Australian Journal of Basic and Applied Sciences, 5(10): 1302-1305, 2011
ISSN 1991-8178

The Study of Planting Density on Some Agronomic Traits of Spring Canola Cultivars

[1]Hossein Bagheri, [2]Younes Sharghi and [3]Mohammad Yazdani

[1]Department of Agriculture, Chaloos Branch, Islamic Azad University, Chaloos, Iran.
[2]Department of Agriculture, Islamshahr Branch, Islamic Azad University, Islamshahr, Iran.
[3]Department of Agronomy, Savadkoh Branch, Islamic Azad University, Savadkoh, Iran.

Abstract: The Brasscicaceae family (formerly Cruciferae) consists of approximately 375 genera and 3200 species of plants, of which about 52 genera and 160 species are present in Australia. Rapeseed (*Brassica napus* L.) is an important alternate oilseed crop in Iran. No information on plant density for rapeseed is available in this region. Therefore a study was initiated to investigate the effects of spacings between rows and spacings within rows on the yield and agronomic characteristics of two genotypes of spring rapeseed (Hyola 308 and RGS003) in Karaj, during 2006 and 2007. The effects of spacings between or within rows on the yield and yield components of Hyola 308 and RGS003, two cultivars of *Brassica napus* L., were studied for 2 years in Karaj, Iran. Rows were spaced at 15, 30 and 45 cm. Spacings within rows were 5, 10 and 15 cm. The results of this study suggested that seed yield was significantly affected by spacings between rows but not by spacings 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) spacings.

Key words: Rapeseed, plant density, row spacing, seed yield.

INTRODUCTION

Canola is the third most important source of plant oil in the world after soybean and palm oil (Sovero, 1997). It is also an excellent rotation crop to control cereal diseases, pests and weeds. It has a good stable yield, which requires normal farm equipment. It grows in areas that receive more than 330 mm of rain, well-drained soil with a good potential for growing wheat, relatively free of broad leaf weeds, and residues of broad leaf herbicides. 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/m2 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, and that with an increase in density 1000-seed weight increased. 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 15-20 cm apart (Lewis and Knight 1987).Rapeseed has generally slight or inconsistent seed yield responses to various row spacing's. 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's between or within rows on the agronomic characteristics of two genotypes of *Brassica napus*.

MATERIAL AND METHODS

This research was conducted during 2006 and 2007 at the Agricultural Research in Karaj, Iran. The soil at the experimental site was loamy, with approximately 14.4 g/kg organic matter. The 0-30 cm soil layers contained respectively 1 050 kg/ha total N, 108.6 kg/ha available P and 406.8 kg/ha available K. The previous crop for the plots sown in 2006 an 2007 was barley (*Hordeum vulgare* L.). The plots were moldboard ploughed in the fall and cultivated twice in the spring. Individual plots were 4 rows by 5 m long. Seeds were hand-sown on 1 May in 2006 and 3 May in 2007, respectively.

In this study, two spring rapeseed cultivars, Hyola 308 and RGS003, were used.The experimental design was a randomized block design with four replications. Treatments consisted of two cultivars (Hyola 308 and RGS003), three spacing's between rows (15, 30 and 45 cm) and three spacing's within rows (5, 10 and 15 cm). In both years, the experiment was fertilized before sowing by to the following fertilization rates: 60 kg N/ha as ammonium sulphate and 60 kg P2O5/ha as triple superphosphate. Additional 60 kg N/ha was applied in both the

Corresponding Author: Hossein Bagheri, Department of Agriculture, Chaloos Branch, Islamic Azad University, Chaloos, Iran.
E-mail: Bagheri_hm2000@yahoo.com

study years, just before flowering. Spacing's between plants were established by dense seeding and then thinning to the desired within-row spacing. No herbicides were applied to the field experiment in either year. Weeds were controlled by hand weeding or by mechanical cultivation as needed. Plots were irrigated five times during both growing seasons. Each irrigation brought the soil moisture back to near the field capacity. All sowings were sprayed with Malathion before flowering to protect against a beetle (*Omophlus cafcasicus*) and aphids.

Treatments were hand-harvested when 30-40% of the seeds changed their color 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 10.0% 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, plant height, branch number per plant, pod number per plant, number of seeds per pod and 1000-seed weight. The data were subjected to analysis of variance using the MSTAT-C and SPSS 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. Data were averaged across years because no significant year by treatment interactions occurred.

RESULTS AND DISCUSSION

Both cultivars used in this study responded to treatments in the same way, thus there was no interaction of cultivars with spacings 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.

Plant Growth:

Results of this study for days to flowering are presented in Table 1. Days to flowering showed variations between the cultivars. The cultivar Hyola 308 was significantly earlier in terms of days to flowering than cv. RGS003. Hyola 308 and RGS003 flowered in 55.6 and 62.5 days, respectively. The effect of spacing between or within rows was significant ($P < 0.01$).

