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EVALUATION OF CANOLA GENOTYPES TO DIFFERENT NITROGEN REGIMES FOR YIELD AND YIELD COMPONENTS

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Abstract

Low canola yield is a common problem in Pakistan. In this context, introduction of improved varieties and suitable fertilization methods may offer a solution. Thus, a field experiment was conducted to assess the yield response of canola genotypes to different nitrogen regimes. The experiment was Randomized Complete Block Design (RCBD) with split plots having three replications. Two canola varieties, Zahoor and PARC were randomized in main plots while two nitrogen (N) application methods, soil and foliar with an unamended control were randomized in sub plots. The seeds were sown on 28th November. The yield was statistically different across the varieties and N application methods. Zahoor than PARC produced maximum biological yield (4676.9 kg ha^{-1}) and seed yield (1520.1 kg ha^{-1}). Whilst soil application of N was superior to foliar application for biological yield (5443.1 kg ha^{-1}) and seed yield (1613.4 kg ha^{-1}). However, interactions between varieties and N application methods had also significant effects on the yields. The soil N application to the both varieties gave the maximum yields. Therefore, it is concluded that the soil application of N to the varieties, Zahoor and PARC could be more effective to maximize yield under agro ecological conditions of Mardan.

INTRODUCTION

Canola (*Brassica napus* L.) breed from rapeseed, ranked 3rd biggest source of the edible oil after soybean and palm oil (Nowlin, 1991) with > 2% erucic acid, > 30 µg glucosinolates (an anti-nutritive factor) and 36-40% protein. Therefore, its oil and meal are very safe and acceptable than soybean and palm oil and meal (Potts et al., 2003; Amin and Khalil, 2005). Canola seeds contains rich amount of oil i.e. 39 to 48% (Si et al., 2003). Its leaves and stem both in dry and green forms are important source of forages with low fiber and high protein contents (Wiedenhoeft and Bharton,1994). Pakistan is deficient in edible oils despite being an agricultural country. Domestic production can only meet 27-31% of the total edible oil consumption in the country (Anonymous, 2005-2006). During 2014-15 (July-March), 1.8 million tons edible oil of value US$ 1.377 billion was imported to meet the gap (GOP, 2014-15). Therefore, it is urgently needed to increase the domestic production. Some recent studies have shown that improved varieties have a yield potential of over 2500 kg ha^{-1} which reflects that a substantial increase up to 2-3 times in average yield is possible (Khan et al., 2006; Al-Solaimani et al., 2015; Farooq et al., 2017). In addition, nitrogen (N) application may also increase yield of the canola (Jackson et al., 2000; Malhi and Leach, 2002; Ozer, 2003) by increasing a number of growth and yield contributing factors such as plant height, number of pods per plant, number of seeds per

pod and seed weight (Al-Hassa, 2006; Al-Solaimani et al., 2015; Farooq et al., 2017). However, applications of N through different methods may have different effects on yield. Foliar methods having multiple advantages such as quick and efficiently N availability, in optimum amount to the plant (Kolota and Osinska, 2001; Ali et al., 2011a and 2011b; Arif et al., 2012 and Ali et al., 2012). The beneficial effects of foliar urea applications, expressed as an increase in yield, (Kolota and Osinska, 2001; Yadav et al., 2014). Contrarily, soil application of N may also increase the yield of canola (Muhammad et al., 2007; Al-Solaimani et al., 2015; Farooq et al., 2017). However, it is still unclear which method is appropriate for yield optimization in canola.

Keeping in view of improved genotypes and nitrogen application methods, a study was therefore conducted to explore the yield response of two canola genotypes to soil and foliar application of N. The main objective of the study was to investigate the effects of application of N through soil and foliar on yield and yield components of canola.

