncea* L.), also known as raya, rai, or lahi, is a significant oilseed crop, oil seed group in India. After peanuts, it is the second-most significant edible oilseed crop in India and produces close to 30% of all oilseeds grown there. A major category of edible oil seed crops, rapeseed-mustard accounts for around 85% of all rapeseed-mustard produced in India and provides about 26.1% of all oil seed output **(Meena *et al*., 2011)**. After China, it holds the top spot in terms of area and production **(Anonymous, 2009).**

The world's fourth-largest economy for oilseeds is India. The world's largest producer of mustard seed, accounting for 35% of global production, is the European Union. China (22%), Canada (21%), and India (11%) were the next three largest producers worldwide **(GOI, 2018).** With a share of 27.8% in the Indian oilseed market, mustard is the second most popular edible oilseed after groundnut. According to the AICRP on Rapeseed-Mustard (2016), India produced 7.9 million tonnes of rapeseed-mustard with an average productivity of 1,088 kg per hectare. This productivity has to be increased to 2562 kg per hectare by 2030 in order to guarantee edible oil and achieve self-sufficiency **(ICAR-DRMR, 2011).** West Bengal's mustard crop produces less than industrialized nations (1,194 kg/ha) mostly because of unfavorable climatic conditions and a lack of resources proper agronomic management. Most of it is agricultural activities. It also has a variety of applications as spices, condiments, leafy vegetables, and forage-fodder for livestock. **(Jakhar *et al*., 2018)** Livestock. Crops may experience varying levels of nutrient and water stress throughout their life cycle. The crop would experience negative effects from heat stress when grown in a late condition, according to long-term trend analysis data for this location **(Kumari *et al*., 2019)**. When compared to soil treatment, foliar spray of major and micronutrients speeds up nutrient transfer, which is crucial for reducing plant stress. The practice of foliar spraying helps nutrients reach the location of food synthesis directly.

One of the most significant agronomic aspects that influences the yield of all crops is nutrient management. The health of the soil has deteriorated as a result of the ongoing and unbalanced application of specific fertilizer nutrients, which has also increased production costs per unit and slowed the pace of productivity growth. In general, farmers employ predominantly nitrogen and phosphorus as plant nutrients in the growth of mustard, which has the effect of increasing potassium and other nutritional deficits. One of the minerals that plants require in order to grow and develop is potassium. Because plants absorb a significant quantity of it, it is an important plant nutrient. For most cultivated crops, the amount of K taken by roots is second only to nitrogen. Because low soil K status is a significant limiting factor in crop yields, it is critical to assess the effect of K nutrition on mustard production.

Planting patterns are crucial in increasing agricultural yield because they influence the interception, absorption, penetration, and utilization of incoming solar energy. Plant density is another crucial factor that may be managed to maximize productivity per unit land area. The optimal plant density with suitable planting geometry is determined by variety, growth behavior, and agroclimatic conditions. It is also true that certain kinds do not display the same phenotypic features under all environmental situations. Improved cultivars are an essential instrument that has boosted productivity in many areas throughout the world. In addition to many other characteristics, cultivars with better yield potential and a wide range of edaphic and climatic tolerance conditions are critical for enhancing yield per unit area and, as a result, overall production **(Kaur and Singh, 2011).**

Keeping these points in view, the present study entitled "**Influence of Potassium and spacing on yield and economics of Mustard (*Brassica juncea* L.)",** was conducted at Crop Research Farm, Department of Agronomy, Naini Agriculture Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, Uttar Pradesh during *Rabi* season of 2022-23.

