Effect of planting date and plant density on morphological traits and yield of four varieties of canola (*Brassica napus* L.) in Astara region

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Abstract: In order to determine of plant density and planting date on morphological traits and yield of Canola a field experimental was conducted in 2008 at Astara region in a Split plot factorial in complete block design with four varieties and three replicates. Treatments were: planting date (08/10/13 and 08/10/28) and two level plant density (42 and 84 plants per m^2). Mean comparison showed that in plant height, Global with 91.91 cm, maximum height and Falcon with 80.46cm height had the lowest (Table 2). Falcon with a 6/729 cm maximum length pods and PF7045 with 5.615 cm, had the lowest pod length. Mean comparison of Variety showed that maximum plant height, yield in plant, biomass plant, yield in plot, oil percentage and number of pods per plant was obtained in Global. Comparison of interaction between Planting date and density, for number of pods per plant showed that the highest number of pods per plant was obtained the first and the second density.

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Key word: canola, plant density, yield, planting date

Introduction

Canola (*Brassica napus* L.) is a valuable oil seed that has attracted the attention of many people in recent years. This plant has been given a great importance in the plan for "oil seed import reduction". The canola plant, on account of enjoying high percentage of oil and protein, was ranked third and second, respectively among the oil seeds. This plant grows annually in the favorable weather conditions. The meal and oil are two products extracted from this plant. The canola seed contains 40-50 percent oil (Crubbens and Denton, 2004). Canola oil contains a desirable profile of saturated fatty acids (7%) and high level of unsaturated fatty oleic acids (about 61%) and medium level of unsaturated fatty linoleic acids (21%) and linoleic acid (11%). This plant can easily be placed in alternation with cereals as a one-year autumnal oil-seed plant. Different researches indicate that through the delay in the sowing date, there occurs a decline in the pod number per plant (Asgari and Moradi, 2008), pod number per plant(Angadi et al, 2003), plant height, pod number(Nanda et al,1999), stem number per plant (Ozer, 2003) and finally seed yield and oil quality (Hocking, 2001; Miralles et al, 2001). Christmas (1996) observed that different canola genotypes do not respond so much to the weather conditions. Also Sun et al. (1991) announced that, like different species, different genotypes adapt themselves to specific climatic conditions. Jasinska et al. (1989) reported that seed yield decreased with delay in sowing date. Also Taylor and Smith (1992) concluded that seed yield declined when sowing date is delayed. Johnson et al. (1995) evaluated three canola cultivars at four sowing dates and found that seed yield was the highest at the first two sowing dates. Shafique et al. (1999) in Pakistan evaluated ten canola varieties and reported that delaying sowing date significantly decreased plant growth and consequently low yield. Kirkland and Johnson (2000) stated that seed yield was greater in the early sowing dates and smaller in the later sowing dates. Horton (2006) found that highest yield of canola was observed from earlier sowings. Growth and yield are functions of a large number of metabolic processes, which are affected by environmental and genetic factors. Gross (1963), reported in the effect of planting date on the growth stages of spring canola that by delaying in planting date, the required time for vegetative and reproductive growth gets shorter which leads to decrease in total performance. Campbell and Kondra (1978), reported that the time of advent of the first flower or vegetative period is the determining factor for maturity, that is: the longer this period, the shorter the duration of next periods (reproductively to maturity); if the reproductive period gets shorter, performance of the crop would be lower. Mahmud Abadi et al (2008) studied the various types of autumnal canola in the region of Bojnoord. They reported that delay (from September 30th to October 26th) in planting the most of its types, leads to a decrease in the plant height and biological performance. To determine the best date for canola planting, an experiment was conducted in the region of Ardabil. Researchers found that planting date of September 20th and 30th, with an average of 3095 and 3036 kg per hectare, respectively are more than planting date of October 10th with the performance of 2390 kg per hectare (Amiri et al, 2008). Saberi et al. (2008) studied the effect of planting date of the yield and grain yield components of various types of canola in the region of Birjand. The obtained results suggested that planting dates of 16.6 and 26th of October has no significant difference in grain yield; and October 6th has the maximum of yield level (1730 kg / ha). Barati et al (2008) conducted a test in the region of

Bojnoored to study the effect of planting date on the growth indices in the various types of canola. Their results suggested that planting date of September 30th, comparing to October 25th and November 11th, is the best planting time because it does not meet the cold season. Various tests in different regions emphasize on the planting of canola in September.

The researches mentioned above show that for reaching to the maximum yield in each region, an optimal density is needed. On the other hand, this amount changes under the effect of different conditions, Changing in the seed or density ratio causes the change of maturity time and/or the way of harvest, so that moisture of seed decreases in harvest time or density increases (Ghosh and Mukhopadhyay ,1994). In researches of Clorke and Simpson (1978), the maximum yield was obtained from the minimum amount of seed (1.5 k/ha) and they concluded that producing of subshrubs and pod, neutralizes the effect of density decrease and the yield is remained fixed or it does not change drastically, but Morrison (1990), reported the increasing of yield under the influence of increasing of density. The decrease of "row spacing" causes increasing of plant spacing on row, and more consistent distribution of them, and it consequently leads to competition decreasing and yield increasing.