MATERIAL AND METHODS

Experimental material and design: Experiment was carried out at Palatto Research Farm, The University of Agriculture Peshawar Amir Muhammad Khan Campus Mardan on 28th November 2015. The experiment was laid out in Randomized Complete Block Design (RCBD) with split plot arrangement having three replications. Overall, the experiment consisted of two varieties of canola (PARC and ZAHOOR), obtained from the Directorate of Oilseeds, Agricultural Research Institute, Tarnab, Peshawar and two nitrogen (N) application methods i.e. soil and foliar application including an umamended control. Varieties were randomized in main plots while N application methods were randomized in sub-plots. The plot size was 7.5 m². The row to row distance was 50 cm and plant to plant distance was 10 cm.

Crop husbandry: The soil was ploughed by rotavator to a depth of 15-20 cm. The crop was sown on well prepared seed bed with the help of hand drill maintaining the 15cm plant to plant and 45 cm row to row distance using seed rate of 5 kg ha^{-1}. The recommended dose of N and P @ 90 and 60 kg ha^{-1} were applied. Weeds were controlled by hoeing before germination and after this by manual removal. The crop was harvested and threshed manually.

Observations: For plant height, five plants per plot were selected randomly and their heights were taken and averaged. In order to count the number of branches per plant, five plants were randomly selected from each plot and their branches were counted and averaged. To observe the number of pods plant five plants from each plot were selected and their pods were counted and averaged. For number of seeds per pod ten pods were randomly selected, threshed, their seeds were counted and averaged. 1000-seeds weight were observed by randomly collecting seeds samples from the plot and weighed. For biological yield, three central rows in each plot were harvested, dried for 10 days and weighted. Then it was determined by following formula,

$$\text{Biological yield (kg ha}^{-1}) = \frac{\text{biological yield per plot}}{\text{row to row dist.} \times \text{no.of rows} \times \text{row length}} \times 10000$$

Seed yield was determined by harvesting three central rows from each plot, sun dried for 10 days and their seeds were threshed. Then seeds were weighted and converted into kg ha^{-1} using following formula,

$$\text{Seeds yield (kg ha}^{-1}) = \frac{\text{seed yield per plot}}{\text{row to row dist.} \times \text{no.of rows} \times \text{row length}} \times 10000$$

To calculate harvest index, the seed yield was divided by biological yield and multiplied by 100 to express the data as percentage.

$$\text{Harvest index (\%)} = \frac{\text{Seed yield}}{\text{biological yield}} \times 100$$

Statistical analysis: Statistical analysis of the data were done using Fisher's analysis of variance (ANOVA) technique and treatments' means were compared by LSD test a 0.05 probability level (Steel et al., 1997).

RESULTS AND DISCUSSION

Plant height (cm): The varieties and N application methods showed significant effect on the plant height (Table 1a). The Zahoor produced maximum plant height (122.4 cm) than PARC (133.69 cm). Among the N application methods, the soil application produced

highest plant height (144.80 cm) as compared to foliar application (129.87 cm). While significantly lowest height (79.52 cm) of plants were observed in control. Likewise, the interaction between varieties and N application methods was also found significant (Table 2a). The soil application of N to Zahoor boosted the plant height (146.07 cm) but it was found at par with soil application of N to variety PARC. The reason of variation in plant height in varieties may be attributed due to their genetic potential and availability of higher amounts of N from soil application. These results are in accordance with the findings of Muhammad et al. (2007) and Farooq et al. (2017).

Number of branches Plant $^{-1}$: The N application methods had significantly effect on the number of branches plant^{-1} while varieties had non-significant effect on the number of branches plant^{-1} (Table 1a). The soil application of N produced highest number of branches plant^{-1} (5.33) than foliar application (4.43). While significantly least number of branches plant^{-1} was in control (4.01). In interaction, soil application of N to both varieties produced maximum number of branches per plant (4.53 and 4.33) (Table 2a). Similar results were also observed by Al-Solaimani et al. (2015) after soil application of nitrogen to canola.

