EFFECT OF SEED RATE AND NITROGEN ON CANOLA PRODUCTIVITY

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Abstract- A field experiment was conducted at Agricultural research station Swabi during winter 2018-19 to study "the effect of various seed rates and nitrogen levels on the productivity of canola". The experiment was conducted in randomized complete block design (RCBD) having three replications. Plot size was 6 m^2 with rows 40 cm apart and 3 m long having 5 rows. Three seed rates (3, 6 and 9 kg ha^{-1}) and four nitrogen levels (0, 50, 75 and 100 kg ha^{-1}) were used. Canola variety Durr-e-NIFA was used as test variety. Nitrogen as a source of Urea was applied in two equal split doses. Half of nitrogen was applied during sowing time and half was applied after the first irrigation. Results of the experiment showed that canola seeding rates and N levels showed significant variation for all of the parameters recorded. Higher siliques $plant^{-1}$(458), grain $siliques^{-1}$(24), thousand grains weight (3.41 g), grain yield (1873 kg ha^{-1}) and oil content (45%) were maintained during the experiment when seed rate were used at the rate of (6 kg ha^{-1}). Nitrogen level (75 kg ha^{-1}) performed better and produced more grains $silique^{-1}$(23), thousand grain weight (3.85 g), biological yield (3969 kg ha^{-1}) and grain yield (2041 kg ha^{-1}). However plots treated with seed rate and N level (6 and 75 kg ha^{-1}), respectively performed better than the rest of the plots while in case of oil content it is recommended that 6 kg seed ha^{-1} and 50 kg N ha^{-1} produced more oil content.

Index Terms- Seed rates; Nitrogen, Canola, Yield and yield components

I. INTRODUCTION

Canola (*Brassica napus* L.) is an annual rabi crop and is grown for its oil and animal feed. After soybean and palm oil, the third-largest source of vegetable oil in the world is canola. Canola can be successfully grown under both arid and irrigated land conditions and is tolerant to all of the extreme environmental conditions (Qaderi *et al.*, 2012). Fertilizer containing nitrogen (N) is essential for increasing crop yield (Rathke *et al.*, 2005). It is one of the most important nutrient elements for crop growth and protein synthesis, cell size, protoplasm, and photosynthetic activity (Yasari and Patwardhan, 2006). N is a part of chlorophyll, the green pigment of the plant that is responsible for photosynthesis (Walch-Liu *et al.*, 2000). Canola requires more minerals and accessible N than cereals, which frequently restricts grain yield. Many researchers have demonstrated that applying large amounts of N considerably improves canola's growth and yield (Kumar *et al.*, 2001). Excess N, however, can reduce grain yield and quality appreciably in canola (Laaniste *et al.*, 2004). An excessive N rate or an inadequate amount of N application could increase N content in grains, decreasing oil content and their commercial value (Chamorro *et al.*, 2002). Fathi *et al.* (2002) reported that increasing nitrogen fertilizer and plant density caused a boost in grain yield in canola and the highest yield per hectare resulted. Salehian *et al.* (2002)

showed that plant density significantly affected the number of siliques, secondary branches and grains plant^{-1}. Leach *et al.,* 1998 stated that increasing the plant population to 110 plants m^{-2} decreased the number of siliques and branches significantly. Prasad and Shakla (1991) concluded that canola grain yield was affected by the interaction between plant density and nitrogen fertilizer, whereby the optimal grain yield could be achieved by increasing plant density and nitrogen levels. N fertilizer mainly increases canola leaf area index and leaf duration (Wright *et al.,* 1988), similarly growth rates, number of flowering branches, plant height, number of flowers, number and weight of siliques and seed yield are influenced by N levels (Grant and Bailey, 1993). Increasing nitrogen fertilizer level and plant density caused a boost in grain yield in canola (Fathi *et al.,* 2002). It has been frequently reported that N fertilizer increased seed yield of canola and winter oilseed rape (Cheema *et al.,* 2001; Hocking and Stapper 2001). The rapeseed adjusted seed yield across a wide range of plant populations, although it did not compensate completely for the decreasing population (Angadi *et al.,* 2003). Plants grown at high densities are often more susceptible to lodging and increased disease incidence without the benefit of any yield increase (Leach *et al.,* 1999). Higher plant population density has been recommended and adopted to ensure a competitive crop and to control weeds in the early growth stages (Morrison *et al.,* 1990). Seeding rate, as well as the row spacing, is considered an important factor to optimize plant population (Diepenbrock, 2000). Seed rate thus influences yield and yield contributing characters of mustard (Johnson *et al.,* 2001). The current was designed to enhance the canola production in the climatic condition of Swabi.