Increasing the spacing between rows considerably delayed the flowering of cultivars. Essentially, such a situation could be expected. This finding agrees with that of Van Deynze *et al.*, (1992), who reported that increased row spacing delayed flowering in rape. In this study, days to flowering varied more than three days across the row spacings (15, 30 and 45 cm). Similarly, days to flowering tended to increase with an increase in spacings within rows. The effect of the cultivar × spacing between rows interaction was significant ($P < 0.01$).
The cultivar, spacing between rows, and the cultivar × spacing between rows interaction were significant ($P < 0.01$) for days to maturity. The results of this study revealed that Hyola 308 (123.0 days) maturated earlier than RGS003 (131.4 days) (Table 1).

With different spacings between rows, large differences occurred in days to maturity as shown in Table 1. The maturity of rape cultivars was generally shorter at the close row spacing than at wide row spacings (30 or 45 cm). This effect can be due to the fact that the crop growth rate increased as plant density increased (Morrison *et al.*, 1990a). Significant differences were found for the cultivar × spacing between rows interaction that were caused by the cultivars reacting to the various spacings in a different manner. There were no significant differences for spacings within rows (Table 1). As can seen in Table 1, there were large differences between the cultivars in plant height. Plant heights for Hyola 308 and RGS003 were 101.4 and 118.3 cm, respectively. Plant height decreased with increasing plant densities, but this variation was more pronounced in Hyola 308 than in RGS003. The effect of spacings between rows on plant height was significant ($P < 0.01$). Increased spacings between rows increased plant height from 104.7 to 114.3 cm. The widest spacing (45 cm) gave the highest plant height for the cultivars (Table 1). Morrison *et al.*, (1990a) also reported that rape grown at the highest plant densities produced smaller plants. Plant height did not differ across spacings within rows.

Table 1: Two-year (2006 and 2007) mean values of several agronomic characteristics and seed yield as affected by cultivar, spacing between or within rows in Karaj, Iran.

Treatments	Days to flowering (d)	Days to maturity (d)	Plant height (cm)	Branch numbers per plant	Number of pods per plant	Number of seeds per pod	1000-seed weight (g)	Seed yield (kg/ha)	Protein content (%)	Oil content (%)
Cultivar(A)										
Hyola308	55.6	123	101.4	4.6	167.8	24.1	4.2	1039	24.3	39.7
RGS003	62.5	131.3	118.3	4.7	176.5	25	4.1	1065	25.8	40.4
	**	**	**	ns	ns	ns	ns	ns	**	**
Spacing between rows(cm) (B)										
15	57.5 c	126 b	104.7 b	4.1 b	127.7 b	23.6 b	4.1	1195 a	25.5	39.7
30	58.8 b	126.6 b	110.4 ab	4.9 a	184.2 a	24.9 a	1.1	1106 a	25.2	40.3
45	60.8 a	128.7 a	114.3 a	5.1 a	204.5 a	25.1 a	4.1	857 b	24.6	40.3
	**		**	**	**	*	ns	**	ns	ns

Spacing within rows (cm) (C)										
5	58.4 b	126.9	108.9	4.5	160.3	24.8	4.1	1121	40	40.1
10	59.1 ab	126.9	111	4.7	171.3	24.3	4.2	1068	40.2	40.2
15	59.7 a	127.6	109.6	4.8	184.8	24.5	4.1	968	40	40.1
	**	ns	ns	ns	ns	ns	ns	ns	ns	ns
CV (%)	1.41	2.45	5.05	9.34	8.56	2.74	4.87	10.6	4.52	5.07
Interactions										
A*B	**	**	ns	ns	ns	ns	ns	ns	**	**
A*C	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
B*C	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
A*B*C	ns	ns	ns	ns	ns	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.

Yield Components:

Branch numbers for the cultivars were nearly similar and ranged from 4.69 (Hyola 308) to 4.76 (RGS003). Significant differences in branch numbers per plant occurred between the various spacings between rows. Generally, an increase in row spacing led to significantly higher branching. This was consistent with the findings of Ali *et al.,* (1996), who reported that low density resulted in an increased number of branches per plant. The data presented in Table (1) show that the number of pods per plant for RGS003 was higher (176.5) than for Hyola 308 (167.8), but the difference was not found significant (Table 1). The highest number of pods per plant was recorded for a 45 cm row spacing. The differences in this character between the three row spacings (15, 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 spacings was a major cause of the increased number of pods per pod. Table (1) demonstrates that the number of seeds per pod for Hyola 308 and RGS003 was approximately equal (24.10 and 25.05, respectively).

