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Calculation of Space between rows and within rows on the yield and agronomic characteristics of two genotypes of spring rapeseed (Hyola 401 and Opera)

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Abstract

In Iran, rapeseed (*Brassica napus* L.) is an important alternative oilseed crop.. The data on plant density of rapeseed is scanty. Therefore this experiment is planed to investigate the effects of space between rows and space within rows on the yield and agronomic characteristics of two genotypes of spring rapeseed (Hyola 401 and Opera) two cultivars of *Brassica napus* L., were studied for 2 years in Karaj, Iran during 2008 and 2009 years. The effects of spacing's between or within rows on the yield and yield components of Hyola401 and Opera, Rows were spaced at 20, 30 and 45 cm. Spacing's within rows were 5, 10 and 20 cm. The results of this study suggested that grain yield was significantly affected by spacing's between rows but not by spacing's within rows, and that rape yields were higher at the narrow (15 cm) row spacing compared to the middle (30 cm) and wider (45 cm) spacing's.

Keywords: Canola, Plant density, Grain yield, Row spacing

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Introduction

In oilseed rape, row spacing or plant density vary considerably worldwide, depending on the environment, production system and cultivar. Previous studies have shown that plant density is an important factor affecting rapeseed yield. Plant density in rapeseed governs the components of yield, and thus the yield of individual plants. A uniform distribution of plants per unit area is a prerequisite for yield stability (Diepenbrock 2000). Al Barzinjy et al. (1999) investigated the effects of different plant densities ranging from 20 to 130 plants/m^2 in rapeseed. They concluded that pods per plant, seed weights and dry matter per plant decreased as plant density increased. Leach et al. (1999) also reported that plants grown at high density had fewer pod-bearing branches per plant but produced more branches. The same researchers also observed that there was no effect of density on seed oil content. Rapeseed is sometimes grown in rows with spacing wide enough to allow for mechanical cultivation. In most areas where herbicides are used, the crop is either broadcast seeded or planted in drill rows spaced 20–20 cm (Lewis and Knight 1987). Rapeseed has generally slight or inconsistent seed yield responses to various row spacing. Therefore, optimum densities for each crop and each environment should be determined by local research.

The objective of this study was to evaluate the effects of different spacing between or within rows on the agronomic characteristics of two genotypes of *Brassica napus*.

Materials and Methods

This research was conducted during 2008 and 2009 at the Karaj in Iran. The soil at the experimental site was loamy, with approximately 4.1 g/kg organic matter.

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The 0–30 cm soil layers contained respectively 850 kg/ha total N, 120.6 kg/ha available P and 430 kg/ha available K. The previous crop for the plots sown in 2008 an 2009 was barley (*Hordeum vulgare* L.). The plots were moldboard ploughed in the fall and cultivated twice in the spring. Individual plots were 5 rows by 6 m long. Seeds were hand-sown on 15 April in 2008 and 18 April in 2009, respectively. In this study, two spring rapeseed cultivars, Hyola401 and Opera were used. The experimental design was a randomized block design with four replications. Treatments consisted of two cultivars (Hyola 308 and Opera), three spacing between rows (20, 30 and 45 cm) and three spacing within rows (5, 10 and 20 cm). In both years, the experiment was fertilized before sowing by to the following fertilization rates: 80 kg N/ha as ammonium sulphate and 75 kg P_2O_5/ha as triple superphosphate. Additional 65 kg N/ha was applied in both the study years, just before flowering. Spacing between plants was established by dense seeding and then thinning to the desired within-row spacing. Plots were irrigated five times during both growing seasons. Each irrigation brought the soil moisture back to near the field capacity. Treatments were hand-harvested when 25–35% of the seeds changed their colour from green to brown in both years. Seed yields were taken at maturity by harvesting the central two rows of each plot for seed yield determination. Seed yield was adjusted to a 12% moisture basis. 15 plants were collected randomly from the central two rows and the following growth and yield component variables were recorded for each plot, days to maturity, pod number per plant, number of seeds per pod and 1000 seed weight.

The data were subjected to analysis of variance using the SAS Software. When the *F*-test indicated statistical significance at the $P = 0.05$ level, Duncan's multiple-range test was used to determine the significance between means.

Results and Discussion

Both cultivars used in this study responded to treatments in the same way, thus there was no interaction of cultivars with spacing within rows. Similarly, no spacing between rows × spacing within rows interaction was observed for any yield or agronomic traits (Table 1). Furthermore, three-way interactions for all parameters investigated were insignificant. In this study, significant effects of cultivar × spacing between rows interaction on days to flowering, days to maturity, protein content and oil content were observed.

