Research Article

Growth and yield attributes of canola varieties under different seed rates

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Abstract

A field experiment was conducted at Bacha Khan University Agricultural Research Farm, Bacha Khan University Charsadda, during winter-2015 to determine the growth and yield attributes of canola varieties under different seed rates. Four seed rates (4, 6, 8 and 10 kg ha⁻¹) and two varieties (Durr-e-NIFA and Zahoor Swati) were tested in the experiment. The experiment was laid out in a randomized complete block design with three replications. Net plot size was 3m x 2m having 5 rows with row to row distance of 40cm. Recommended dose of NP (60 & 75 kg ha⁻¹) was applied. All the P was applied at sowing time while N was applied in split doses (Half at the time of sowing and the remaining half in first irrigation). All other agronomic practices were equally maintained for all plots. The results showed that maximum emergence m⁻² (97), days to maturity (165), plant height (149 cm), biological yield (3709 kg ha⁻¹) and grain yield (2170 kg ha⁻¹) was produced at seed rate of 10 kg ha⁻¹. Maximum 1000-grains weight (3.92 g) was produced at the seed rate of 4 kg ha⁻¹. Maximum emergence m⁻² (82) was recorded for the variety Zahoor Swati. The variety Durr-e-NIFA produced maximum plant height (145 cm) and 1000-grains weight (3.69 g). Biological yield (3751 kg ha⁻¹) and grain yield (2228 kg ha⁻¹) increased with increasing seed rate from 4 to 10 kg ha⁻¹ in case of Durr-e-NIFA variety.

Keywords: Canola varieties; Seed rates; Growth and Yield attributes

Introduction

Canola (*Brassica napus* L.) belongs to the family Brassicaceae. It is the most important source of vegetable oil in the world including Pakistan. Its leaves and stem also provide good quality forage yield to livestock [1, 2]. The seeds of canola contain 40-45% oil and 36-40% protein. Its oil and meal are now acceptable as alternatives to soyabean oil and meal [3, 4]. Canola oil has

lower level of saturated fats (only 6%) than any other edible vegetable oils [5]. Canola oil is better for human health because of its lowest content of saturated fatty acids among vegetable oils and moderate content of poly-unsaturated fatty acids [6]. In Pakistan, canola was grown on an area of 215.4 thousand hectares with a total production of 178.8 thousand tons. Its average yield was 830 kgha⁻¹, while in

Khyber Pakhtunkhwa, it was grown on an area of 16.7 thousand hectares with a production of 7.3 thousand tons with an average yield of 437 kg ha⁻¹ [7]. Seed rate is an important factor for optimum plant population. The establishment of an adequate and uniform canola stand is critical to achieve high grain yield and grain oil content. Seed yield of canola is a function of population density, number of pods plant⁻¹, number of seeds pod⁻¹ and seed weight. However, yield structure is variable and adjustable across a wide range of populations [8]. Seed rates significantly affects days to maturity, siliques m⁻², grains silique⁻¹, thousand grains weight, grain yield and oil percentage [9]. Increase in the seed rate up to 8 kg ha⁻¹ resulted maximum seed yield [10]. Increase in the seed rate beyond 8 kg ha⁻¹ declined number of pods plant⁻¹ and number of seeds pod⁻¹ [11].

Variety selection as per agro-climatic conditions of the locality is very important. Canola varieties vary significantly for many characteristics like seed yield, oil yield, number of pods plant⁻¹, number of seeds pod⁻¹ [12]. Some varieties are tall while others are dwarf due to their genetic potential [13]. Similarly a variation has also been found in number of branches plant⁻¹ [14]. Disease resistance, seed quality, vigorous growth and development are other important characteristics which have never been ignored in variety selection for a locality. No variety contains all the required characteristics, but the basic pre-requisites in cultivar selection are lodging, disease resistance, yield and yield related attributes. So selection of desirable varieties is an important economic and management decision for a specific locality [15]. Keeping in view the increasing demand of vegetable oils, the present study was therefore conducted to determine the effects of different seed rates and varieties on growth

and yield attributes of newly evolved high yielding varieties of canola.

Materials and methods

A field experiment was conducted at Bacha Khan University Agricultural Research Farm, Bacha Khan University Charsadda, Khyber Pakhtunkhwa-Pakistan during the winter season 2015-16. The objective of the experiment was to investigate the effect of seed rates and varieties on growth and yield components of canola in the agro-climatic conditions of Charsadda. Four seed rates (4, 6, 8 and 10 kg ha⁻¹) and two canola varieties (Durr-e-NIFA and Zahoor Swati) were tested in the experiment. The experiment was laid out in a randomized complete block design with three replications. Net plot size was 3m x 2m having 5 rows 40cm apart. The recommended dose of NP (60 & 75 kg ha⁻¹) was applied. All the P was applied at sowing time, while N was applied in split doses (half at the time of sowing and the remaining half with first irrigation). All other agronomic practices were equally maintained for all plots. Data were recorded on emergence m⁻², days to physiological maturity, plant height, 1000-grains weight, biological yield and grain yield. Emergence m⁻² was recorded by counting the number of seedlings in three central rows, each row one meter long in three different places in each plot and the counts were averaged and converted in to number of seedlings m⁻² by using the following formula:

