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## Effects of Basal and foliar application of potassium in Indian mustard (*Brassica juncea* L.)

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### Abstract

The present investigation aimed to find out the “Effects of Basal and Foliar Application of Potassium in Indian Mustard (*Brassica juncea* L.) was carried out at Agronomy Research Farm of Faculty of Agriculture and Veterinary Science, Mewar University, Gangrar, Chittorgarh, Rajasthan. Geographically Chittorgarh. The experiment was laid out in Randomized Block Design. Replicated thrice with 09 treatment combinations, comprising like T<sub>1</sub> Control, T<sub>2</sub> 40 kg K at basal, T<sub>3</sub> 20 kg K at basal followed by 20 kg top dressing at 25 DAS, T<sub>4</sub> 30 kg K at basal followed by 10 kg top dressing at 25 DAS. T<sub>5</sub> 2 Foliar applications of KNO<sub>3</sub> at 25 DAS and 50 DAS, T<sub>6</sub> 20 kg K at basal followed by 1 foliar application of KNO<sub>3</sub> at 25 DAS, T<sub>7</sub> 30 kg K at basal followed by 1 foliar application of KNO<sub>3</sub> at 25 DAS, T<sub>8</sub> 20 kg K at basal followed by 1 foliar application of KNO<sub>3</sub> at 50 DAS and T<sub>9</sub> 40 kg K at basal followed by 2 foliar applications of KNO<sub>3</sub> at 25 DAS and 50 DAS.

The application of Potassium fertilizer on productivity was found most effective improve success on growth yield and nutrient uptake of mustard crops. The plant height was found to be maximum (8.74, 45.76 and 173.55 cm) at 20, 40 DAS and at harvest, The higher dry matter accumulation (1.36, 22.44 and 129.60) respectively, were recorded at 20, 40 DAS and at harvest, The maximum leaf area index (8.87), The highest seed yield (1645.00 kg/ha), The maximum biological yield (6174.92 kg/ha), The highest straw yield (4529.92 kg/ha), The higher potassium content (0.47 and 0.59%), The maximum potassium uptake (7.73 and 29.44 kg/ha), The highest net return (₹52250), The maximum B:C (1.74) in under treatment T<sub>9</sub> (40 kg K at basal followed by 2 foliar applications of KNO<sub>3</sub> at 25 DAS and 50 DAS, which was at par with T<sub>5</sub> and T<sub>7</sub>). Whereas the minimum growth yield and nutrient uptake were recorded in T<sub>1</sub> (Control).

**Keywords:** Basal and foliar application of potassium mustard on growth, yield nutrient content, uptake and economics

### Introduction

Indian mustard (*Brassica juncea* L.) is a member of the Brassicaceae family, is commonly known as mustard. The word "mustard. Rapeseed-mustard is currently India's third most important oilseed crop, trailing only groundnut and soybean. India is the world's largest producer, consumer, and importer of oilseeds. Indian mustard (*Brassica juncea* L.), one of nine major oilseeds grown in India, is an important winter season Rabi crop. The gap between rapeseed-mustard production and demand is widening, so production must be increased to achieve self-sufficiency.

The application of potassium enhances the absorption of both native and added major nutrients, improving overall plant growth and development, ultimately leading to increased seed and stover yield. The beneficial effects of potassium on mustard yield are attributed to its role in enzymatic reactions, growth processes, hormone production, protein synthesis, and the translocation of photosynthates to reproductive parts, thus enhancing crop yield. Potassium also contributes to crop quality by regulating stomatal function, improving performance under water stress, and providing resistance to pests, diseases, and lodging (Rao and Srinivasarao, 1996) [5]. In terms of nutrients required by plants, potassium (K) is deemed essential after nitrogen. It is also known as "the quality nutrient" because of its role in several physiological, chemical, and biological processes in plants. Potassium controls stomata's opening and closing, which controls CO<sub>2</sub> intake and improves photosynthesis (Paliwal and Singh, 2014) [4].

Potassium also facilitates protein and starch synthesis in plants. Potassium helps to increase drought tolerance in plants by affecting plant-soil-water relationship besides yield advantage. Therefore, it is required in large amounts for proper growth and development in plants (Paliwal and Singh, 2014)<sup>[4]</sup>.