An experiment to study the Effects of sowing date and plant density on some morphological traits of canola cultivars was conducted at the Astara region, Guilan, Iran.the purpose of this study was to understand morphological changes in different cultivars at planting dates and plant density.

Materials and Methods

This experiment conducted with 4 varieties Falcon, PF7045, Jerriss and Global on two planting dates (08.10.13 and 08.10.28) and two level plant density (42 and 84 plants per m^2) in a sandy soil. Experiment was conducted in Astara region in a Split plot factorial in complete block design with three replicates. Four varieties as main plots were arranged in main plots and planting dates and density factorial experiment were split into subplots. In this experiment, plant height, Pod length, Seed weight per plant, 1000 grain weight, Number of pods per plant, number of seeds per pod,Biomass per plant,% Oil and yield were measured. After removal of border effects, measurements were carried out on area of 1 m^2 each plot. The data were statistically analyzed by computing MSTAT-C package program with randomized block design.

Results and Discussion

ANOVA with split-plot factorial experiment was conducted in the normal data in randomized complete block and F tests were significant for most traits (Table 1). Mean comparison showed that in plant height, Global with 91.91 cm, maximum height and Falcon with 80.46cm height had the lowest (Table 2). Falcon with a 6.729 cm maximum length pods and PF7045 with 5.615 cm, had the lowest pod length. Planting date in traits of biomass per plant, yield per plot, plant height, number of pods per plant, seeds per pod and seed oil showed a significant difference at the level of 1%. In terms of plant height, no significant difference was observed between the Global and Jerriss. Interaction between varieties and sowing dates showed that maximum plant height, in Global and in first planting date is achieved; that with Jerriss and Falcon varieties, in first planting date was not significant (Table 3). Finally, we can say that the maximum plant height is achieved in the first planting date (Table 4). Increasing plant density increased plant height (Table 5). Mean comparison of Variety showed that maximum plant height, yield in plant, biomass plant, yield in plot, oil percentage and number of pods per plant was obtained in Global. Interactions mean comparison shows that the highest this traits was obtained in the first planting date. In the first planting date, plant biomass (10.15 g), seed yield per plot (333.302 g), number of pods per plant and seeds per pod were the highest. Comparison of planting date in varieties for number of pods per plant showed that no significant differences between the two varieties PF7045 and Global of Planting date (Table 3). Comparison of interaction between Planting date and density, for number of pods per plant showed that the highest number of pods per plant was obtained the first and the second density. Comparison interaction variety and density showed the highest biomass per plant was obtained in second density in Global. Effect of plant density in biomass per plant, yield per plot, number of pods per plant and oil percentage showed significant differences at the level of 1%. Maximum weight of 1000 grains, in Global and in first planting date is achieved. The highest biomass per plant (879.14 g) was obtained in the first density. The highest biomass and yield per plot are obtained in second density. The highest percentage of oil in Global variety was found with 40.26 percent that with other varieties, there were significant differences at the level of 1%. Between varieties in terms of yield per plot, significant differences were observed. Early planting time causes more aggregative absorption of solar radiation and thermal units by plant which leads to height, subshrub and leaf number and consequently biological yield increases. These results are in accordance with the researches of Hodyson (1979), Genkins and Liech (1986), Degendayt and Kondra (1987), Chay and Thurling(1989), Schmidt(1992), Ghosh and Mukhopadhyay(1994). The obtained results correspond with the results obtained by the researches of Norton *et al(1991)*, Taylor and Smith (1992), Gross (1963), Yousuf and Bullock (1993), Darby (1994), Singh *et al*.(1996).

Table 1. Analysis of variance on mean of squares of measured traits on canola

variety	Number of seeds/Pod	Number of pods/ plant	Pod length(cm)	Oil%	Yield / plot(g)	Biomass /plant(g)	Yield / plant(g)	Plant height(cm)
Falcon	20.73^{B}	54.72^{C}	6.729^{A}	48.75^{B}	238.3^{C}	10.28^{B}	2.162^{C}	80.46^{C}
PF7045	16.74^{C}	81.98^{A}	5.615^{C}	47.72^{C}	275.9^{B}	11.29^{B}	3.035^{B}	$83.15B^{C}$
Jerriss	25.95^{A}	68.14^{B}	6.354^{B}	48.71^{B}	257.8^{BC}	16.33^{A}	3.889^{A}	88.12^{AB}
Global	20.21^{B}	84.16^{A}	6.112^{B}	49.26^{A}	327.1^{A}	17.33^{A}	3.897^{A}	9191^{A}