Emergence m⁻² = $\frac{\text{Total no. of seedlings emerged}}{\text{R-R distance (m)} \times \text{row length (m)} \times \text{No. of rows}}$
 Data for days to physiological maturity were counted from the date of sowing to the date when the color of 80% siliques turned from green to brown in each plot. Plant height was recorded by measuring the height of 10 randomly selected plants from ground level to the top of the plant in each plot at physiological maturity and then their average was calculated. For thousand grains weight, 1000 grains were counted from grain lot of each plot and weighed with the help of

electronic balance. Biological yield was calculated after harvesting three central rows in each plot at maturity and dried and Biological yield (kg ha^{-1}) = $\frac{\text{Biological yield in three central rows (kg)} \times 10000}{\text{R-R distance (m)} \times \text{row length (m)} \times \text{No. of rows}}$

Grain yield was calculated by weighing grains of three central rows in each plot and then

Grain yield (kg ha^{-1}) = $\frac{\text{Grain yield in three central rows (kg)} \times 10000}{\text{R-R distance (m)} \times \text{row length (m)} \times \text{No. of rows}}$

Statistical analysis

The data recorded were analyzed statistically using analysis of variance techniques appropriate for randomized complete block design. Significant differences among treatments were determined using least significant difference (LSD) test for main as well as interaction effects [16].

Results

Emergence m^{-2}

Data regarding emergence m^{-2} of canola as affected by seed rates and varieties are

weighed and then converted to kg ha^{-1} by the following formula

converted to kg ha^{-1} using the following formula

shown in Table 1. Seed rate and varieties had significant effect on emergence m^{-2} while the interactive effect of S and V was found non-significant. Maximum emergence m^{-2} (97) was observed with the seed rate of 10 kg ha^{-1} while minimum emergence m^{-2} (61) was recorded with the seed rate of 4 kg ha^{-1} . In case of varieties, maximum emergence m^{-2} (82) was observed in Zahoor Swati as compared to Durr-e-NIFA (77).

Table 1. Emergence m^{-2} , days to physiological maturity and plant height of canola as affected by seed rates and varieties

Treatments	Emergence m^{-2}	Days to maturity	Plant height (cm)
Seed rate (S) (kg ha^{-1})			
4	61d	162b	138c
6	71c	162b	141bc
8	88b	162b	144ab
10	97a	165a	149a
LSD value	5.947	1.235	5.281
Canola varieties (V)			
Durr-e-NIFA	77b	162	145a
Zahoor Swati	82a	163	141b
LSD value	4.205	Ns	3.734
LSD value for interaction			
S x V	Ns	Ns	Ns

Means in the same category followed by different letters are significantly different at $P \geq 0.05$ levels. * = significant
 Ns = non-significant

Days to physiological maturity

Table 1 shows the effect of seed rates and varieties on days to maturity of canola. Statistical analysis showed that seed rates significantly affected days to maturity, while varieties and the interaction of S and V had

non-significant effect on days to maturity. Among seed rates, 10 kg ha^{-1} took maximum days to maturity (165), while minimum day to maturity (162) were taken by 4 kg ha^{-1} which was statistically similar with days to maturity taken by 6 and 8 kg ha^{-1} .

Plant height (cm)

Data regarding plant height as affected by seed rates and varieties are presented in Table 1. Plant height of canola was significantly affected by seed rates and varieties while S x V was non-significant. Maximum plant height (149 cm) was recorded in plots where 10 kg ha⁻¹ seed rate was used, while minimum plant height (138 cm) was recorded in plots in which 4 kg ha⁻¹ seed rate was used which was statistically similar to that produced by 6 kg ha⁻¹ (141 cm). In case of varieties, taller plants were produced by Durr-e-NIFA (145 cm) as compared to Zahoor Swati which produced shorter plants (141 cm).

1000-grains weight (g)

Thousand grains weight of canola was significantly affected by seed rates and varieties while their interaction did not affect 1000-grains weight significantly (Table 2). In seed rates, maximum 1000-grains weight (3.92 g) was found in plots where 4 kg ha⁻¹ seed rate was used, while minimum 1000-grains weight (3.30 g) was found in 10 kg ha⁻¹ which was statistically similar with that of 8 kg ha⁻¹ (3.51 g). In case of varieties, Durr-e-NIFA gave maximum grain weight (3.69 g) as compared to Zahoor Swati (3.51 g).