## Materials and Methods

The field experiment was conducted at Agriculture Research Farm, Mewar University Gangrar, Chittorgarh, Rajasthan during 2024-25, which is situated at South- East part of Rajasthan at an elevation of 582.17m above mean sea level at 24°35' N latitude and 73 ° 42' E longitude. It falls under the agro- climatic zone IV A i.e. Sub humid Southern Plain and the Aravalli hills of Rajasthan. The experiment consisted of nine treatment combinations involving different levels of potassium fertilizers with use of RGN-73 variety planting at 20 cmX30 cm. spacing.

## Results and Discussion

### Growth parameters

The showed in (Table 1) of mustard changed with the advancement of the growth period on all the observation the increase in plant height was found to be maximum (8.74, 45.76 and 173.55 cm) at 20, 40 DAS and at harvest under treatment T<sub>9</sub> (40 kg K at basal followed by 2 foliar applications of KNO<sub>3</sub> at 25 DAS and 50 DAS, which was at par with T<sub>7</sub> and T<sub>5</sub>). The significantly effect of potassium on dry matter accumulation. The maximum dry matter accumulation (1.36, 22.44 and 129.60) respectively, were recorded at 20, 40 DAS and at harvest, under treatment T<sub>9</sub> (40 kg K at basal followed by 2 foliar applications of KNO<sub>3</sub> at 25 DAS and 50 DAS, which was at par with T<sub>7</sub> and T<sub>5</sub>, the maximum leaf area index (8.87). It maintains the balance between respiration and transpiration. K deficient plants show a reduced rate of photosynthesis and mottled chlorosis. Amanullah and Khan (2015) also reported that increasing rate of K fertilizer increased the growth and development of the plant. Because of osmotic activity of potassium provides the physical force that expands cells during growth. New cells accumulate K in the large central vacuole that occupies 80 to 90% of the cell volume. The K attracts water and inflates the cell, stretching it to a new larger size. Potassium-deficient plants can exhibit low growth rates and small cells (Khan *et al.*, 2004)<sup>[2]</sup>. It performs many functions in plant such as promoting growth, aiding in translocation of plant substances, maintenance of stability and pH control, strengthening plant tissues, promoting root growth in conjunction with adequate supply of phosphorus, regulating water utilization by plant improving quality by counteracting the undesirable effects due to excessive supply of major growth promoting element nitrogen. In the preceding section, it was emphasized that application of 40 kg K at basal followed by 2 foliar applications of KNO<sub>3</sub> at 25 DAS and 50 DAS did cause about significant improvement in overall growth of the crop expressed in terms of plant height, number of branches by virtue of photosynthetic efficiency. Thus, its greater uptake and active participation in all structure, carbon assimilation, photosynthesis, starch formation, translocation of protein and sugar, entry of water into plants and root development increased growth attributes under adequate potassium supply, which was responsible for better performance of yield attributes with higher rate of fertilizer consisting of

higher levels of potassium. The present findings are within the close vicinity of those reported with application of potassium by Tahir *et al.* (2003)<sup>[9]</sup>, Khatkar *et al.* (2009)<sup>[3]</sup>, Singh *et al.* (2010)<sup>[8]</sup> and Bhati *et al.* (2014)<sup>[1]</sup>.