Effects were significant at the 5% (*) or 1% (**) level or not significant (ns)

LSD0.01= 0.9843, 1.208, 1.9737 and 1.1630 for A × B interaction effects on days to flowering, days to maturity, protein content and oil content, respectively

Yield components

The data presented in Table (1) show that the number of pods per plant for Opera was higher (192.5) than for Hyola401 (177.8), but the difference was not found significant (Table 1). The highest number of pods per plant was recorded for a 45cm row spacing. The differences in this character between the three row spacing (20, 30 and 45 cm) were large. Similarly, Momoh and Zhou (2001) stated that the number of effective branches and pods per branch decreased with increasing plant density. Higher branching observed in wide row spacing was a major cause of the increased number of pods per pod. Table (1) demonstrates that the number of seeds per pod for Hyola401 and Opera was approximately equal (26.20 and 27.1, respectively). There were also significant differences due to row spacing. An increase in row spacing resulted in consistent increases in the number of seeds per pod in both rape cultivars. Similar results were also observed by Taylor and Smith (1992). Data collected in the average results of two study years indicate that there were no significant differences for 1000-seed weight between the cultivars. The increase in row spacing did not significantly affect 1000-seed weight (Table 1). This agrees with previous reports which found out that 1000-seed weight was not significantly affected by plant densities (Morrison et al., 1990b; O'Donovan 1996). The cultivars Hyola401 and Opera gave about the same 1000-seed weight at the 20, 30 and 45 cm row spacing. Seed weight did not respond to changes in spacing within rows (5, 10 and 20cm).

Grain yield

The results indicated that Opera out yielded Hyola401 in seed yield. Seed yields for Hyola 401 and Opera were 1150 and 1210 (kg/ha). The difference between the cultivars was insignificant (Table 1). The yield values obtained in the present study are lower than the average commercial seed yields reported for rapeseed in the previous studies. Indeed, lower seed yields are also obtained in other crops grown in this area. The close row spacing of 20 cm gave the maximum seed yield of 1283 kg/ha. On average, 20 cm row spacing produced about 8 and 42% higher seed yield than 30 and 45 cm spacing. There are some reports of increased yield with narrower row spacing in rapeseed (Christensen and Drabble, 1984; Morrison et al., 1990b; O'Donovan, 1994). On the other hand, high plant populations can also contribute to the control of the growth and development of weeds in rapeseed

Table 1: Two-year (2008 and 2009) mean values of several agronomic characteristics and seed yield as affected by cultivar, spacing between or within rows in Karaj, Iran

Treatments	Number of pods per plant	Number of seeds per pod	1000-seed weight (g)	Grian yield (kg/ha)	Oil content (%)
Cultivar(A)					
Hyola401	177.8	26.2	4.8	1150	40.7
Opera	192.5	27.1	4.4	1210	42.5
	ns	ns	ns	ns	**
Spacing between rows(cm) (B)					
20	137.7 b	24.4 b	4.6	1283 a	39.7
30	194.6 a	25.8 a	2.1	1153 a	40.3
45	224.3 a	26.4 a	4.3	892 b	40.3
	**	*	ns	**	Ns
Spacing within rows (cm) (C)					
5	171.3	25.9	4.1	1189	40.1
10	181.4	25.3	4.6	1013	40.2
20	197.8	25.2	4.1	995	40.1
	ns	ns	ns	ns	Ns
CV (%)	10.7	5.73	6.8	12.4	6.08
Interactions					
A*B	ns	ns	ns	ns	**
A*C	ns	ns	ns	ns	Ns
B*C	ns	ns	ns	ns	Ns
A*B*C	ns	ns	ns	ns	Ns

Effects were significant at the 5% (*) or 1% (**) level or not significant (ns); LSD0.01= 0.9843, 1.208, 1.9737 and 1.1630 for A × B interaction effects on days to flowering, days to maturity, protein content and oil content, respectively

plants (O'Donovan, 1994). The data of the present study suggest that summer rape grown at higher plant density would produce higher seed yield compared to the lower population density.

Oil content

Seed oil content of cv. Opera as the average results of the two years was found to be higher (42.5%) than that of cv. Hyola401 (40.7%). Oil content did not change due to various spacing between or within rows. Increased spacing between rows (from 20 to 45 cm) caused an increase in the oil content of rape. However, the variations observed in oil content were insignificant (Table 1). This result is in agreement with Morrison et al. (1990b) finding that there were no consistent effects of row spacing and seeding rate on the oil concentration of summer rape.

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