Table 2. Thousand grains weight, biological yield and grain yield of canola as affected by seed rates and varieties

Treatments	1000-grains weight (g)	Biological yield (kg ha ⁻¹)	Grain yield (kg ha ⁻¹)
Seed rate (S) (kg ha⁻¹)			
4	3.92a	2127d	1622c
6	3.66b	2648c	1754c
8	3.51bc	3365b	1998b
10	3.30c	3709a	2170a
LSD value	0.242	227.909	167.631
Canola varieties (V)			
Durr-e-NIFA	3.69a	2925	1930
Zahoor Swati	3.51b	2999	1842
LSD value	0.171	Ns	Ns
LSD value for interaction			
S x V	Ns	*	Ns

Means in the same category followed by different letters are significantly different at $P \geq 0.05$ levels. * = significant. Ns = non-significant.

Biological yield (kg ha⁻¹)

Biological yield of canola varieties varied considerably by seed rates and S x V (Table 2). Among seed rates maximum biological yield (3709 kg ha⁻¹) was produced by 10 kg ha⁻¹ while minimum biological yield (2127

kg ha⁻¹) was produced by seed rate of 4 kg ha⁻¹. Based on the interaction between seed rates and varieties, variety Durr-e-NIFA produced maximum biological yield (3751 kg ha⁻¹) when sown at the seed rate of 10 kg ha⁻¹ (Figure 1).

Figure 1. Biological yield (kg ha⁻¹) of canola as affected by seed rates and varieties

Grain yield (kg ha⁻¹)

Table 2 shows data about grain yield of canola varieties as affected by seed rates. It is evident from statistical analysis that seed rate significantly affected grain yield of canola, however the interaction of varieties and seed rates was found non-significant. Among seed rates, maximum grain yield (2170 kg ha⁻¹) was recorded with the seed rate of 10 kg ha⁻¹ while minimum grain yield (1622 kg ha⁻¹) was produced by 4 kg ha⁻¹ seed rate.

Discussion

Emergence m⁻² of canola was significantly affected by seed rates and varieties. Higher emergence m⁻² was recorded with higher seed rate as compared to lower seed rate. Maximum emergence m⁻² was recorded in plots with the seed rate of 10 kg ha⁻¹. The effect of seed rate on the emergence m⁻² of canola might be due to more seedlings emerged due to higher number of seeds sown. These results are in line with those of [17] who concluded that increasing seeding rate increased emergence in canola. In case of varieties, maximum emergence⁻² was

observed in Zahoor Swati as compared to Durr-e-NIFA. The difference of varieties for emergence m⁻² might be due to the genetic variations between them. Seed rates significantly affected days to physiological maturity of canola while varieties and S x V were found non-significant for their effect on days to maturity. Plots treated with higher seed rates took more days to maturity than the lower seed rates. Maximum days to maturity were taken by plots of 10 kg ha⁻¹ seed. Similar results were found by Inamullah *et al.* [9] who stated that higher seed rates of canola took more days to maturity. Plant height also increased with increase in seed rate. Seed rate of 10 kg ha⁻¹ produced taller plants. These results are similar to those reported by Karamzadeh *et al.* [10]. In case of varieties, Durr-e-NIFA resulted in higher plant height than that of Zahoor Swati. The reason might be the genetic variations between the varieties. Our results are in line with [18] who stated that there was significant difference for plant height among different varieties. Thousand grains weight of canola significantly

affected by seed rates and varieties. In case of seed rates, maximum 1000-grains weight was observed with the seed rate of 4 kg ha⁻¹. Higher seed rate had low grain weight which might be due to the fact that competition among plants increases with higher plant density. Lower seed rate resulted in higher 1000-grains weight which might be due to low competition for resources among the plants which resulted to increase the grain weight. These results are in line with [19]. In case of varieties, Durr-e-NIFA gave more 1000-grains weight than that of Zahoor Swati. It might be due to the difference in the genetic make-up of the varieties. Biological yield of canola significantly varied by various seed rates and maximum biological yield was produced by the plots seeded with 10 kg seed ha⁻¹. Biological yield increased with increasing seed rate due to higher density. Similar results were found by Ogrodowczyk and Wawrzyniak [20] who stated that with an increase in seed rate, higher biological yield was harvested in canola crop. Grain yield of canola was significantly affected by seed rates. Maximum grain yield was recorded with 10 kg ha⁻¹ while. [20, 21] reported the same results that increase in yield is strongly correlated with increase in yield components such as siliques plant⁻¹, grains silique⁻¹ etc.

Conclusions and recommendations

It was concluded that seed rate of 10 kg ha⁻¹ gave maximum performance in terms of emergence m⁻², plant height, biological yield and grain yield. The variety Durr-e-NIFA performed better in terms of plant height and 1000-grains weight. So, it is recommended that variety Durr-e-NIFA should be grown at the seed rate of 10 kg ha⁻¹ to get the highest biological and grain yield.

Authors' contributions

Conceived and designed the experiments: B Khan, M Islam & M Jawad, Performed the experiments: M Jawad, J Ali, M Ishaq & A

Rehman, Data collection and field inspections: M Jawad, Z Hussain, M Islam, WA Shah, R Amin, Anjum & B Khan, Statistical Analysis of the data: M Islam, Anjum & Z Hussain, Contributed reagents/materials/ analysis tools: R Amin & WA Shah, Wrote the paper: M Islam & M Jawad.

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