### Yield attributes and yield

The significantly effect of potassium on yield data presented in Table 2. The highest seed yield (1645.00 kg/ha) respectively, was recorded under treatment T<sub>9</sub> (40 kg K at basal followed by 2 foliar applications of KNO<sub>3</sub> at 25 DAS and 50 DAS, which was at par with T<sub>7</sub> and T<sub>5</sub>. Effect of potassium on biological yield maximum biological yield (6174.92 kg/ha) respectively, was recorded under treatment T<sub>9</sub> (40 kg K at basal followed by 2 foliar applications of KNO<sub>3</sub> at 25 DAS and 50 DAS), which was at par with T<sub>7</sub> and T<sub>5</sub>. Straw yield of mustard changed with on all given treatment. The highest straw yield (4529.92 kg/ha) under treatment T<sub>9</sub> (40 kg K at basal followed by 2 foliar applications of KNO<sub>3</sub> at 25 DAS and 50 DAS), which was at par with T<sub>7</sub> and T<sub>5</sub>. This increase in seed yields due to K application may be attributed to the fact that K is main yield limiting plant nutrient in K deficient soils. Applied K is reported to enhance the absorption of native as well as added major nutrients and thereby improves overall growth and development of plant and ultimately the seed yield. In addition the beneficial influence of K application on the yield of mustard may be attributed to its role in various enzymatic reactions, growth processes, hormone production and protein synthesis and also the translocation of photosynthates to reproductive parts thereby leading to higher yield of crop. Yadav *et al.* (2024)<sup>[10]</sup>, Yadav *et al.* (2013)<sup>[11]</sup> and Paliwal and Singh (2014)<sup>[4]</sup> reported similar results in mustard. The high yield associated with higher level of potassium application might be due to its greater uptake and active participation in all structure, cell elongation, carbon assimilation, starch formation, translocation of protein and sugar, entry of water into plants root development, plant tolerance to diseases, drought and cold as well for making the balance between protein and carbohydrates in Indian mustard (Singh *et al.*, 2010)<sup>[8]</sup>.

### Nutrient content and uptake

A data Table 3 examine the significantly effect of potassium on potassium content in seed and straw. The higher potassium content (0.47 and 0.59%) respectively, was recorded in seed and straw under treatment T<sub>9</sub> (40 kg K at basal followed by 2 foliar applications of KNO<sub>3</sub> at 25 DAS and 50 DAS, which was at par with T<sub>7</sub> and T<sub>5</sub>. Potassium uptake of mustard by seed and straw changed with on all given treatment. The maximum potassium uptake (7.73 and 29.44 kg/ha) in seed and straw under treatment T<sub>9</sub> (40 kg K at basal followed by 2 foliar applications of KNO<sub>3</sub> at 25 DAS and 50 DAS, which was at par with T<sub>7</sub> and T<sub>5</sub>). Thus, the beneficial effect of K on photosynthesis and metabolic processes augments the production of photosynthates and their translocation in different plant parts including seed, which ultimately increased the uptake of N in seed and straw. These results are in accordance with the findings of Singh (2017)<sup>[7]</sup>.

### Economics

Significantly noted net return of mustard data showed in Table 4. The highest net return (₹52250) in under treatment T<sub>9</sub> (40 kg K at basal followed by 2 foliar applications of

KNO<sub>3</sub> at 25 DAS and 50 DAS, which was at par with T<sub>7</sub> and T<sub>5</sub>). Benefit cost ratio of mustard maximum B: C (1.74) in under treatment T<sub>9</sub> (40 kg K at basal followed by 2 foliar

applications of KNO<sub>3</sub> at 25 DAS and 50 DAS, which was at par with T<sub>5</sub> and T<sub>7</sub>). Similar result was found by Sharma and Thakral (2023)<sup>[6]</sup>.

