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Influence of Nitrogen Timing and Levels on Yield and Yield Components of Canola

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Abstract
The experiment on response of nitrogen application timing and levels on yield and yield components of canola was conducted at New Developmental Farm the University Agriculture Peshawar, during Rabi season 2013-2014. The experiment consist of three timing (full at sowing, split application and rosette stage) and levels 80 and 120kg N ha^{-1} of nitrogen. The experiment was designed in randomized complete block with three replications. Canola Cultivar Abasin-95 was used as testing crop. The results indicated that more number of branches plant^{-1} (7), number of pods plant^{-1} (276), grain pod^{-1} (21), biological yield (3659kgha^{-1}), grain yield (1337kg ha^{-1}), thousand grain weight (4g) and harvest index (12%) were significantly affected except number of branches plant^{-1}. Split application were proved more effective as compared full at sowing or rosette stage of both nitrogen levels 80 and 120kg N ha^{-1} to obtain higher yield in agro- ecological conditions of Peshawar.
Keywords: Nitrogen, full sowing, rosette stage and canola cultivars

1. Introduction

Rapeseed (*Brassica napus L.*) belongs to the Cruciferae family, the common species are Nigra, Carinata, juncea, oleracea and compestries (Holmes,1980). Rapeseed or mustard was grown from 300Bc in Indus valley of Pakistan as a fodder crop. Both are traditional oil seed crops of Pakistan are grown in large area of four provinces of country (Khan *et al*., 2004). In Pakistan rapeseed or mustard are popular in Punjab, overall country producing 162.2 thousand tons of rapeseed and mustard from an area of 190.3 thousand hectares in which Punjab produce 96.3 thousand tons from an area of 111.5 thousand hectare. The consumption of total edible oil 2.821million tons, 0.684 million ton (24%) come from local resources and 2.137million ton (76%) are imported (Mahmood *et al*., 2005).

Rapeseed is a rich source of oil and protein. The seed constitute of 42-48% oil contents, 43.6% protein and complete profile of amino acids (i.e. lysine, methionine). The rapeseed oil is of low quality because it contains 40% of euric acid and glucosinolates (10micromole/g) therefore it is not use as regular cooking oil (Anonymously; 1996). Glucosinolates causes the nutrional disorder, effects growth and reproduction of animal in high quantities. The euric acid effect the taste and flavor of edible oil (Velmorel *et al;* 1986). Canadian scientists developed rapeseed cultivars with low euric acid and glucosinolates. This cultivar was latter named canola (Anonymous, 1992)

Like all other crops, growth, developmental process and grain yield of canola depends upon biotic and abiotic factors. Nitrogen plays important role in growth and development of canola plant (Brandt *et al*; 2007). According to Wright *et al*., (1988) reported rapid leaf area development increase crop assimilation, prolonged life of leaves and improvement in leaf area duration due to higher nitrogen application, on the other hand higher rate of nitrogen application may results in decrease of oil contents per unit seed rates (Yusuf and Bullock, 1993;Velichka *et al*., 1998; Jasinska *et al*., 1997).

Nitrogen fertilization had a positive significant effect on seed yield, seed weight, number of pods per plants and number of seeds per plant (Abzad Gohri and Amri 2010).

Keep in view the importance of nitrogen present research will be conducted in order to study the response of canola to different application timings and different nitrogen levels to determine the effective nitrogen application time and appropriate nitrogen utilization time to improve canola yield.

2. Materials and Methods

The present experiment was conducted at new Developmental Farm The University of Agriculture Peshawar, during Rabi season 2013-14.The experiment consist of Nitrogen applied to canola crop were 80 and 120 kg ha^{-1} the nitrogen application timings were full at sowing and half each at sowing and rosette stage. Cultivar Abasin-95 was sown with a seed rate 8kg ha^{-1}. Each plot was 10.5/m² having 8 rows and row-row distance of 50 cm and row length 3/m. Basal dose of TSP at rate of 60kg ha^{-1} was used a P source, urea was use as N source. After the plants reach 6-8cm hoeing was done in order to controlled weeds. All the agronomic practices were applied as required according to crop need.

The treatments consist of nitrogen levels and its time of application give in following arrangement

Treatments	Sowing time	Rosette stage
T1 =	80 kg N ha^{-1}	0 kg N ha^{-1}
T2 =	40 kg N ha^{-1}	40 kg N ha^{-1}
T3 =	0 kg N ha^{-1}	80 kg N ha^{-1}
T4 =	120 kg N ha^{-1}	0 kg N ha^{-1}
T5 =	60 kg N ha^{-1}	60 kg N ha^{-1}
T6 =	0 kg N ha^{-1}	120 kg N ha^{-1}
T7=	120 kg N ha^{-1}	0 kg N ha^{-1}

Data was collected on the following parameters which are explained below.