Materials and Methods

The experiment was conducted during *Rabi* of 2022-23, Crop Research Farm, Department of Agronomy, Naini Agriculture Institute, Sam Higginbottom University of Agriculture Technology And Sciences, Prayagraj, Uttar Pradesh. Which is located at 25.24' 42'' N latitude, 81.50' 56" E longitude and 98m altitude above the mean sea level (SL). The experiment was conducted in Randomized Block Design with 9 treatments each replicated thrice. The plot size of each treatment was 3m x 3m. Factors are three levels of Potassium (30,40,50 kg/ha) and the spacing 25×10 cm, 35×10 cm, 45×10 cm. The Mustard crop was sown on 15 October 2022. Harvesting was done by taking 1m^2 area from each plot. And from it five plants were randomly selected for recording growth and yield parameters. The treatment details are as follows,

T_1 -(Potassium 30 kg/ha + Spacing 25 x 10 cm),

T_2 -(Potassium 30 kg/ha + Spacing 35 x 10 cm),

T_3 – (Potassium 30 kg/ha + Spacing 45 x 10 cm),

T_4 -(Potassium 40 kg/ha + Spacing 25 x 10 cm),

T_5 -(Potassium 40 kg/ha + Spacing 35 x 10cm),

T_6 -(Potassium 40 kg/ha + Spacing 45 x 10 cm),

T_7 -(Potassium 50 kg/ha + Spacing 25 x 10 cm),

T_8 -(Potassium 50 kg/ha + Spacing 35 x 10 cm),

and T_9 -(Potassium 50 kg/ha + Spacing 45 x 10 cm).

The observations were recorded for plant height, dry weight, Crop growth rate, number of siliqua/plant, number of seeds/siliqua, test weight, seed yield and stover yield. The data was subjected to statistical analysis by analysis of variance method **(Gomez and Gomez, 1976).**

Results and Discussion

<u>Yield Attributes:</u>

Number of siliqua/plant

Observations regarding the post harvest of treatments are given in table 1.

The significant higher number of siliquae/plant (276) were observed in treatment-9 (Potassium 50 kg/ha + Spacing 45 x 10 cm), which was significantly superior over rest of the treatment. However, treatment-8 (Potassium 50 kg/ha + Spacing 35 x 10 cm) was found to be statistically at par with treatment- 9 (Potassium 50 kg/ha + Spacing 45 x 10 cm). With the application of K 50kg/ha, a significantly larger number of siliquae/plant (276) was seen. The fact that K plays a crucial part in plant metabolism, which is a crucial necessity for plant growth and development, may be the cause of this improvement in growth and yield characteristics. These findings are consistent with those of **Lakhan *et al*. (2017)**. And also, this was possibly due to less competition between plants for nutrient, soil moisture, space and solar radiation etc. in wider spacing than closer spacing. This also confirm the results of **Kushwaha *et al.* (2006).**

Number of seeds/siliqua

The significant higher number of seeds/siliquae (16.54) were observed in treatment-9 (Potassium 50 kg/ha + Spacing 45 x 10 cm), which was significantly superior over rest of the treatment. However, treatment-8 (Potassium 50 kg/ha + Spacing 35 x 10 cm) was found to be statistically at par with treatment- 9 (Potassium 50 kg/ha + Spacing 45 x 10 cm). With the application of K 50kg/ha, a significantly larger number of seeds/siliquae (16.54) were seen. Increased transfer of photosynthates from source to sink and greater crop development can be linked to the more seeds per siliquae **(Tripathi *et al*., 2010).**

Test weight (g)

The maximum test weight (4.45 g) was observed in treatment-9 (Potassium 50 kg/ha + Spacing 45 x 10 cm), and the minimum test weight (3.71 g) was observed in treatment-2. However, there was no significant difference among the treatments. The potassium treatment of 50 kg/ha resulted in the highest test weight (4.45 gramme) being reported. According to **Tripathi *et al*. (2010**), increased photosynthate translocation from source to sink and improved crop growth are both responsible for the greater 1000- seed weight.