**Table 1:** Effect of Basal and Foliar Application of Potassium on growth of Indian Mustard

| S. No.         | Treatments details                                                                          | Plant height (cm) |        |            | Dry matter accumulation |        |            | Leaf Area Index |
|----------------|---------------------------------------------------------------------------------------------|-------------------|--------|------------|-------------------------|--------|------------|-----------------|
|                |                                                                                             | 20 DAS            | 40 DAS | At harvest | 20 DAS                  | 40 DAS | At harvest |                 |
| T <sub>1</sub> | Control                                                                                     | 5.76              | 34.65  | 143.54     | 1.23                    | 13.22  | 117.54     | 5.66            |
| T <sub>2</sub> | 40 kg K at basal                                                                            | 6.87              | 36.54  | 145.65     | 1.25                    | 14.87  | 118.50     | 6.87            |
| T <sub>3</sub> | 20 kg K at basal followed by 20 kg top dressing at 25 DAS                                   | 6.87              | 36.75  | 147.65     | 1.27                    | 15.55  | 121.33     | 7.22            |
| T <sub>4</sub> | 30 kg K at basal followed by 10 kg top dressing at 25 DAS                                   | 7.55              | 37.55  | 148.55     | 1.28                    | 16.33  | 122.44     | 7.35            |
| T <sub>5</sub> | 2 Foliar applications of KNO <sub>3</sub> at 25 DAS and 50 DAS                              | 8.54              | 42.76  | 156.44     | 1.33                    | 17.55  | 127.55     | 8.65            |
| T <sub>6</sub> | 20 kg K at basal followed by 1 foliar application of KNO <sub>3</sub> at 25 DAS             | 7.98              | 38.65  | 153.54     | 1.28                    | 16.76  | 124.54     | 7.56            |
| T <sub>7</sub> | 30 kg K at basal followed by 1 foliar application of KNO <sub>3</sub> at 25 DAS             | 8.64              | 44.55  | 158.65     | 1.34                    | 20.44  | 127.98     | 8.76            |
| T <sub>8</sub> | 20 kg K at basal followed by 1 foliar application of KNO <sub>3</sub> at 50 DAS             | 8.43              | 42.65  | 154.64     | 1.31                    | 17.33  | 126.44     | 8.44            |
| T <sub>9</sub> | 40 kg K at basal followed by 2 foliar applications of KNO <sub>3</sub> at 25 DAS and 50 DAS | 8.74              | 45.76  | 173.55     | 1.36                    | 22.44  | 129.60     | 8.87            |
|                | S.E. (m) (±)                                                                                | 0.10              | 0.62   | 2.25       | 0.02                    | 0.25   | 1.60       | 0.12            |
|                | CD (P=0.05)                                                                                 | 0.30              | 1.77   | 6.43       | 0.06                    | 0.71   | 4.58       | 0.33            |

**Table 2:** Effect of Basal and Foliar Application of Potassium on Yield of Indian Mustard

| S. No.         | Treatments details                                                                          | Yield (kg/ha) |                  |             |                   |
|----------------|---------------------------------------------------------------------------------------------|---------------|------------------|-------------|-------------------|
|                |                                                                                             | Seed yield    | Biological yield | Straw yield | Harvest index (%) |
| T <sub>1</sub> | Control                                                                                     | 865.00        | 3891.14          | 3026.14     | 22.23             |
| T <sub>2</sub> | 40 kg K at basal                                                                            | 1245.00       | 5288.87          | 4043.87     | 23.54             |
| T <sub>3</sub> | 20 kg K at basal followed by 20 kg top dressing at 25 DAS                                   | 1274.00       | 5405.18          | 4131.18     | 23.57             |
| T <sub>4</sub> | 30 kg K at basal followed by 10 kg top dressing at 25 DAS                                   | 1324.00       | 5466.56          | 4142.56     | 24.22             |
| T <sub>5</sub> | 2 Foliar applications of KNO <sub>3</sub> at 25 DAS and 50 DAS                              | 1512.00       | 6019.11          | 4507.11     | 25.12             |
| T <sub>6</sub> | 20 kg K at basal followed by 1 foliar application of KNO <sub>3</sub> at 25 DAS             | 1445.00       | 5888.35          | 4443.35     | 24.54             |
| T <sub>7</sub> | 30 kg K at basal followed by 1 foliar application of KNO <sub>3</sub> at 25 DAS             | 1425.00       | 5645.80          | 4220.80     | 25.24             |
| T <sub>8</sub> | 20 kg K at basal followed by 1 foliar application of KNO <sub>3</sub> at 50 DAS             | 1465.00       | 5962.56          | 4497.56     | 24.57             |
| T <sub>9</sub> | 40 kg K at basal followed by 2 foliar applications of KNO <sub>3</sub> at 25 DAS and 50 DAS | 1645.00       | 6174.92          | 4529.92     | 26.64             |
|                | S.E. (m) (±)                                                                                | 16.89         | 97.48            | 42.31       | 2.54              |
|                | CD (P=0.05)                                                                                 | 48.26         | 278.49           | 120.88      | NS                |