In order to count the number of branches 10 plants were randomly selected from each plot and their branches were counted and averaged. Three plants from each plot were selected. Their pods were counted and averaged. Grain $pods^{-1}$ data 10 pods were randomly selected, threshed, counted their seed and averaged. Thousand grain weights were counted by randomly collecting sample from grain obtained from the plot after threshing of each treatment and weighed to record 1000-seed weight. Biological yield, four central rows in each plots were harvested, dried for 10 days and weighed. Four central rows were harvested from each plot using a sickle and sun dried for 10 days and threshed. The grains collected weighed with electronic balance and then converted into kg ha^{-1} by using the formula. To calculate harvest index, the grain yield was divided by biological yield and multiplied by 100 to express the data as percentage.

$$\text{Biological yield (kg ha}^{-1}\text{)}=\frac{\text{biological yield plot}}{\text{row to row dist. x no of rowsxrow lenght}}x10000$$

$$\text{Grain yield (kg ha}^{-1}\text{)}=\frac{\text{Grain yield plot}^{-1}}{\text{row to row dist. x no of rowsxrow lenght}}x10000$$

$$\text{Harvest index (\%)}=\frac{\text{Grain yield}}{\text{biological yield}}x100$$

The data recorded was analyzed statistically using analysis of variance techniques appropriate for randomized complete block design with arrangement. Means were compared using LSD test at 0.05 level of probability, when the F-values were significant (Jan *et al.*2009).

3. RESULTS AND DISCUSSION

3.1. Number of branches $plant^{-1}$

Data regarding number of branches $plant^{-1}$ presented in Table 1. Statistical analysis of the data indicated that nitrogen timing and nitrogen levels had no significantly affect on number of branches. The possible reason might that it is genetically character which cannot be effected by external application of fertilization. The other reason might that nitrogen mostly deal with vegetative growth not phenology. Several other studies have reported effect of rate and timing of N fertilization on the number of branches in canola which not for form expectation as nitrogen fertilizer stimulate better plant growth and development (Butter *et al.*2006). They found Nitrogen application more effective on canola crop.

3.2. Number of pods $plant^{-1}$

Data regarding number of pods per plant showed in Table 2. Statistical analysis of the data indicated that nitrogen application timing and level are significantly affected numbers of pods. More pod plant (251) was obtained with application of 80 kg N ha^{-1} as compared with (186 pod $plant^{-1}$) from 120 kg N ha^{-1}. More pods $plant^{-1}$ were (235) obtained with equal split application followed by full at rosette stage (215), followed by (205) full at sowing time. These results are in conformity with Khorshidi *et al.* (2013) who found higher Nitrogen application resulted in more numbers of pod per plant.

3.3. Grain $pods^{-1}$

Data recorded on Grain pod $plant^{-1}$ are presented in Table 3. Canola was significantly influenced by N fertilizer statistical analysis of the data indicated that nitrogen timing and levels are significantly affected grain pod^{-1}. More grain pod^{-1} (21) were obtained with application of 80 kg N ha^{-1} as compared with (11 grain pod^{-1}) from 120 kg N ha^{-1}. More grain pods ha^{-1} (18) were obtained with equal split application followed by full at sowing time (14), followed by (13) full at rosette stage. The reason may be affective time of nitrogen application and other reason may be better utilization of nitrogen by plants. These results are in line with Khorshidi *et al*. (2013). Who reported higher number of grain per pod for high N applications.

3.4. Thousand grain weight (g)
Data regarding 1000 grains weight are presented in Table 4. Statistical analysis of data showed that 1000 grains weight of canola was significantly influenced by N timing and levels. More grain weight (3.8) were obtained with application of 80 kg N ha^{-1} as compared with (3.5 thousand grain weight) from 120 N kg ha^{-1}. More thousand grain weight (3.91) were obtained with rosette stage (3.91) application followed by equal split application (3.75) and followed by full at sowing (3.35). It could be better utilization of N application by plants and might be appropriate time of application. The findings are conformity with Khorshidi *et al.* (2013) who found that higher N application results more grain weight.