II. IDENTIFY, RESEARCH AND COLLECT IDEA

A field experiment was conducted at Agricultural research station Swabi during winter 2018-19 to study the effect of seed rate and nitrogen on canola productivity. The experiment was conducted in randomized complete block design (RCBD) having three replications. Plot size was 6 m^2 with rows 40 cm apart and 3 m long having 5 rows. Three seed rates (3 , 6 and 9 kg ha^{-1}) and four nitrogen levels (0, 50,75 and 100 kg ha^{-1}) were used. Canola variety Durr-e-NIFA was used as test variety. The crop was sown on 3rd November. Recommended dose of phosphorus (60 kg ha^{-1}) was applied at the time of seed bed preparation. Nitrogen as a source of Urea was applied in two equal split doses. Half of nitrogen was applied during sowing time and half was applied after first irrigation.

Statistical analysis

The data recorded was analyzed statistically using analysis of variance techniques appropriate for randomized complete block design. Significant differences among treatments was determined using least significant difference (LSD) test for main as well as interaction effects (Steel and Torrie, 1984).

III. WRITE DOWN YOUR STUDIES AND FINDINGS

RESULTS AND DISCUSSION

Number of siliques plant^{-1}, grains siliques^{-1} and thousand grain weight of canola as affected by different nitrogen levels and seed rates are given in Table 1. Data analysis revealed that seed rates and nitrogen application has a significant effect on siliques plant^{-1} while the interaction between N x SR was found non-significant. Mean values of the data showed that more and less number of siliques plant^{-1} (485 and 430) was produced with the application of 100 kg N ha^{-1} and control plots, respectively. Among seed rates, number of siliques plant^{-1} (458 and 462) was found statistically at par for both 6 and 9 kg seed ha^{-1}, respectively. N fertilizer mainly increases siliques plant^{-1} by increasing N levels (Grant and Bailey, 1993). Similar result was also observed by Karamzadeh *et al.* (2010) and Taheri *et al.* (2012). Salehian *et al.* (2002) showed that plant density significantly affected the number of siliques and secondary branches of canola crop. These results are in line with Angadi *et al.* (2003); Shahraki *et al.* (2012) and (Malidareh, 2010).

Number of grain siliques^{-1} of canola was significant affected with the application of N levels and seed rate. Among the nitrogen, number of grains silique^{-1} (23 and 24) was found statistically similar for both 75 and 100 kg N ha^{-1}. The reason is that as the level of N increases the grains siliques^{-1} increases (Ahmadi and Bahrani 2009). Shahraki et al. 2012 showed that higher and lower N levels significantly affected grains siliques^{-1}. Among seed rates, seed rate of 6 kg ha^{-1} proved superior and produced more grains silique^{-1}(24) while less grains silique^{-1} (20) were observed with the seed rate of 3 kg ha^{-1}. These lines are parallel with (Malidareh, 2010). The increase in seed rate reduced yield components, number of seeds per pod and number of pods per plant (Etemadi *et al.,* 2013). Thousand grain weight of canola was significantly affected by various levels of nitrogen, seed rates and also the interaction between N x SR. Heavier grains (3.85 g) were recorded in plots which received 75 kg N ha^{-1} while control treatments resulted in lighter grain (3.07 g). These results are similar with the finding of Malhi *et al.* (2006). In case of seed rates, higher thousand grains weight (3.41 g) was observed with the seed rate of 6 kg ha^{-1} while lower thousand grains weight (3.15 g) was obtained with 3 kg seed ha^{-1}. The statement is also in line with Arslan *et al.* (1994) and (Malidareh, 2010). The SR x N interaction indicated that increasing seed rate and N levels upto (6 and 75 kg ha^{-1}) respectively, increased grain weight of canola (fig. 1).