**Table 3:** Effect of Basal and Foliar Application of Potassium on Potassium content and uptake of Indian Mustard

| S. No.         | Treatments details                                                                          | Potassium content (%) |       | Potassium uptake (kg/ha) |       |
|----------------|---------------------------------------------------------------------------------------------|-----------------------|-------|--------------------------|-------|
|                |                                                                                             | Seed                  | Straw | Seed                     | Straw |
| T <sub>1</sub> | Control                                                                                     | 0.25                  | 0.45  | 2.16                     | 13.32 |
| T <sub>2</sub> | 40 kg K at basal                                                                            | 0.34                  | 0.52  | 4.23                     | 21.03 |
| T <sub>3</sub> | 20 kg K at basal followed by 20 kg top dressing at 25 DAS                                   | 0.36                  | 0.53  | 4.59                     | 21.90 |
| T <sub>4</sub> | 30 kg K at basal followed by 10 kg top dressing at 25 DAS                                   | 0.36                  | 0.55  | 4.77                     | 22.78 |
| T <sub>5</sub> | 2 Foliar applications of KNO <sub>3</sub> at 25 DAS and 50 DAS                              | 0.42                  | 0.62  | 6.35                     | 27.94 |
| T <sub>6</sub> | 20 kg K at basal followed by 1 foliar application of KNO <sub>3</sub> at 25 DAS             | 0.38                  | 0.56  | 5.49                     | 24.88 |
| T <sub>7</sub> | 30 kg K at basal followed by 1 foliar application of KNO <sub>3</sub> at 25 DAS             | 0.44                  | 0.64  | 6.27                     | 27.01 |
| T <sub>8</sub> | 20 kg K at basal followed by 1 foliar application of KNO <sub>3</sub> at 50 DAS             | 0.41                  | 0.59  | 6.01                     | 26.54 |
| T <sub>9</sub> | 40 kg K at basal followed by 2 foliar applications of KNO <sub>3</sub> at 25 DAS and 50 DAS | 0.47                  | 0.65  | 7.73                     | 29.44 |
|                | S.E. (m) (±)                                                                                | 0.04                  | 0.12  | 1.23                     | 3.22  |
|                | CD (P=0.05)                                                                                 | 0.12                  | 0.35  | 3.65                     | 9.65  |

**Table 4:** Effect of Basal and Foliar Application of Potassium on Economics of Indian Mustard

| S. No.         | Treatments Details                                                                          | Net return | B:C  |
|----------------|---------------------------------------------------------------------------------------------|------------|------|
| T <sub>1</sub> | Control                                                                                     | 23250      | 1.16 |
| T <sub>2</sub> | 40 kg K at basal                                                                            | 34250      | 1.22 |
| T <sub>3</sub> | 20 kg K at basal followed by 20 kg top dressing at 25 DAS                                   | 35700      | 1.28 |
| T <sub>4</sub> | 30 kg K at basal followed by 10 kg top dressing at 25 DAS                                   | 38200      | 1.36 |
| T <sub>5</sub> | 2 Foliar applications of KNO <sub>3</sub> at 25 DAS and 50 DAS                              | 46600      | 1.61 |
| T <sub>6</sub> | 20 kg K at basal followed by 1 foliar application of KNO <sub>3</sub> at 25 DAS             | 44250      | 1.58 |
| T <sub>7</sub> | 30 kg K at basal followed by 1 foliar application of KNO <sub>3</sub> at 25 DAS             | 43250      | 1.54 |
| T <sub>8</sub> | 20 kg K at basal followed by 1 foliar application of KNO <sub>3</sub> at 50 DAS             | 45250      | 1.62 |
| T <sub>9</sub> | 40 kg K at basal followed by 2 foliar applications of KNO <sub>3</sub> at 25 DAS and 50 DAS | 52250      | 1.74 |
|                | S.E. (m) (±)                                                                                | 564        | 0.12 |
|                | CD (P=0.05)                                                                                 | 1690       | 0.35 |

## Conclusion

In the light of results summarized above, it may be concluded that for higher growth and seed yield, of 40 kg K at basal followed by 2 foliar applications of KNO<sub>3</sub> at 25 DAS and 50 DAS, should preferred over other combination proved beneficial for getting higher yield and profitability of mustard. The observations are based on one season data, to get more precise information, it is suggested that the experiment.

It can be concluded that the we can suggest to farmer use of 40 kg K at basal followed by 2 foliar applications of KNO<sub>3</sub> at 25 DAS and 50 DAS increasing yield of crops and improved soil nutrient status.

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