3.5. Biological yield
Data recorded on biological yield are presented in Table 5. Analysis of variance of the data revealed that biological yield of canola was significantly influenced by N timing and levels. More biological yield (3645) was obtained with application of 80 kg N ha^{-1} as compared with (3210.5 biological yield) from 120 kg N ha^{-1}. More biological yield (3768.6) were obtained with equal split application followed by full at sowing (3400) and followed at rosette stage (3113.6). It might be possible reason that biological yield enhance with nitrogen application. These results are in line with Sana *et al.* (2003) who found that higher N application produced more biological yield.

3.6. Grain yield plot^{-1}
The data regarding grain yield of canola presented in Table 6. Analysis of variance of data that grain yield of canola was significantly influenced by N application timing and levels. More grain yield plot $^{-1}$ (1172.1) were obtained with application of 80 kg N ha^{-1} as compared with (874 grain yield plot $^{-1}$) from 120 kg N ha^{-1}. More grain yield plo^{1} (1145) obtained with equal split application followed by full at sowing (996) and followed by rosette stage (927). The reason may be better utilization of N by plants. These results are in line with Sana *et al.* (2003). Who found that higher N application results more grain yield (kg ha^{-1}).

3.7. Harvest index
Data recorded on HI is presented in Table 7. Analysis of variance of data revealed that HI of canola was significantly influenced by N application timing levels. More HI (11.6) was obtained with application of 80 kg N ha^{-1} as compared with (9.8 HI) from 120 kg N ha^{-1}. More HI obtained (11.1) were obtained with equal split application followed by rosette stage (11) and followed by full at sowing time (10.1). The reason may be due to better utilization of N by plants. The other reason might be effective of application. These results are in line with Rethka *et al*. (2004) who found that high N application results best % Harvest Index.

4. Conclusions and Recommendations
it is concluded from the results that to obtained the higher yield of canola the nitrogen application timings (at sowing time and rosette stage) with 80 and 120kg ha^{-1} resulted in higher yield of canola and hence recommended for obtaining higher yield under agro ecological condition of Peshawar.

Table 1. Number of Branches of canola influenced by different nitrogen timings and levels

Nitrogen (Kg ha^{-1})	Nitrogen timings			Mean
	Full at sowing	Equal split application	Rosette Stage	
80	6	7	7	6.7
120	6	6	7	6.6
Mean	6.5b	6.5b	7.16a	

NS

Table 2. Number of Pods per plant of canola influenced by different nitrogen timings and levels

Nitrogen (Kg ha^{-1})	Nitrogen timings			Mean
	Full at sowing	Equal split application	Rosette Stage	
80	234	278	242	251
120	178	194	189	187
Mean	206b	236b	215a	

LSD for Nitrogen timing = 2.25

Table 3. Grain per Pods of canola influenced by Nitrogen Timings and levels

Nitrogen (Kg ha^{-1})	Nitrogen timings			Mean
	Full at sowing	Equal split application	Rosette Stage	
80	17	21	16	18
120	11	14	10	12
Mean	14b	18b	13a	

LSD for nitrogen timings = 2.17

Table 4. Thousand grain weight (g) canola influenced by Nitrogen Timings and levels

Nitrogen (Kg ha^{-1})	Nitrogen timings			Mean
	Full at sowing	Equal split application	Rosette Stage	
80	3.3	4.1	4.0	3.8
120	3.3	3.4	3.8	3.5
Mean	3.35b	3.75b	3.91a	

LSD for nitrogen timings = 2.01

Table 5. Biological Yield (kg ha^{-1}) of canola influenced by Nitrogen Timings and levels

Nitrogen (Kg ha^{-1})	Nitrogen timings			Mean
	Full at sowing	Equal split application	Rosette Stage	
80	1142.6	1317.3	1056.3	1172.1
120	850.6	974	798.6	874.4
Mean	996.6b	1145.6b	927.5a	

Nitrogen (Kg ha^{-1})	Nitrogen timings			Mean
	Full at sowing	Equal split application	Rosette Stage	
80	3659.5	3911.5	3363.9	3645.0
120	3142	3626.2	2863.3	3210.5
Mean	3400.79b	3768.9b	3113.6a	

LSD for nitrogen timings = 2.27

Table 6. Grain yield (kg ha^{-1}) influenced by Nitrogen Timings and levels

LSD for nitrogen timings = 2.26

Table 7. Harvest Index (%) of canola influenced by Nitrogen Timings and levels

Nitrogen (Kg ha^{-1})	Nitrogen timings			Mean
	Full at sowing	Equal split application	Rosette Stage	
80	10.5	12	12.3	11.6
120	9.6	10.3	9.6	9.8
Mean	10.1b	11.1b	11a	

LSD for nitrogen timings = 2.01

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