Number of pods Plant^{-1}: The effects of N application methods and varieties on number of pods plant^{-1} were significant (Table 1a). The variety Zahoor produced maximum number of pods plants^{-1} (155.09) as compared to variety PARC (94.44). Among the N application methods, the soil application of N produced highest number pods plants^{-1} (143.23) which was found at par with foliar application of N (129.80). While significantly least number of pods plants^{-1} (101.27) were in control. The interaction between varieties and N application methods was also found significant (Table 2a). Soil application of N to both varieties produced the maximum number of pods. These results imply that soil application of N in canola is most important element for increase the plant growth which is responsible for increase the yield of canola; however, it was against the findings of Malhi and Leach (2002).

Number of seed pod $^{-1}$: Varieties showed non-significant while N application methods showed significant effect on the number of seeds pods^{-1} (Table 1a). The soil application of N produced highest (25.73) while control produced least number of seeds pod^{-1}. On the other hand, interaction between varieties and N application methods were also found significant (Table 2a). The variety Zahoor with soil application of N increased the number of seeds pod^{-1} (26.40) although similar level of increase was observed in variety PARC with soil application. This was due to N application increases the plant growth which ultimately increased the seeds pod^{-1}. These results agree with those of Muhammad et al. (2007); Al-Solaimani et al. (2015); Farooq et al. (2017).

1000 seed weight (g): The varieties showed non-significant while N application methods showed significant effect on 1000 seeds weight (Table 1b). The soil application of N produced highest 1000 seeds weight (5.43 g) as compared to foliar application (4.93 g). The lowest seed weight (4.28 g) was in control. However, interaction between varieties and N application methods was also significant (Table 2b). The application of N in soil to variety Zahoor produced highest 1000 seeds weight (5.46 g) but it remained statistically similar to the soil application of N to variety PARC. This suggests that soil N application is an efficient method that can increase seed weight as compare to other methods. Similar results were observed by Wahid (2003) in canola.

Biological yield (kg ha^{-1}): The varieties and N application methods had significant effect on biological yield (Table 1b). Zahoor produced maximum biological yield (4676.9 kg ha^{-1}) than PARC. Among the N application methods, the soil application produced highest biological yield (5443.1 kg ha^{-1}) as compared to foliar application (4712.4 kg ha^{-1}). The significantly lowest biological yield (3600 kg ha^{-1}) was in control. However, interaction between varieties and N application methods were also found significant (Table 2b). The soil application of N to both varieties produced highest biological yield (5486.2 and 5400 kg ha^{-1}). These results are in line with a recent study (Farooq et al., 2017).

Seed yield (kg ha^{-1}): The varieties and N application methods varied significantly for seed yield (Table 1b). Zahoor produced maximum biological yield (1520.1

kg ha^{-1}) than PARC. The N application through soil produced maximum seed yield (1643.4 kg ha^{-1}). While significantly lowest seed yield (1161.6 kg ha^{-1}) was in control. Nevertheless, interaction between varieties and N application methods was also found significant (Table 2b). The soil and foliar application to both varieties statistically similar seed yield (1647.1 and 1579.7 kg ha^{-1}). The increase in seed yield was due positive increase in all the yield contributing factors in these treatments. Recent studies also observed the similar results (Al-Solaimani et al., 2015; Farooq et al., 2017).

Harvest index (%): Nitrogen application methods and varieties showed significantly effect on harvest index (Table 1b). The variety Zahoor produced high harvest index (35.71) than variety PARC (28.84). Among the N application methods, the soil application gave highest harvest index (40.80) as compared to foliar application (31.16). While significantly lowest harvest index (24.84) was in control. The interaction between varieties and N application methods was also significant (Table 2b). The variety Zahoor with soil application of N gave highest harvest index (44.87) although it was at par with variety PARC with soil application of N. This has been also observed by Farooq et al. (2017).

Table 1(a). Effects of canola genotypes and nitrogen application methods on yield and yield components.