There were also significant differences due to row spacings. An increase in row spacings 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 papers which found out that 1000-seed weight was not significantly affected by plant densities (Kondra, 1977, Morrison *et al.,* 1990b, O'Donovan, 1996). The cultivars Hyola 308 and RGS003 gave about the same 1000-seed weight at the 15, 30 and 45 cm row spacing. Seed weight did not respond to changes in spacings within rows (5, 10 and 15 cm).

Seed Yield:

The results indicated that RGS003 out yielded Hyola 308 in seed yield. Seed yields for Hyola 308 and RGS003 were 1039 and 1065 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 15 cm gave the maximum seed yield of 1195 kg/ha. On average, 15 cm row spacing produced about 8 and 40% higher seed yield than 30 and 45 cm spacings. 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 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.

Seed Oil Content:

Seed oil content of cv. RGS003 as the average results of the two years was found to be higher (40.81%) than that of cv. Hyola 308 (39.74%). Oil content did not change due to various spacings between or within rows. Increased spacings between rows (from 15 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's *et al.,* (1990b) finding that there were no consistent effects of row spacing and seeding rate on the oil concentration of summer rape.

Seed Protein Content:

A comparison of Hyola 308 and RGS003 used in this study showed highly significant differences in protein content (Table 1). The cultivar RGS003 had higher protein content (25.86%) than cv. Hyola 308 (24.39%). In contrast, the protein content was not affected by changes in plant density. This result concurs with the findings of Kondra (1977) and Van Deynze *et al.,* (1992), who reported that protein content did not change with varying plant densities. However, Shrief *et al.,* (1990) reported that protein content was higher under higher population densities.

REFERENCES

Al-Barzinjy, M., O. Stolen, J.L. Christiansen, J.E. Jensen, 1999. Relationship between plant density and yield for two spring cultivars of oilseed rape (*Brassica napus* L.). Acta, Agr. Scand. Sect. B, Soil Plant Sci., 49: 129-133.

Ali M.H., S.M.H. Zaman, S.M.A. Hossain, 1996. Variation in yield, oil and protein content of rapeseed (*Brassica campestris*) in relation to levels of nitrogen, sulphur and plant density. Indian J. Agron., 41: 290-295.

Christensen, J.V., J.C. Drable, 1984. Effect of row spacing and rapeseed seeding rate on rapeseed yield in Nortwest Alberta. Can. J. Plant Sci., 64: 1011-1013.

Diepenbrock, W., 2000. Yield analysis of winter oilseed rape (*Brassica napus* L.): a review. Field Crops Res., 67: 35-49.

Kondra, Z.P., 1977. Effect of plant size and seeding rate on rapeseed. Can. J. Plant Sci., 57: 277-280.

Leach, J.E., H.J. Stevenson, A.J. Rainbow, L.A. Mullen, 1999. Effects of high plant populations on the growth and yield of winter oilseed rape (*Brassica napus*). J. Agr. Sci., 132: 173-180.

Lewis, C.E., C.W. Knight, 1987. Yield response of rapeseed to row spacing and rates of seeding and N fertilization in interior Alaska. Can. J. Plant Sci., 67: 53-57.

Momoh, E.J.J., W. Zhou, 2001. Growth and yield responses to plant density and stage of transplanting in winter oilseed rape (*Brassica napus* L). J. Agron. Crop Sci., 186: 253-259.

Morrison, M.J., P.B.E. McVetty, R. Scarth, 1990a. Effect of altering plant density on growth characteristics of summer rape. Can. J. Plant Sci., 70: 139-149.

Morrison, M.J., P.B.E. McVetty, R. Scarth, 1990b. Effect of row spacing and seeding rates on summer rape in Southern Manitoba. Can. J. Plant Sci., 70: 127-137.

O'Donovan, J.T., 1994. Canola (*Brassica rapa*) plant density influences Tartary buckwheat (*Fagopyrum tataricum*) interference, biomass, and seed yield. Weed Sci., 42: 385-389.

Shrief, S.A., R. Shabana, A.F. Ibrahim, G. Geisler, 1990. Variation in seed yield and quality characters of four spring oil rapeseed cultivars as influenced by population arrangements and densities. J. Agron. Crop Sci., 165: 103-109.

SOVERO, M., 1997. Rapeseed, a new oilseed crop for the United States. New crop resource on line program. Internet: http://www.hort.purdue.edu/newcrop/proceedings 1993/V2-302.html. Access: 16 May 2002.

Taylor, A.J., C.J. Smith, 1992. Effect of sowing date and seeding rate on yield components of irrigated canola (*Brassica napus* L.) grown on a red-brown earth in South-Eastern Australia. Aust. J. Agr. Res., 43: 1629-1641.

Van, Deynze A.E., P.B.E. McVetty, R. Scarth, S.R. Rimmer, 1992. Effect of varying seeding rates on hybrid and conventional summer rape performance in Manitoba. Can. J. Plant Sci., 72: 635-641.