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# Effect of nitrogen and potassium levels on yield and some of the agronomical characteristics in Mustard *(Brassica juncea)*

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**Abstract**

A field experiment was carried out at Qazvin-Iran during 2009-2010 to assess the effect of different levels of nitrogen ($N_0$, $N_{75}$, $N_{150}$ and $N_{225}$ kg $ha^{-1}$) and potassium ($K_0$, $K_{45}$, $K_{90}$ and $K_{135}$ kg $ha^{-1}$) on yield and some of the agronomical characteristics in Mustard *(Brassica juncea*). Experiment was conducted as factorial randomized complete block design with three replications. The results showed that increased amount of nitrogen and Potassium up to 225 kg N $ha^{-1}$ and 135 kg K $ha^{-1}$ respectively had a positive and significant ($p<0.01$) effect on thousand seed weight (TSW), seed yield (SY) and seed oil yield (SOY). The maximum and minimum of the above mentioned traits were observed in the treatment $N_{225}$, $K_{135}$ kg $ha^{-1}$ and $N_0$, $K_0$ kg $ha^{-1}$ respectively. However, increased levels of nitrogen and potassium had a significant effect on seed oil percentage (SOP) and harvest index (HI) but showed no consistent trend. The highest and lowest values of seed oil percentages were obtained in the treatment of $N_{75}$, $K_{90}$ kg $ha^{-1}$ and $N_0$, $K_0$ kg $ha^{-1}$, also the maximum and minimum of harvest index were recorded in the treatments $N_{225}$, $K_{90}$ and $N_{75}$, $K_0$ kg $ha^{-1}$. Moreover the results indicate that the interaction effect of nitrogen and Potassium on all of the characters being studied was significant ($p<0.01$).

**Keywords**: Agronomical characteristics, Mustard, Nitrogen, Potassium, Yield.

## Introduction

Mustard (*Brassica juncea*) is considered one of the most important oil seed crops in all over the world and particularly in Iran. Mustard plantation is widely practiced in Iran due to the ideal climate conditions and soil fertility present in this region. In addition, some optimum agronomic traits such as high resistance to drought, high temperature, pest and disease have made this crop compatible to almost different climate and geographical conditions (Wysocki & Corp, 2002). Mustard can be cultivated in a variety of soils but a fertile soil with a clay-loam texture is best for producing higher yields. Generally soil nutrition management is one of the most significant points in terms of crop breeding. Of all the essential nutrients, nitrogen as an important limiting factor in crop productivity is required by the Mustard in its largest quantity. Plants usually obtain nitrogen by fertilizer application. Nitrogen supports the plant with rapid growth, increasing seed and fruit production and enhancing quality of leaf and oil seed crops (Allen & Morgan, 2009).

Nitrogen management is crucial in cropping system; it is often difficult to strike between levels sufficient for normal plant growth and those that are acceptable for human consumption (Maereka *et al.,* 2007). Addition of Nitrogen fertilizer at the flowering stage significantly improves the seed yield and quality in most crops (Vijaya *et al.,* 2011). As the highest seed yield of Mustard in Southern Alberta was achieved by the application of 95 kg N ha-1 supported by Mckenzie *et al.* (2006) who reported that sufficient levels of nitrogen lead to higher yields of Mustard. Potassium is the second most absorbed mineral element by the plants coming after nitrogen and in some cases calcium. As the yield and yield components have increased significantly by an elevation in different levels of Potassium (Amanullah *et al.,* 2011).

Addition of NKP fertilizers increase the crop yield as well as nutritional quality generally, for example fertilizers nitrogen and potassium increased oil concentration in oil seed crops (Zhao *et al.,* 2008).

## Materials and methods

A field experiment was conducted at the Agronomic Research Area, Qazvin (49 55´ E, 36 15´ N and 1300 m)-Iran during 2009-2010. The average of minimum and maximum annual temperature is 12.4°C and 41.6°C respectively and the annual precipitation is 309 mm. The purpose of this experiment was to study the impact of different levels of nitrogen and potassium on yield and some of the agronomical characteristics in Mustard. The experiment consisted four levels of nitrogen (0, 75,150 and 225 kg N/ha) and four levels of Potassium (0, 45, 90 and 135 kg K/ha) and was laid out in completely randomized block design replicated three times and a net plot size of 1.8m x 6m. Each plot contained six rows (4-meters wide) of Mustard with a plant density of 110 plants per $m^2$. Soil samples were taken before sowing of crop to a depth of 30 cm for physico-chemical analysis. The soil chemical property showed that the experimental soil was clay-loam in texture containing 0.83% OC, 1.33 (ds/m) EC×$10^3$, 8.25% TNV, 35% SP, 8% Total N, absorbable K 288 mg.$kg^{-1}$, 29% clay, 45% silt and 26% sand with a pH of 7.8. Weeds were controlled by Treflan and Triflurex (4-5 liters $ha^{-1}$) and that were applied prior to planting and incorporated into soil by disking. Potassium as Potassium-sulfate was applied before planting, whereas nitrogen was supplied from urea and added to plots in three periods ($^1/_3$ basal before planting, $^1/_3$ at stemming

