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Effect of plant density on morphological traits three canola cultivars in North, Iran (*Brassica napus* L.)

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Abstract

This study was conducted to find the effect of row spacing on three varieties of H19, Zarfam ad Goliath. The experimental lay out was factorial based on randomized complete block design with 4 replications. Experimental factors included 3 row spacing of 30, 40 and 50 cm and as 3 winter canola cultivars of H19, Zarfam and Goliath. Results showed that simple varieties has significant effect on the number of branches in plants ($P<0.05$), number of pods per branch, number of pods on main stem and seed oil Percent ($P<0.01$). The effect of planting distance had a significant effect on the number of branches and pods on main stem ($P<0.01$). Results of interaction between varieties and row spacing showed that the maximum percentage of oil content found in Zarfam variety with an average of 41.8 % and in distance of 30cm in rows.

Keywords: Canola, Row spacing, Variety, Seed oil percent

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Introduction

Statistics indicate that canola has more annual production growth than soybean, cotton, sunflower and peanut and its production increased from fifth to third order. Increasing population followed by increasing number of vegetable consumers in recent years has caused more than 90% consumption of oil in Iran supply via imports. Canola cultivars oil has higher value in comparison with other oil seeds due to its high unsaturated fatty acids.

One way to increasing seed yield/m^2 is using suitable cultivars compatible with climate conditions of any region in desired planting density in a manner to create minimum competition among plants. One of the main goals in agriculture is determining best plant density to yielding desired yield. Desired density is obtained when canopy have maximum leaf area to up take sunlight at the beginning of reproductive stage (larry et al., 2002). Goals such as improving absorbed sunlight by changing plant density and also changing row spacing is perused in agricultural plants (Maddonni et al., 2001). Increasing light penetrating into lower parts of canopy by changing its structure is a management way to improve yield (Reta-Sanches and Fowler, 2002). Heikkinen and Auld (1991) recommended densities more than to plants per meter square to canola. James and Anderson (1994) suggested that yield increased with increasing in plant density by increasing pod/m^2. Potter et al. (2002) observed in studying rows spacing and seed rate effect on canola cultivars that seed yield increased significantly with increasing density to 50 plants per/m^2. Canola is first choice to supplying needed vegetable oil in the country. According to studies, canola planting needs more consideration than other oily seeds due to its compatibility with most the country region and its higher qualitative oil.

Materials and Methods

The experiment was carried out Chaloos agricultural research station, Chaloos, Iran in 2010-2011. The soil texture of the experimental site was loam clay (28% clay, 21% silt and 24% sand) with pH of 8.2 and EC of 0.62 ds. 100 (kg/ha) ammonium phosphates and 85

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kg/ha urea were applied prior to planting and appropriate practices were used for weed and insect control. The experimental lay out was factorial based on randomized complete block design, with 4 replications. Experimental factors included 3 row spacing of 30, 40 and 50 cm and as 3 winter canola cultivars of H19, Zarfam and Goliath. Goliath has been extensively cultivated in the north of Iran in recent years, where two other cultivars are newly introduced. Each plot was 8.4 m^2 and the length of sowing lines in each plot was 5 m. Plots allocated to 30, 40 and 50 cm row spicing, comprised 14, 9 and 7 sowing lines, respectively. The required water was supplied through precipitation (310 mm) during growth stages. Seven insecticides were applied at the rate of 145 g/h at flowering stage to control pests. Weeds were removed by hand weeding during growth stages. At the time of harvest, in order to control boarder effects, plants from the sides of each plot were removed. To measure yield components including number of branch in plant, number of pods/main stem, number of pods/second stem and ten plants were harvested from each plot at the time of maturity. Evaluated traits were determined as followed:

1) Number of pods/ main and second stem and number of branch in plant was determined from the 10 plant sample. Pods in the main stems were counted and then divided by 10.

2) To determine seed oil content samples were taken from each seed yield sample. They were oven-dried at 130°C for 3 hours, cooled in desiccators and then oil percentages were determined using Nuclear Magnetic Resonance (NMR) system. The obtained data were subjected to variance analysis as a split-split plot design using the Statistical Analysis System (SAS Institute, 1998). The source of variation, degrees of freedom and expected mean square for evaluated traits appear in Table 1. Comparison of means was performed by Duncan's Multiple Range Test at P<0.05 and 0.01.

Results and Discussion

The number of branches per plant

Cultivars (P<0.01) and row spacing (P<0.05) exhibited a significant difference in number of stem in plant (Table 1). H19 and Goliath showed higher number of pods main/stem compared with Zarfan (Table 1). The row spacing × cultivar interaction was not significant for number of pods main/stem (Table 1). The lowest number of number of stem in plant was observed in Zarfam when grew at 30 cm row spacing (Table 1). The number of branches can affect the grain yield of canola as well as the biological yield, therefore, having a high biomass the increase in grain yield. Plant population decreases, individual plants progressively produce more branches, pods/plant and seeds/pod. Canola seed yield is a function of population density, number of pods/plant, number of seeds/pod and seed weight. However, yield structure is very plastic and adjustable across a wide range of populations (Diepenbrock, 2000). These results agreed with those of Kuchtova and Vasak Kuchtova et al. (1998) and Leach et al. (1999).