Table 1. Number of siliques plant^{-1}, number of grains siliques^{-1} and thousand grain weight (g) of canola as affected by various seed rates and nitrogen application.

Seed rate (kg ha^{-1})	Siliques plant^{-1}	Grains silique^{-1}	Thousand grain weight
3	448 b	20 c	3.15 c
6	458 a	24 a	3.41 a
9	462 a	22 b	3.38 b
LSD (0.05)/Significance	6	1	0.08
Nitrogen levels (kg ha^{-1})			
0	430 d	20 c	3.07 c
50	442 c	22 b	3.16 b
75	466 b	23 a	3.85 b
100	485 a	24 a	3.18 a
LSD(0.05)/Significance	6	1	0.07
Interactions	NS	NS	0.14 (fig. 1)

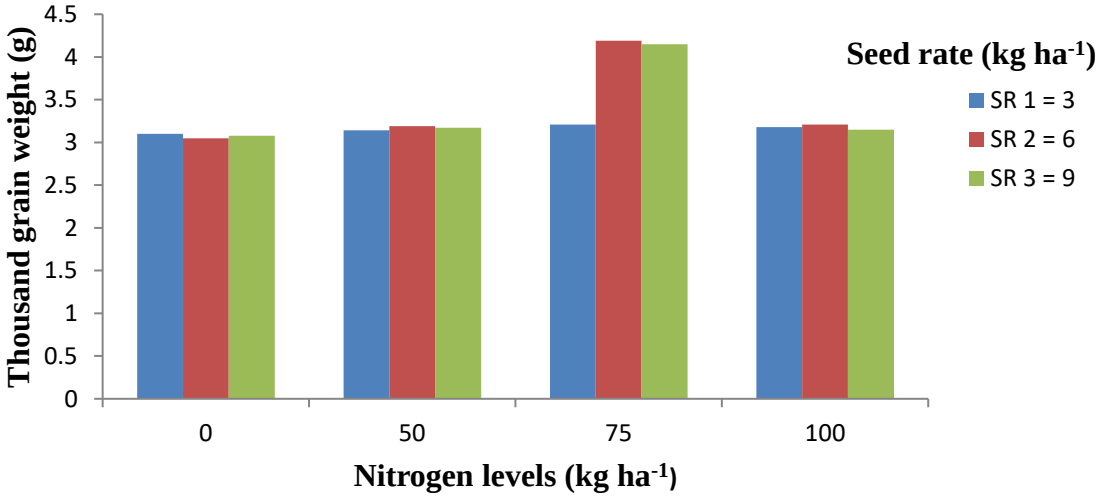

Figure 01. Interaction between seed rate and N levels for thousand grain weight of canola

Data concerning biological yield, grain yield and oil content of canola are described in table 2. Biological yield of canola was significantly affected by various nitrogen level and seed rates, while their interaction was found non-significant. Maximum biological yield was recorded when nitrogen was applied at the rate of 100 kg ha^{-1} which is statistically similar to 75 kg N ha^{-1}. Similar results were earlier reported by Ahmadi and Bahrani (2009) who stated that biological yield was increased by increasing the fertilizer level. In case of seed rates, maximum biological yield was obtained when seed rate were used at the rate of 9 kg ha^{-1} while 3 kg ha^{-1} resulted in minimum biological yield. Biological yield increased with increasing seed rate due to higher density