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*Table 1. Analysis of variance for studied traits*

| SOV | DF | TSW | SY | SOP | SOY | HI |
|---|---|---|---|---|---|---|
| Replication | 2 | 1.89** | 452031.81** | 2.34** | 95355.39** | 7.54*8 |
| Nitrogen | 3 | 9.60** | 14368864.18** | 68.21** | 2327710.41** | 33.81** |
| Potassium | 3 | 2.527** | 2436681.68** | 11.12** | 506085.85** | 35.85** |
| Nitrogen × Potassium | 9 | 0.22** | 260515.68** | 0.55** | 50205.09** | 5.85** |
| Error | 30 | 0.03 | 12683.34 | 0.08 | 2293.41 | 0.80 |
| Total | 47 | - | - | - | - | - |
| CV (%) | - | 7.13 | 4.58 | 0.74 | 4.58 | 4.53 |

*** significant at 1%*

*Table 2. Means comparison (simple effect) of nitrogen and Potassium on investigated traits*

| Treatments | TSW (g) | SY (kg ha$^{-1}$) | SOP (%) | SOY (kg ha$^{-1}$) | HI (%) |
|---|---|---|---|---|---|
| Nitrogen level (kg ha$^{-1}$) | | | | | |
| $N_0$ | 1.35d | 978.8d | 37.12c | 367.4c | 19.45b |
| $N_{75}$ | 2.15c | 2272c | 42.86a | 977.8b | 17.62c |
| $N_{150}$ | 3.2ab | 3214b | 39.75b | 1284a | 20.93a |
| $N_{225}$ | 3.27a | 3366a | 39.07b | 1319a | 21.33a |
| Potassium level (kg ha$^{-1}$) | | | | | |
| $K_0$ | 1.85c | 18720d | 38.65b | 727.2c | 17.63c |
| $K_{45}$ | 2.4b | 2349c | 39.1b | 918.8b | 19.33b |
| $K_{90}$ | 2.75a | 2755b | 40.54a | 1132a | 20.87a |
| $K_{135}$ | 2.87a | 2856a | 40.49a | 1170a | 21.5a |

*Any two means not sharing a common letter differ significantly from each other at 5% probability.*

and $^1/_3$ at flowering stages). Land leveler was used for leveling the land then furrower was used for creating furrow in 60 cm. Seeds were sown on September 15, 2009 on depth of 1.5 cm maintaining 30 cm row spacing in each plot. Thinning and hoeing can be done 20-85 DAS to maintain plant-to-plant distance at 3 cm. The trials were harvested from June 10th -15th (2010). Data were recorded on 1000-seed weight (g), seed yield (kg ha-1), seed oil percentage (%), harvest index (%) and seed oil yield (kg/ha). The data were analyzed following Analysis of Variance (ANOVA) technique using the statistical computer program MSTATC. Means were compared by using Multiple Range Test of Duncan.

**Results and discussion**

The results revealed that the simple effect of nitrogen, potassium and the interaction between them on the TSW, SY, SOP, SOY and HI was significant at 1% level of probability (Table 1).

*Thousand seed weight (TSW)*

Comparison of means with Duncan's Multiple Range Test at 5% level of probability showed that increased N and K levels up to 225 kg N ha$^{-1}$ and 135 kg K ha$^{-1}$ increased TSW as the maximum and minimum TSW of (3.27, 2.87 g) and (1.35, 1.85 g) were found in the treatments $N_{225}$, $K_{135}$ and $N_0$, $K_0$ (Table 2). These results are similar with that of Reager *et al.* (2006) who reported that there is significant effect of application of different levels of nitrogen on thousand seed weight. Data on the interaction effect of nitrogen and Potassium on TSW illustrated in Fig. 1 shows that the treatments $N_{225}$ $K_{135}$ gave the maximum TSW. In the treatments of $N_0$-$N_{225}$ with respect to the TSW the magnitude of differences between the treatments $K_{90}$ and $K_{135}$ was relatively small.