Oil Content (%)

In data table 1 The significant higher percentage of oil content (44.03%) was observed in treatment-9 (Potassium 50 kg/ha + Spacing 45 x 10 cm), which was significantly superior over rest of the treatment. However, treatment-8 (Potassium 50 kg/ha + Spacing 35 x 10 cm) was found to be statistically at par with treatment- 9 (Potassium 50 kg/ha + Spacing 45 x 10 cm). The significant higher percentage of oil content (44.03%) was observed with addition of K. might have activated the enzymes responsible for producing oil and caused higher oil content. Beneficial effect of K on oil content was also reported by **Singh *et al.* (2017)**.

Seed Yield (t/ha)

The significant higher seed yield (2.33 t/ha) was observed in treatment-9 (Potassium 50 kg/ha+ Spacing 45 x 10 cm), which was significantly superior over rest of the treatment. However, treatment-8 (Potassium 50 kg/ha + Spacing 35 x 10 cm) was found to be statistically at par with treatment- 9 (Potassium 50 kg/ha + Spacing 45 x 10 cm). With the treatment of 50kg/hapotassium, a significantly increased seed output (2.33 t/ha) was noted. The fact that K is crucial for processes including photosynthesis, water interactions, protein synthesis, and at least 60 distinct enzyme systems inside the plant explains why there is an increase in seed production after K treatment. Similar findings are in agreement with **Rohit and Jitendra Singh (2020)**, and a further increase in seed output may be attributable to less competition, which led to more uniform dispersion of the roots and leaves. It encourages a more efficient use of light by improving the absorption of PAR during the blooming stage and radiation during the seed filling stage. Equivalent leaf spacing allowed for more sunlight absorption byeach leaf. That might possibly be because mustard crops are better able to convert solar radiation into the generation of seeds because to larger leaf surfaces that can intercept sunlightand evenly spaced plants **(Beenish *et al*., 2019).**

Stover Yield (t/ha)

The significant higher stover yield (3.53 t/ha) was observed in treatment-9 (Potassium 50 kg/ha + Spacing 45 x 10 cm), which was significantly superior over rest of the treatment. However, treatment-8 (Potassium 50 kg/ha + Spacing 35 x 10 cm) was found to be statistically at par with treatment- 9 (Potassium 50 kg/ha + Spacing 45 x 10 cm). The fact that K is the primary plant nutrient limiting yield in K deficient soils may be the cause of the rise in seed and stover yields brought on by K treatment. According to reports, applied K increases the plant's general growth and development as well as the uptake of important nutrients, leading to increased seed and stover output. Additionally, the role of K in numerous enzymatic reactions, growth processes, hormone production, protein synthesis, and the translocation of photosynthates to reproductive parts may be responsible for the beneficial effect of K application on the yield of mustard **Yadav and others (2013)**.

Harvest Index (%)

The significant higher Harvest index (41.06 %) was observed in treatment-3 (Potassium 30 kg/ha + Spacing 45 x 10 cm), which was significantly superior over rest of the treatment. However, treatment-2 (Potassium 30 kg/ha + Spacing 35 x 10 cm) was found to be statistically at par with treatment- 3 (Potassium 30 kg/ha + Spacing 45 x 10 cm). The trend in the projected study under potash applied plants might be due to decrease in the transpiration rate which ultimately maximize the water retention and utilization **(Syrovy *et al*., 2015).** The performance of potash in the plant growth and development might be due to trigger out the bio-chemical, morphological and physiological processes as a catalyst in the mustard crop plants **(Trivedi *et al*., 2014).**

ECONOMIC ANALYSIS

Gross Returns

Observations regarding the economics of treatments are given in table 2.

It is the total monetary value of the economic produce (seeds) and by-product (stover) obtained from the crops. It is calculated by multiplying the yield of main and by-product with the prevailing market prices which is expressed in INR/ha.

Highest gross return (116616 INR/ha) was obtained in treatment-9 (Potassium 50kg/ha + Spacing 45 x 10 cm) as compared to other treatments.

Net Returns

The net profit from each treatment combination was calculated separately and multiplied to one hectare, by using the following formula.