(Malidareh, 2010 and Ogrodowczyk and Wawrzyniak 2004). Nitrogen and seed rates were significantly affected grain yield while the interaction between SR x N has a non-significant effect on grain yield of canola. Grain yield of canola was statistically at par for both 75 and 100 kg N ha^{-1} as compared to control treatment. Similar result was reported by Thurling (1974) who observed that increasing in nitrogen levels increased grain yield of canola. In case of seed rates, 6 and 9 kg seed ha^{-1} gave statistically the same grain yield of canola followed by 3 kg seed ha^{-1}. Increasing seed rate increased seed yield of canola (Brandt *et al.*, 2007). The increase in yield is strongly correlated with increased in yield components such as siliques $plant^{-1}$, grains $silique^{-1}$, and grains weight (Malidareh, 2010). Oil content as affected by various levels of nitrogen and seed rates. It is evident from the analysis that grain oil content of canola was significantly affected by various nitrogen levels, seed rates and SR x N. Mean values of the data showed that increasing nitrogen level decreased the grain oil content of canola. More oil content (45%) were recorded with the application of 50 kg N ha^{-1} while low oil content (40%) was recorded with the application of 100 kg N ha^{-1}. Among seed rates, higher oil contents (45%) were recorded with the seed rate of 6 kg ha^{-1} while lower oil contents (42%) were recorded with the seed rate 9 kg ha^{-1}. The SR x N interaction indicated that increasing seed rate and N levels upto (9 and 100 kg ha^{-1}) respectively, decreased the oil content of canola (fig. 2).

Table 2. Biological yield (kg ha^{-1}), grain yield (kg ha^{-1}) and oil content of canola as affected by various seed rates and nitrogen levels.

Seed rate (kg ha^{-1})	Biological yield (kg ha^{-1})	Grains yield (kg ha^{-1})	Oil content (%)
3	2529 c	1688 b	44 b
6	3713 b	1873 a	45 a
9	4380 a	2026 a	42 c
LSD (0.05)/Significance	602	226	0.83
Nitrogen levels (kg ha^{-1})			
0	2681 b	1518 b	44 b
50	3126 b	1679 b	45 a
75	3969 a	2041 a	44 b
100	4387 a	2211 a	40 c
LSD(0.05)/Significance	521	195	0.96
Interactions	NS	NS	1.66 (fig. 2)