Nitrogen Sources	Plant height (cm)	No of branches plan^{-1}	No of pods plant^{-1}	No of Seeds pod $^{-1}$
V1	122.43 a	4.76	155.09 a	22.57
V2	113.69 b	4.42	94.44 b	19.62
LSD	2.78	3.13	56.40	3.13
Control	79.52 c	4.01 c	101.72 b	16.63 c
N1	144.80 a	5.33 a	143.23 a	25.73 a
N2	129.87 b	4.43 b	129.80 ab	20.93 b
LSD	4.85	2.53	30.04	2.53

V1-Zahoor, V2-PARC, N1-Soil N application, N2-Foliar N application

Means in a column not sharing the same letters differ significantly from each other at $P < 0.05$

Table 1(b). Effects of canola genotypes and nitrogen application methods on yield and yield components.

Nitrogen Sources	1000 seeds weight (g)	Biological yield (kg ha^{-1})	Seed yield (kg ha^{-1})	Harvest index (%)
V1	4.92	4676.9 a	1520.1 a	35.71 a
V2	4.84	4493.5 b	1357.7 b	28.84 b
LSD	0.25	176.08	65.78	2.19
Control	4.28 c	3600 c	1161.6 c	24.84 b
N1	5.43 a	5443.1 a	1643.4 a	40.83 a
N2	4.93 b	4712.4 b	1541.8 b	31.16 b
LSD	0.19	169.26	50.55	7.12

V1-Zahoor, V2-PARC, N1-Soil N application, N2-Foliar N application

Means in a column not sharing the same letters differ significantly from each other at $P < 0.05$

Table 2a. Interactive effects of canola genotypes and nitrogen application methods on yield and yield components.

Interaction	Plant height (cm)	No of branches plan^{-1}	No of pods plant^{-1}	No of Seeds pod $^{-1}$
V1 × C	84.03 d	4.50 b	71.27 c	17.53 b
V1 × N1	146.07 a	5.46 a	178.60 a	26.40 a
V1 × N2	137.20 b	4.33 b	139.27 b	23.80 b

Continued table 2a				
V2 × C	75.00 e	3.53 c	63.27 c	15.73 b
V2 × N1	143.53 ab	5.20 a	147.40 ab	25.06 a
V2 × N2	122.53 c	5.53 b	107.87 b	18.06 b
LSD	6.86	3.58	46.73	3.58
C-control, V1-Zahoor, V2-PARC, N1-Soil N application, N2-Foliar N application				
Means in a column not sharing the same letters differ significantly from each other at P < 0.05				

Table 2b. Interactive effects of canola genotypes and nitrogen application methods on yield and yield components.

Interaction	1000 seeds weight (g)	Biological yield (kg ha^{-1})	Seed yield (kg ha^{-1})	Harvest index (%)
V1 × C	4.30 c	3688.9 d	1359.3 c	28.47 bc
V1 × N1	5.46 a	5486.2 a	1647.1 a	44.87 a
V1 × N2	5.00 b	4855.6 bc	1554.0 b	33.69 b
V2 × C	4.26 c	3511.1 d	933.9 b	21.21 c
V2 × N1	5.40 a	5400.0 ab	1579.7 a	36.79 ab
V2 × N2	4.86 b	4596.3 c	1529.7 b	28.52 bc
LSD	0.27	422.21	24.77	10.08
C-control, V1-Zahoor, V2-PARC, N1-Soil N application, N2-Foliar N application				
Means in a column not sharing the same letters differ significantly from each other at P < 0.05				

CONCLUSION

This study concludes that nitrogen application methods are important factor in determining the yield of canola. Both varieties, Zahoor and PARC performed well under the soil application of N. Hence, soil application of nitrogen than foliar application is a better option to maximize the canola yield under agro ecological conditions of Mardan.

REFERENCES

Ali., K, F. Munsif, Z. Husain, I. Khan, N.Ahmad, N. Khan and M. Shahid. 2011a. Effect of different weed control methods on Weeds and maize grain yield. Pak. J. Weed Sci. Res., 17 (4): 313-321.

