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*Full Length Research Paper*

# Effect of nitrogen and split doses of potassium on quality aspects of *Brassica species*

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**Field experiments were conducted on three different *Brassica* spp. (*Brassica juncea, Brassica carinata and Brassica nupus*) with three levels of nitrogen (40, 80 and 120 kg of N ha$^{-1}$) and 2 methods of time of potassium application at 80 kg ha$^{-1}$ ((i) 100% basal and (ii) 50% basal + 50% at the time of 1st irrigation), during Rabi season of 2003 - 2004 and 2004 - 2005 showed that *Brassica* spp. responded significantly to the application of N and K. Maximum oil yield was observed in case of *B. carinata* (PBC-9221) and minimum under *B. napus*. Higher dose of nitrogen 120 kg N ha$^{-1}$ produced maximum oil yield. Split application of potassium also produced higher oil yield than basal dose of potassium.**

**Key words:** *Brassica*, nitrogen, potassium.

## INTRODUCTION

The optimization of fertilizer application is a must to reduce the burden on our foreign exchequer. Since about 50% of the nitrogen fertilizers and all potassium fertilizers are imported, the correct information regarding doses and time of fertilizer application for the new varieties is an urgent need under localized condition. Although, beneficial effect of split application of nitrogen on oilseed crops have been well documented, however, very contradictory and meager information is available on split doses of potassium and its interaction with nitrogen. Most research data shows that basal and split application of potassium is equally good, but some recent studies conducted on oilseed crops show beneficial effect of split doses of potassium over basal doses, due to the fixation and leading loses in intensively cropped area.

*Brassica* oilseed contains 20 - 30% proteins on a whole seed basis, which adds to the value of the seed. The meal by-product after oil extraction contains between 36 - 44% protein and is generally used as animal feed (Kimber and McGregor, 1995). The rapeseed-mustard crop has a high requirement for nitrogen needing considerably more than that provided by most soil, and generous use of nitrogen fertilizer is therefore, necessary for optimum yield (Holmes, 1980). Nitrogen is required in large amount in plant tissues, since it is a component of critical plant constituents including proteins, amino acid, nucleotides, nucleic acids and chlorophyll (Grant and Bailey, 1990). Potassium plays a major part in the enzyme systems that control the metabolism of photo-synthesis and their conversion to oil. Nevertheless, it does not usually have a major effect on oil and protein content of the seed (Holmes, 1980). Different varieties of a crop respond differently under varying climatic and agronomic manipulation especially fertilizer management. Thus, improved varieties have been tested for their agronomic requirements.

The quantum of agronomic research carried out in India for evolving better package of practices for oilseed crops is predominated by fertilizer management via fertilizer doses, its method and time of application. Although, beneficial effect of split application of nitrogen on oilseed crops have been well documented, however very contradictory and meager information is available on split doses of potassium and its interaction with nitrogen. Most research data show basal or split application of potassium is equally good, but some recent studies conducted on oilseed crops show beneficial effects of splits doses of potassium over basal doses, due to the fixation and leaching loses in intensively cropped area.

Keeping these in view of the effect of varying levels of

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**Table 1.** Oil content and oil yield as influenced by nitrogen and time of potassium application of different species of *Brassica.*

| Treatment | Oil content (%) | | Oil yield (kg ha$^{-1}$) | |
|---|---|---|---|---|
| | 2003 - 2004 | 2004 - 2005 | 2003 - 2004 | 2004 - 2005 |
| ***Brassica* species** | | | | |
| *B. juncea* (Kranti) | 37.49 | 38.70 | 656.93 | 718.71 |
| *B. carinata* (PBC-9221) | 38.65 | 39.96 | 851.58 | 914.18 |
| *B. napus* (GSL-1) | 39.77 | 40.63 | 554.47 | 602.81 |
| SEM± | 0.30 | 0.36 | 6.37 | 7.04 |
| CD at 5% | 0.92 | 1.08 | 19.20 | 21.16 |
| **Nitrogen level (kg ha$^{-1}$)** | | | | |
| 40 | 39.32 | 40.64 | 539.57 | 590.48 |
| 80 | 38.56 | 39.68 | 703.47 | 768.37 |
| 120 | 38.04 | 38.98 | 819.92 | 876.84 |
| SEM± | 0.30 | 0.36 | 6.37 | 70.4 |
| CD at 5% | 0.92 | 1.08 | 19.20 | 21.16 |
| **Time of K application** | | | | |
| 100% basal | 38.50 | 39.62 | 667.79 | 720.25 |
| 50% basal + 50% at 1st irrigation | 38.77 | 39.91 | 707.58 | 770.21 |
| SEM± | 0.23 | 0.27 | 4.75 | 4.76 |
| CD at 5% | NS | NS | 13.66 | 14.29 |

nitrogen and time of potassium application on quality aspects of *Brassica* species was evaluated in sandy loamy soil of western Uttar Pradesh.