*Seed yield (SY)*

The results indicate that SY increased with an increase in N and K rates up to 225 kg N ha$^{-1}$ and 135 ka K ha$^{-1}$. As the maximum and minimum SY (3366, 2865 kg ha$^{-1}$ and 978.8, 18720 kg ha$^{-1}$) were observed in the treatments of $N_{225}$, $K_{135}$ (Table 2). These results are supported by that of Mir *et al.,* (2010) who reported that seed yield increased with increasing amounts of Potassium and Lone and Khan (2007) who reported that greater numerical seed yield was produced by greater levels of nitrogen. Data presented in the Fig.2 clearly shows that the maximum SY was found from the interaction of $N_{225}$ $K_{135}$. In each level of nitrogen application with an increase in the Potassium level no significant variation was recorded between treatments $K_{90}$ and $K_{135}$ on SY.

*Seed oil yield (SOY)*

The results suggest that the treatments $N_{225}$, $K_{135}$ gave significantly the highest (1319, 1170 kg ha$^{-1}$) and $N_0$, $K_0$ the lowest (367.4, 727.2 kg ha$^{-1}$) SOY respectively (Table 2). These results are in line with that of Singh *et al.* (2008) who reported that increase in the seed yield was due to graded levels of nitrogen. The highest amount of SOY was observed from the interaction of treatments $N_{225}$ $K_{135}$ and the lowest from $N_0$ $K_0$ has been depicted in the (Figure 3). The results pertaining to SOY presented in the (Fig. 3) exhibits a slight difference between treatments $K_{90}$ and $K_{135}$ in all of the nitrogen rates.

*Seed oil percentage (SOP)*

*Fig.1 The interaction effect of nitrogen and Potassium on thousand seed weight a*

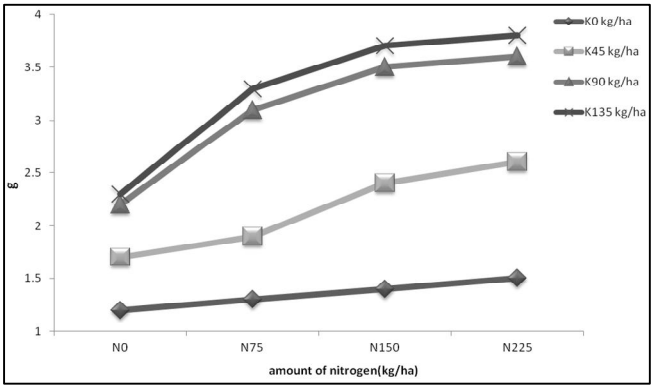

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*Fig.2 The interaction effect of nitrogen and Potassium on seed veild*