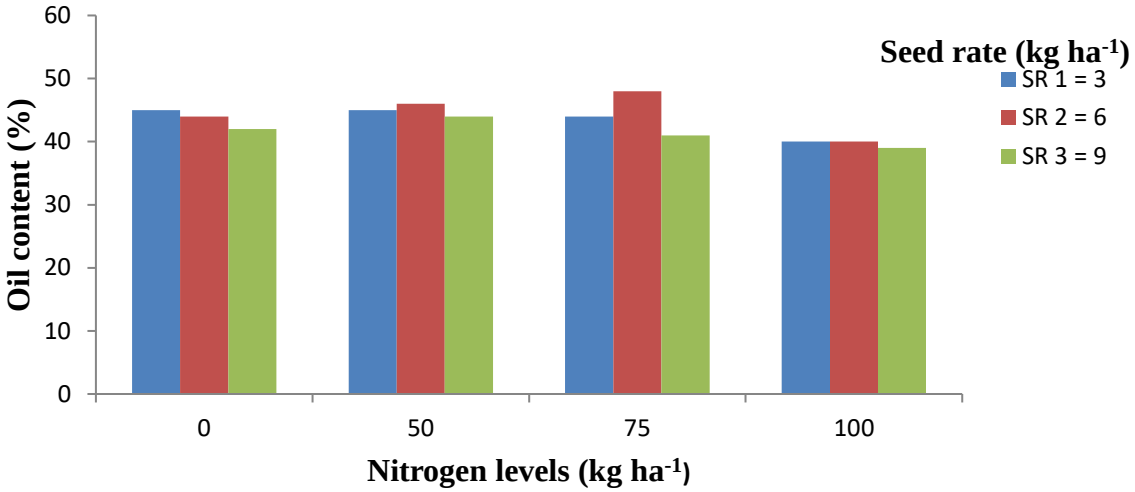

Figure 02. Interaction between seed rate and N levels for oil content of canola

IV. CONCLUSION

It was revealed from the results of the experiment that canola seeding rates and N levels showed significant variation for all of the parameters recorded. High number of siliques plant^{-1}(458), grain siliques^{-1}(24), thousand grains weight (3.41 g) and grain yield (1873 kg ha^{-1}) were maintained during the experiment when seed rates was used at the rate of (6 kg ha^{-1}) while N applied at the rate of (75 kg ha^{-1}) produced higher grains silique^{-1}(23), thousand grain weight (3.85 g), biological yield (3969 kg ha^{-1}) and grain yield (2041 kg ha^{-1}). It is recommended that seed rate at the rate of 6 kg ha^{-1} and N application at the rate of 75 kg ha^{-1} produced more grain yield while in case of oil content it is recommended that 6 kg seed ha^{-1} and 50 kg N ha^{-1} produced more oil content.

APPENDIX

Appendixes, if needed, appear before the acknowledgment.

REFERENCES

[1] Ahmadi, M., & Bahrani, M. J. (2009). Yield and yield components of rapeseed as influenced by water stress at different growth stages and nitrogen levels. *American-Eurasian Journal of Agriculture and Environmental Science, 5*, 755-761.

[2] Angadi, S.V., Cutforth, H. W., McConkey, B. G., & Gan, Y. (2003). Yield adjustment by Canola grown at different plant populations under semiarid conditions. *Crop Science, 43*, 1358-1366.

[3] Arslan, N. (1994). Effect of sowing date and plant density on seed yield of Nigel (*Nigella damascene* L). *Journal of Field Crops Central Research Institute, 3*, 1-2.

[4] Brandt, S. A., Malhi, A., Ulrich, D., Lafond, G. P., Kutcher, H. R., & Johnston, A. M. (2007). Seeding rate, fertilizer level and disease management effects on hybrid versus open pollinated canola (*Brassica napus* L.). *Canadian Journal of Plant Science, 87*, 255-266.

[5] Chamorro, A. M., Tamagno, L. N., Bezus, R., & Sarandon, S. J. (2002). Nitrogen accumulation, partition and nitrogen-use efficiency in canola under different nitrogen availabilities. *Communication in Soil Science and Plant Analysis, 33*, 493-504.

[6] Cheema, M. A., Saleem, M. F., Muhammad, N., Wahidi, M. A., & Baber, B. H. (2010). Impact of rate and timing of nitrogen application on yield and quality of canola. *Pakistan Journal of Botany, 42*(3), 1723-1731.

[7] Diepenbrock, W. (2000). Yield analysis of winter oilseed rape (*Brassica napus* L.): A review, *Field Crops Research, 67*, 35-49.

[8] Etemadi, M. E., Daliri, M. S., & Mousavi, A. A. (2013). The effect of seeding rate on yield and yield component of three canola varieties in Iran North. *Advances in Environmental Biology, 7*(1), 198-200.

[9] Fathi, G., Saeidi, A. B., Siadat, S. A., & Ebrahimpour, F. (2002). Effect of different levels of nitrogen fertilizer and plant density on seed yield of Colza cv. PF 7045 under Khuzestan province conditions. *Iranian Journal of Science and Technology, 25*, 43-58.

[10] Grant, C. A., Bailey, L. D., & Bailly, S. (1993). Fertility management in canola production. *Canadian Journal of Plant Science, 73*, 651-670.

[11] Hocking, P. J., Randall, P. J., & Demarco, D. (1997). The response of dry land canola to nitrogen fertilizer: Partitioning and mobilization of dry matter and nitrogen, and nitrogen effects on yield components. *Field Crops Research, 54*, 201-220.

[12] Johnson, L. B., Patrick, M. C., Ericksmoen, E. D., Bryan, E. H., & Nild, R. (2001). New Canola production practices. Challenge research to rrovide defined techniques to producers, annual report. *Dickinson Research Extension Center,* Pp. 55-60.

[13] Karamzadeh, A., Mobasser, H. R., Ramee, V., & Ghanbari-Malidarreh, A. (2010). Effects of Nitrogen and seed rates on yield and oil content of canola (*Brassica napus* L.). *American-Eurasian Journal of Agriculture and Environmental Science, 8*(6), 715-721.