## MATERIALS AND METHODS

Field experiments were conducted with 3 *Brassica* species (*Brassica Juncea, Brassica carinata* and *Brassica napus*) at the Raja Balwant Singh College, Bichpuri Agra, during Rabi seasons of 2003 - 2004 and 2004 - 2005 with three levels of nitrogen (40, 80 and 120 kg ha$^{-1}$) and two times of potassium application (100% basal and 50% basal + 50% at the time of 1st irrigation) in split plot design with four replications. The soil of the experimental field was sandy loam in texture and had pH (1:2.5) 7.5 and 7.6, OC 0.54% and 0.53%, available N was in lower (198.20 and 192.60 kg ha$^{-1}$), available P in medium range (25.62 and 23.28 kg ha$^{-1}$) and available K was in higher range (295.60 and 290.85 kg ha$^{-1}$) during 2003 - 2004 and 2004 - 2005 respectively. N and K as per treatments were applied through urea (46% N) and MOP (60% K) respectively and a common dose of P was applied at 30 kg $P_2O_5$ ha$^{-1}$ as basal in all the plots. The crop at maturity was harvested and seed and stover yields were recorded in kg per plots and converted into q ha$^{-1}$. The processed plant samples were analyzed by Micro- kjeldhal's method used in preparation of aliquot to determine potassium content in plant. These nutrients were analyzed as per procedure described by Singh et al. (1999) N and K were expressed in percents.

## RESULTS AND DISCUSSION

### Oil content (%)

The results pertaining to oil content in seed (%) are presented in Table 1. In general, the oil content in seed during 2003 - 2004 was slightly higher than during 2004 - 2005.

#### *Species*

A significant variation was recorded on oil content in different species of *Brassica*. However, oil obtained from *B. napus* was significantly higher as compared to *B. juncea,* in both the years, while the differences between *B. napus* and *B. carinata* were not significant in both the years.

#### *Levels of nitrogen application*

Application of nitrogen exhibited adverse effect on the oil content. Lower fertilized crop showed maximum oil content which was significantly reduced with the application of 80 kg N ha$^{-1}$ during both years of experimentation. The oil content was significantly depressed further due to application of 120 kg N ha$^{-1}$ over 80 kg N ha$^{-1}$.

The data show a depression in oil content by about 1.28 and 1.66 unit with the application of 120 kg N ha$^{-1}$ when compared with 40 kg N ha-1. Similarly 80 kg N ha$^{-1}$ gave a depression of 0.76 and 0.96 unit as compared to 40 kg N ha$^{-1}$ during 2003 - 2004 and 2004 - 2005, respectively.

**Table 2.** Protein content and protein yield as influenced by nitrogen and time of potassium application of different species of *Brassica.*

| Treatment | Protein content (%) | | Protein yield (Kg ha$^{-1}$ ) | |
|---|---|---|---|---|
| | 2003 - 2004 | 2004 – 2005 | 2003 - 2004 | 2004 - 2005 |
| ***Brassica* species** | | | | |
| *B. juncea* (Kranti) | 20.96 | 21.24 | 374.70 | 402.73 |
| *B. carinata* (PBC-9221) | 22.19 | 22.44 | 497.88 | 522.30 |
| *B. napus* (GSL-1) | 22.79 | 22.94 | 322.79 | 345.68 |
| SEM± | 0.22 | 0.23 | 4.76 | 5.32 |
| CD at 5% | 0.65 | 0.70 | 14.35 | 16.04 |
| **Nitrogen level (Kg ha$^{-1}$)** | | | | |
| 40 | 19.55 | 19.85 | 268.51 | 287.79 |
| 80 | 22.34 | 22.48 | 408.14 | 435.99 |
| 120 | 24.05 | 24.28 | 519.73 | 546.93 |
| SEM± | 0.22 | 0.23 | 4.76 | 5.32 |
| CD at 5% | 0.65 | 0.70 | 14.35 | 16.04 |
| **Time of K application** | | | | |
| 100% basal | 21.31 | 21.51 | 377.22 | 398.92 |
| 50% basal + 50% at 1st irrigation | 22.65 | 22.90 | 419.70 | 448.22 |
| SEM± | 6.16 | 0.17 | 3.49 | 3.91 |
| CD at 5% | 0.45 | 0.49 | 10.04 | 11.25 |

***Time of potassium application***

It is clear from the table under reference that split dose of potassium application slightly increased the oil content in seed, but the variation was not significant in both the years.