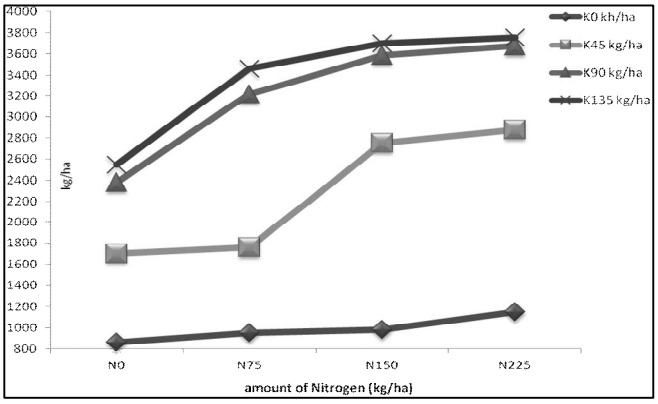



*Fig.3 The interaction effect of nitrogen and Potassium on seed oil yield*

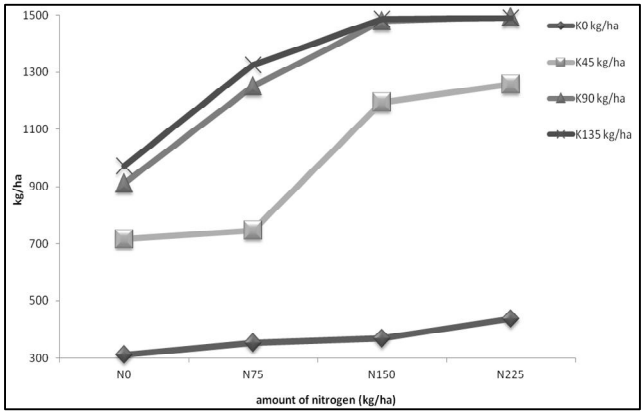
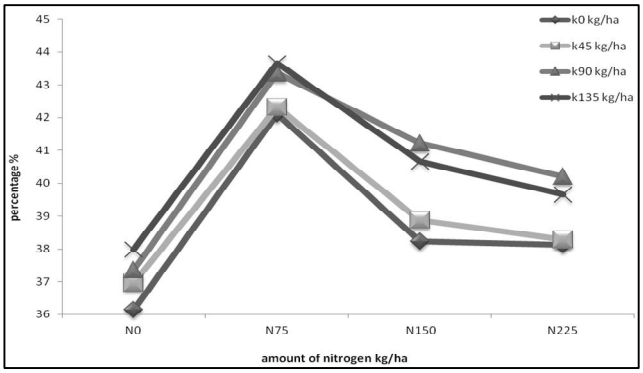
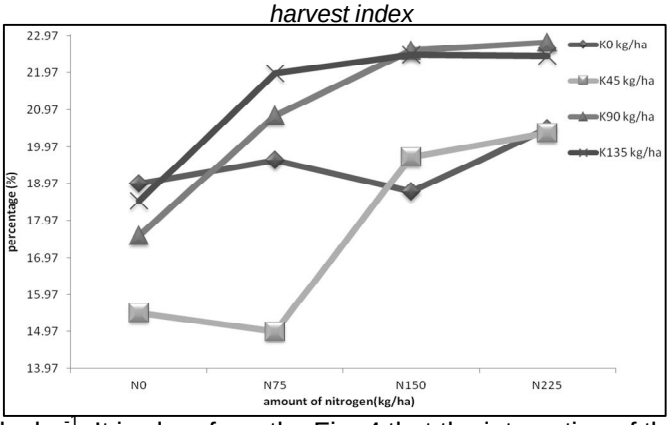



*Fig.4 The interaction effect of nitrogen and Potassium on the seed oil percentage*




Based on the comparison of means with Duncan's Multiple Range Test at 5% level of probability application of doses above 75 kg N $ha^{-1}$ and 90 kg K $ha^{-1}$ exhibited adverse effect on the SOP, as lower fertilized crop showed maximum SOP (42.86%) in the treatment $N_{75}$ and 40.54% in the treatment $K_{90}$ comparing with the minimum contents of 37.12 and 38.65% in the treatments $N_0$, $K_0$ respectively (Table 2). These results are in agreement with that of Varsha *et al.* (2011) who reported that the seed oil percentage was significantly depressed further with the application of nitrogen in doses above 80

*Fig.5. The interaction effect of nitrogen and Potassium on harvest index*




kg $ha^{-1}$. It is clear from the Fig. 4 that the interaction of the treatments $N_{75}$ and $K_{135}$ brought about maximum SOP, while the lowest SOP was produced by the interaction of the treatments $N_0$ $K_0$. The results in the (Fig. 4) reflect that the SOP in the treatments $K_{90}$ and $K_{135}$ did not differ significantly.

*Harvest index (HI)*

A depression in the HI was seen with graded levels of nitrogen at 75 kg $ha^{-1}$ from the comparison of means with Duncan´s Multiple Range Test at 5% level of probability. The application of nitrogen in doses above 75 kg $ha^{-1}$ has exhibited an increase in the HI. In addition, the lowest and highest values of HI were noted in the treatments of $N_{75}$ and $N_{225}$ respectively. Also the HI increased where potassium level used was increased from $K_0$-$K_{75}$. A perusal of data in (Table 2) reveals that the maximum and minimum values of the HI (21.5, 19.33%) were found in the treatments $K_0$ and $K_{135}$ respectively. These results significantly differed with that of Bhat *et al.* (2006) who reported that nitrogen application exhibited pronounced and positive effect on the HI in all levels of application. As evident from the data given in Fig. 5, the highest and lowest values of the HI were recorded from the interaction of treatments $N_{225}$ $K_{90}$ and $N_{75}$ $K_{45}$ respectively. The magnitude of differences between the treatments $K_{90}$ and $K_{135}$ was relatively small in all levels of nitrogen application.

**Conclusion**

The results pertaining to the traits under investigation exhibits a slight difference between the treatments $N_{150}$ and $N_{225}$ and treatments $K_{90}$ and $K_{135}$. So it can be concluded from a perusal of the results and from the economical point of view that the recommended treatments $N_{150}$ and $K_{90}$ are best and more economical than all other treatments for achieving the highest traits of thousand seed weight, seed yield, seed oil yield and harvest index and the treatments $N_{75}$ and $K_{90}$ for the highest trait of seed oil content.

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