Number of pods/ second stem

Cultivars and row spacing also exhibited significant difference (P<0.01) in number of pods main/stem (Table 1). Zarfam showed higher number of pods/main stem compared with H19 and Goliath (Table 1). The row spacing × cultivar interaction was non-significant for number of pods/main stem (Table 2). The lowest number of pods/main stem was observed in H19 when grew at 30 cm row spacing (Table 1). In narrow rows the yield of second stem is the primary contributor to total yield. Johnson and Hanson (2003) reported a higher performance culture within narrower than wider rows, the plant is uniformly distributed, the proper distribution of solar radiation in vegetation and reduce is competition within species and this will increase the number of pods per plant. Seed yield of canola is a function of population density, number of pods per plant and number of seeds per pod. However, yield structure is very plastic and adjustable across a wide range of population (Diepenbrock, 2000).

Number of pods/main stem

Cultivars also exhibited significant difference (P<0.01) in number of pods/main stem (Table 1). H19 showed higher number of pods/main stem compared with Zarfan and Goliath (Table 1). The lowest number of pods/main stem was observed in Goliath when plants grew at 50 cm row spacing (Table 1). Plants grow in low plant density receive more solar radiation compared to denser populations resulting in a greater portion of vegetative dry matter to allocate the branches. The row spacing × cultivar interaction was non-significant for number of pods/main stem (Table 2). Regarding different cultivars, the process of this trait varied in different row spacing. The lowest number of pods/main stem was observed in Goliath when grew at 50 cm row spacing (Table 1). In narrow rows the yield of main stem is the primary contributor to total yield. Therefore, cultivars that have higher main stem yield potential are the best suited in narrow row spacing cultivation.

Seed oil content

Obtained results indicated that only cultivars showed significant effects (P<0.01) on seed oil content and other factors were not significant for this trait (Table 1). Zarfam showed the highest seed oil content (40.9%), indicating the better performance of hybrids

Table 1: Mean Comparison the effect of cultivars and planting row spacing on some canola agronomic traits.

Treatment	Number of Stem/plant	Number of Pods/second stems	Number of Pods/main stem	Seed oil content %
Variety(A)				
V_1=H19	2.8^{a}	22.2^{b}	37.6^{a}	27.9^{c}
V_2=Zarfam	2.3^{b}	28.3^{a}	36.6^{a}	40.9^{a}
V_3=Goliath	2.8^{a}	19.3^{c}	27.5^{b}	31.1^{b}
Row Spacing(B)				
$R.S_1$=30 cm	2.2^{c}	20.2^{c}	33.4^{a}	33.4^{a}
$R.S_2$=40 cm	2.7^{b}	23.2^{b}	34.1^{a}	32.7^{a}
$R.S_3$=50 cm	3.1^{a}	26.3^{a}	34.2^{a}	33.8^{a}
Variety* Row Spacing(AB)				
$V_1*R.S_1$	2.2^{cd}	$19.1d^{e}$	39.4^{a}	26.8^{d}
$V_1*R.S_2$	2.8^{abc}	$21.4d^{e}$	34.9^{a}	28.2^{cd}
$V_1*R.S_3$	3.4^{a}	26.1^{bc}	38.6^{a}	28.7^{cd}
$V_2*R.S_1$	1.9^{d}	23.5^{cd}	36.4^{a}	41.8^{a}
$V_2*R.S_2$	2.4^{bcd}	28.8^{ab}	35.5^{a}	39.5^{a}
$V_2*R.S_3$	2.8^{ab}	32.4^{a}	38.1^{a}	41.4^{a}
$V_3*R.S_1$	2.5^{bc}	17.9^{e}	24.5^{b}	31.7^{b}
$V_3*R.S_2$	2.9^{ab}	19.5^{de}	32^{ab}	30.3^{bc}
$V_3*R.S_3$	3.1^{a}	20.5^{de}	26.1^{b}	31.2^{b}
Significant (M.S)				
A	*	**	**	**
B	**	**	NS	NS
A*B	NS	NS	NS	NS
CV%	11.43	10.31	12.36	4.17

Means with similar letter were not significant at the 5% probability level; Levels of significant:* =P< 0.05, **= P<0.01 and NS = not significant

compared with other types (Table 1). Row spacing had no significant effects on this trait. Potter et al. (1998) reported that oil content was not affected neither by row spacing nor plant density in both low and medium rainfall regions. Morrison et al. (1990) and Leach et al. (1999) reported no effects of sowing rates on seed oil content while Van Deynze et al. (1992) showed a small decrease in oil content as sowing rate increased to 9 (kg.ha-1). Similarly, Morrison et al. (1990) found few consistent effects of row spacing on oil content.

Conclusion

This study showed that the planting density, where an equidistant arrangement is applied, results in the highest seed yield of canola cultivars. Therefore, regarding the climatic condition in the north of Iran, application of row spacing (30cm) in Zarfam cultivar is recommended. Zarfam cultivar had the best performance and exhibited the highest seed oil content. Based on results from this study, application of Zarfam considering 30 cm row spacing is recommended.

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