Ali, K., S. K. Khalil, F. Munsif, A. Rab, K. Nawab, A. Z. Khan, A. Kamal and Z. H. Khan. 2012. Response of maize to various nitrogen Sources and tillage practices. *Sarhad J. Agric., 28(1): 09-14.*

Ali, K., F. Munsif, M.Zubair, H. Akbar, Z. Hussain M. Shahid, Iftikhar ud Din and N. khan. 2011b. Management of organic and inorganic nitrogen for different maize varieties. *Sarhad J. Agric., 27(4): 525-529.*

Arif. M., K. Ali, M. Umair, F. Munsif, K. Ali, Inamullah, M. Saleem and G. Ayub. 2012. Effect of biochar, FYM and mineral nitrogen alone and in Combination on yield and yield components of maize.

Al-Hassa. 2006. Irrigation interval and nitrogen level effects on growth and yield of canola (*Brassica Napus* L). Sci. J. King Faisal Uni., 7: 87-103.

Al-Solaimani, S.G., F. Alghabari and M.Z. Ihsan. 2015. Effect of different rates of nitrogen fertilizer on growth, seed yield, yield components and quality of canola (*Brassica napus* L.) under arid environment of Saudi Arabia. Int. J. Agron. Agri. Res., 7: 1-7.

Anonymous, 2005-2006. Economic Survey of Pakistan. Islamabad: Economic Advisor's wing, Finance Division.

Amin, R. and S.K. Khalil. 2005. Effect of pre- and post-emergence herbicides and row spacing on canola. Sarhad J. Agri., 21: 165-170.

Farooq, M., S. Iqbal, M.Z. Afridi, F. Munsif, M. Tauseef and K. Rehman. 2017. Optimization

of nitrogen for increasing the productivity of canola. Agri. Res. Tech., 3: 1-5.

GOP. 2014-2015. Govt. of Pakistan. Pakistan Economic Survey 2008-2009. Islamabad: Economic Advisor's wing, Finance Division.

Khan, F.A., S. Ali, A. Shakeel, A. Saeed and G. Abbas. 2006. Correlation Analysis of Some Quantitative Characters in *Brassica napus* L. J. Agri. Res., 44: 7-14.

Muhammad, N., M.A. Chemma, M.A Wahid, N. Ahmad and M. Zaman. 2007. Effect of source and method of nitrogen fertilizer application on seed yield and quality of canola (*Brassica Napus* L). Pakistan J. Agri. Sci., 44: 74-78.

Nowlin, D. 1991. Winter canola. Agri. Consult., 47: 8

Potts, D.A., G.W. Rakow, D.R. Males and D.L. Woods. 2003. The development of canola quality *Brassica juncea*. Can. J. Plant Sci., 83: 117-118.

Malhi, S.S. and D. Leach. 2002. Optimizing yield and quality of canola seed with balanced fertilization in the Parkland zone of western Canada. Proc. Soils and Crop Workshop, February 2002, Saskatoon, SK.

Jackson, G.D. 2000. Effects of nitrogen and sulfur on canola yield and nutrient uptake. Agron. J., 92: 644–649.

Özer, H. 2003. Sowing date and nitrogen rate effects on growth, yield and yield components of two summer rapeseed cultivars. Eur. J. Agron., 19: 453-463.

Kolota, E., and M. Osinska. 2001. Eficiency of foliar nutrition of field vegetables grown at different nitrogen rats. In: Proc. IC Environ. Probl. N-Fert. Acta Hort., 563: 87-91.

Wahid, M.A. 2003. Effect of different fertilizers as source of nitrogen and their methods of application on growth, seed yield and oil quality of canola (*Brassica napus* L). M.Sc. thesis. Pakistan: Department of Agronomy, University of Agriculture Faisalabad.

Wiedenhoeft, M. and B.A. Barton. 1994. Management and environment effects on Brassica forage quality. Agron. J., 86: 227–237.

Yadav, H.K., P. Dogra and V. Yadav. 2014. Effect of foliar application of N and Zn on growth and yield of cauliflower (Brassica Oleracea var. Botrytis L.) CV. Snowball. Agri. Sustain. Develop., 2: 56-58.