[14] Kumar, A., Singh, D. P., Bikram, S., & Yashpal, Y. (2001). Effects of nitrogen application and partitioning of biomass, seed yield and harvest index in contrasting genotype of oilseed brassica. *Indian Journal of Agronomy, 46*, 528-532.

[15] Laaniste, P., Jaudu, J., & Eremeev, V. (2004). Oil content of spring oilseed rapeseeds according to fertilization. *Agronomy Research, 2*, 83-86.

[16] Leach, J., Stevensen, H., & Renbow, A. J. (1998). Effect of high plant population on growth and yield of winter rapeseed oil. *Journal of Agricultural Sciences Cambridge, 132*, 173-180.

[17] Malhi, S. S., & Gill, K. S. (2006). Cultivar and fertilizer srate interaction effect on canola yield, seed quality and s uptake. *Canadian Journal of Plant Science, 86*, 91-98.

[18] Malidarreh, A. G. (2010). Effects of nitrogen rates and splitting on oil content and seed yield of canola. *American-Eurasian Journal of Agriculture and Environmental Science, 8*(2), 161-166.

[19] Morrison, M. J., McVetty, P. B. E., & Scarth, R. (1990). Effect of row spacing and seeding rates on summer rape in southern Manitoba. *Canadian Journal of Plant Science, 70*, 127-137.

[20] Ogrodowczyk, M., & Wawrzyniak, M. (2004). Adoption and path- coefficient analysis for assessment of relationship and interrelationship of yield and yield parameters of winter oilseed rape. *Rosliny Oleiste, 25*(2), 479-491.

[21] Prasad, S., & Shakla, D. N. (1991). The effect of nitrogen and plant population on yield, percent of oil seed of canola (*Brassica napus* L.). *Canaadian Journal of Plant Science, 38*, 283- 291.

[22] Qaderi, M. M., Kurepin, L. V., & Reid, D. M. (2012). Effects of temperature and watering regime on growth, gas exchange and abscisic acid content of canola (*Brassica napus* L.) seedlings. *Environmental and Experimental Botany, 75*, 107-113.

[23] Rathke, G. W., Christen, O., & Diepenbrock, W. (2005). Effects of nitrogen source and rate on productivity and quality of winter oilseed rape (*Brassica napus* L.) grown in different crop rotations. *Field Crops Research, 94*, 103-113.

[24] Salehian, H., Rafiey, M., Fathi, G., & Siadat, S. A. (2002). Effect of plant density on growth and seed yield of colza varieties under andimeshk conditions. *Iranian Journal of Science and Technology, 23*, 33-39.

[25] Shahraki, M., Galavi, M., Keykha, H., Fanaei, H., & Mir, B. (2012). The study of effects nitrogen and different planting dates of canola in Iranshahr climatic region. *Annals of Biological Research, 3*(6), 2790-2793.

[26] Taheri, E., Soleymani, A., & Javanmard, H. R. (2012). The effect of different nitrogen levels on morphological traits of two cultivars of rapeseed in Isfahan region. *International Journal of Agriculture and Crop Science, 4*(21), 1587-1590.

[27] Thurling, N. (1974). Morpho physiological determinants of yield in rapeseed (Brassica campestris and Brassica napus L.). Australian Journal of Agriculture Research, 25, 711-721.

[28] Walch-Liu, P., Neumann, G., Bangerth, F., & Engels, C. (2000). Rapid effects of nitrogen form on leaf morphogenesis in tobacco. *Journal of Experimental Botany, 51*, 227-237

[29] Wright, G. C., Mith, C. J., & Woodroof, M. R. (1988). The effect of irrigation and nitrogen fertilizer on rape seed (*Brassica napus* L.) production in South Eastern Australia. *International Journal of Agriculture and Crop Science, 9*, 1-13.

[30] Yasari, E., & Patwardhan, A. M. (2006). Physiological analysis of the growth and devolvement of canola (*Brassica napus* L.). *Asian Journal of Plant Science, 5*(5), 745-752.

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