Net return (Rs/ha)= Gross return (Rs/ha) – cost of cultivation (Rs/ha)

Net return (85013 INR /ha) was found to be highest in treatment-9 (Potassium 50 kg/ha + Spacing 45 x 10 cm) as compared to other treatment.

Benefit Cost Ratio

Benefit : cost ratio was computed as the ratio of net returns and cost of cultivation in the following formula.

$$\text{B:C ratio} = \frac{\text{Net returns (INR/ha)}}{\text{Total cost of cultivation (INR/ha)}}$$

Benefit Cost ratio (2.69) was found to be highest in treatment-9 with (Potassium

50 kg/ha + Spacing 45 x 10 cm) as compared to other treatments.

CONCLUSION

It revealed that with the application of Potassium 50 kg/ha along with the spacing 45 x 10 cm (Treatment-9), has performed positively and improved growth and yield parameters. Higher grain yield, gross returns, net returns and benefit cost ratio were also recorded with application of with Potassium 50 kg/ha along with the spacing 45 x 10 cm (Treatment-9). These findings are based on one season therefore; further trials may be requiredfor further confirmation.

Table 1. Influence of Potassium and Spacing on yield attributes of Mustard.

S. No.	Treatments	No of Siliquae/ plant	No of Seeds/ siliquae	Test weight (g)	Oil content (%)	Seed yield (t/ha)	Stover yield (t/ha)	Harvest index (%)
1.	Potassium 30 kg/ha + Spacing 25 x 10 cm	242	14.11	3.74	38.24	1.54	2.57	37.38
2.	Potassium 30 kg/ha + Spacing 35 x 10 cm	248	14.84	3.71	39.31	1.81	2.69	40.20
3.	Potassium 30 kg/ha + Spacing 45 x 10 cm	252	15.36	3.80	40.71	1.89	2.71	41.06
4.	Potassium 40 kg/ha + Spacing 25 x 10 cm	256	14.96	3.92	39.54	1.81	2.84	38.96
5.	Potassium 40 kg/ha + Spacing 35 x 10 cm	264	15.38	4.05	41.66	1.92	2.92	39.63
6.	Potassium 40 kg/ha + Spacing 45 x 10 cm	266	15.79	4.21	42.63	2.04	3.08	39.81
7.	Potassium 50 kg/ha + Spacing 25 x 10 cm	263	15.27	4.13	39.80	2.10	3.21	39.53
8.	Potassium 50 kg/ha + Spacing 35 x 10 cm	270	16.11	4.31	43.61	2.23	3.41	39.52
9.	Potassium 50 kg/ha + Spacing 45 x 10 cm	276	16.54	4.45	44.03	2.33	3.53	39.76
	F-Test	S	S	NS	S	S	S	S
	S Em±	2.28	0.29	0.17	0.66	0.06	0.06	0.60
	CD (p=0.05)	6.85	0.86	--	1.98	0.17	0.17	1.80

Table 2. Influence of Potassium and Spacing on economics of Mustard

S. No.	TREATMENT COMBINATIONS	Cost of cultivation (INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	B:C RATIO
1.	Potassium 30 kg/ha + Spacing 25 x 10 cm	32336	77077	44741	1.38
2.	Potassium 30 kg/ha + Spacing 35 x 10 cm	31636	90590	58954	1.86
3.	Potassium 30 kg/ha + Spacing 45 x 10 cm	30936	94394	63458	2.05
4.	Potassium 40 kg/ha + Spacing 25 x 10 cm	32669	90740	58071	1.78
5.	Potassium 40 kg/ha + Spacing 35 x 10 cm	31969	95895	63926	2.00
6.	Potassium 40 kg/ha + Spacing 45 x 10 cm	31269	102102	70833	2.27
7.	Potassium 50 kg/ha + Spacing 25 x 10 cm	33003	105255	72252	2.19
8.	Potassium 50 kg/ha + Spacing 35 x 10 cm	32303	111411	79108	2.45
9.	Potassium 50 kg/ha + Spacing 45 x 10 cm	31603	116616	85013	2.69

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