**Oil yield**

***Species***

Data presented in Table 1, clearly indicate that the oil yield (kg ha$^{-1}$) significantly differed due to species of *Brassica* during both years. *B. carinata* yielded higher oil, while *B. napus* manifested lesser production of oil yield and the differences were found significant. The mean data of two years shows that *B. carinata* produced 34.45 and 22.09% oil yield over *B. napus* and *B. juncea* respectively.

***Levels of nitrogen application***

The effect of nitrogen application on the oil yield of mustard during both years of experimentation was significant. These exhibited significant increase in oil yield with 80 kg N ha$^{-1}$ over 40 kg N ha$^{-1}$, which gave a mean difference of 240 kg ha$^{-1}$. The effect of 120 kg Nha-1 on oil yield (kg ha$^{-1}$) was significantly different from the yield obtained due to application of 80 kg Nha$^{-1}$.

***Time of potassium application***

The data presented in Table 1 clearly indicate that time of potassium application brought about significant difference in oil yield. Split doses of potassium (50% basal + 50% broadcast at 1st irrigation) showed better performance than 100% basal application of potassium. The per cent increase in oil yield was 12.4 and 13.00 kg during 2003 - 2004 and 2004 - 2005, respectively.

**Protein content (%)**

***Species***

The results with respect to protein content (%) are presented in Table 2. It is observed from the data that the variation among different species of *Brassica* was significant. This showed that *B. napus* had maximum protein content, which is at par with *B. carinata,* while *B. juncea* noticed lowest protein content in seed.

***Levels of nitrogen application***

A perusal of data in Table 2 reveals a significant increase in protein content due to application of nitrogen at both

levels over 40 kg N $ha^{-1}$. The protein content which was lowest under 40 kg N $ha^{-1}$ with a mean value of 19.70% and was increased to 22.31% with the application of 80 kg N $ha^{-1}$. It further increased to 24.16% with the application of 120 kg N $ha^{-1}$.

### *Time of potassium application*

Split application of potassium had significant effect on protein content in both years. The mean maximum value (22.78%) of protein content was recorded with the application of split dose of potassium and minimum value 21.41% protein with full dose potassium by basal application.

## Protein yield

### *Species*

A perusal of the data clearly indicates that the protein yield varied significantly among species of *Brassica*. *B. carinata* produced the maximum protein yield followed by *B. juncea* while, *B. napus* produced minimum yield of protein in both the years.

### *Levels of nitrogen application*

Nitrogen application exhibited pronounced effect on the protein yield during both years of experimentation. The yield of protein increased with increasing level of nitrogen. There was significant difference in the protein yield due to 80 kg N $ha^{-1}$ over 40 kg N $ha^{-1}$. Further increase in nitrogen dose of 120 kg N $ha^{-1}$ brought about significant increase over 80 kg N $ha^{-1}$.

### *Time of potassium application*

The split application of potassium (50% basal + 50% broadcast at 1st irrigation) significantly improved the protein yield in both years. It gives 419.70 and 448.22 kg $ha^{-1}$ protein during 2003 - 2004 and 2004 - 2005, respectively.

## Conclusion

Based on the results of the investigation, it is recommended that to ensure maximum oil and protein yield and remuneration from *Brassica species* under semi arid conditions of western Utter Pradesh, the oil content of mustard seed significantly varied among *Brassica* species, maximum being with *B. napus* (40.20%), which gave a difference of 0.50 and 0.89 unit over *B. carinata* and *B. juncea.* Application of nitrogen had an adverse effect on the oil content. Lower (40 kg N $ha^{-1}$) fertilized crop showed maximum oil content of 39.98%, which progressively decreased with successive increase in the dose of nitrogen with lowest oil content, being in crop fertilized with 120 kg N $ha^{-1}$ (38.51%).

Maximum oil yield (882.88 kg $ha^{-1}$) and protein yield (510.00 kg $ha^{-1}$) were observed in case of *B. carinata* (PBC-9221) and minimum under *B. napus*. Higher dose of nitrogen 120 kg N $ha^{-1}$ produced maximum oil and protein yield (Gupta et al., 2007; Jackson, 1967). Split application of potassium also produced higher oil and protein yield than basal dose of potassium.

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