** and *: Significant at 0.01 and 0.05 probability levels.

Table 2- Mean comparison traits in four varieties of canola

variety	planting dates	Plant height(cm)	Number of pods/ plant	1000 grain weight(g)	Biomass /plant(g)	Yield / plant(g)	Yield / plot(g)
Falcon	08.10.13	90.94^{ABC}	61^{D}	2.122^{CDE}	11.9^{DE}	2.767^{C}	296.3^{BC}
	08.10.28	69.98^{E}	48.42^{E}	2.48^{BCD}	8.667^{F}	1.557^{D}	180.2^{E}
PF7045	08.10.13	84.46^{CD}	82.92^{A}	2.282^{BCDE}	13.17^{CD}	2.653^{C}	327.6^{B}
	08.10.28	81.84^{D}	80.66^{A}	2.605^{ABC}	9.417^{EF}	3.417^{B}	224.2^{D}
Jerriss	08.10.13	92.95^{AB}	71.88^{BC}	2.052^{DE}	16.17^{ABC}	2.777^{C}	219.7^{D}
	08.10.28	83.29^{D}	64.40^{CD}	2.69^{AB}	16.50^{AB}	5.002^{A}	295.8^{BC}
Global	08.10.13	95.88^{A}	79.84^{AB}	2.978^{A}	19.17^{A}	4.763^{A}	365.7^{A}
	08.10.28	87.94^{BCD}	88.46^{A}	2.830^{E}	15.50^{BC}	3.030^{BC}	288.6^{C}

* Different letters indicate significant differences at the level of 5%

Table 3 - mean comparison of interaction variety and sowing date

s.o.v	DF	Yield / plot	Yield / plant	Biomass /plant	Number of seeds/Pod	Number of pods/ Plant	Oil%	Pod length	1000 grain weight	Plant height
replication	2	111.249	0.084	0.869	4.363	10.716	0.018	0.087	0.044	0.763
variety	3	**17464.965	**8.29	**150.242	**173.127	**560.515	**4.944	**2.615	^{ns} 0.044	*312.923
error	6	388.848	0.047	3.669	2.239	18	0.008	0.131	0.077	47.426
date	1	**36476.213	0.002 ^{ns}	** 79/825	**73.507	^{ns} 37.031	**1.613	^{ns} 0.145	^{ns} 0.022	**1272.25
var*date	3	** 23735.819	**10.001	^{ns} 11.464	20.483 ^{ns}	**61.464	**8.801	^{ns} 0.044	**1.952	**178.609
density	1	** 22568.013	^{ns} 0.169	**54.827	^{ns} 5.031	*66.977	** 3.162	^{ns} 0.023	0.001 ^{ns}	91.964 ^{ns}
var* density	3	** 9180.806	** 1.279	**35.466	^{ns} 8.720	**62.585	** 0.426	^{ns} 0.068	**2.841	^{ns} 63.94
date*density	1	**51945.156	^{ns} 0.142	^{ns} 0.0005	^{ns} 2.921	*57.597	** 3.741	^{ns} 0.267	^{ns} 0.009	28.985 ^{ns}
date* density* var	3	**2353.962	^{ns} 0.830	^{ns} 5.317	*45.712	^{ns} 24.103	** 1.744	^{ns} 0.224	**0.725	**150.406
error	24	888.877	0.162	6.082	7.855	12.022	0.007	0.150	0.145	33.423
%CV		10.85	12.39	17.86	13.40	4.80	0.18	6.25	16.02	6.73

* Different letters indicate significant differences at the level of 5%

Table 4 - mean comparison of traits at different planting dates

planting dates	Plant height(cm)	Number of pods/ plant	Number of seeds/Pod	1000 grain weight	Oil%	Biomass /plant	Yield / plant	Yield / plot
08.10.13	91/059	74	22/145	2/385	48/795	15/10	3/282	302/333
08.10.28	80/762	74/49	19/67	2/401	48/428	12/521	3/251	247/2

Table 5 - mean comparison of traits at different plant density

density	Plant height (cm)	Number of pods/ plant	Number of seeds/ Pod	1000 grain weight	Oil%	Biomass /plant	Yield / plant	Yield / plot
84 plant/m^2	87/295	69/88	21/232	2/385	48/355	12/742	3/186	296/45
42 plant/m^2	84/526	74/61	20/584	2/375	48/868	14/879	3/347	253/083

References:

1. Amiri S, Siadat A, Khanzadeh H, Jahani Y .2008. Determination of suitable planning date for canola varieties in the region of Ardabil. The summary of the articles of the Tenth Congress of Agriculture and Plant Breeding Science of Iran, 2008 August 19th-20th, Karaj.
2. Angadi, S.V., H.W. Cutforth, B.G. McConkey and Y. Gan, 2003. Yield adjustment by canola grown at different plant population under semiarid conditions. Crop Sci., 43: 1358-1366.
3. Asgari, A. and A. Moradie-dalini, 2008. Evaluation, yield components and vegetative characters of rapeseed cultivars in different planting date. Seed and Plant J., 23: 419-430.
4. Barati M, Azizi M, Gazanchian A .2008. Evaluation of correlation coefficients of different characteristics about 8 types of canola in the optimal and delayed planting dates. The summary of the articles of the Tenth Congress of Agriculture and Plant Breeding Science of Iran, 2008 August 19th-20th, Karaj.
5. Campbell DC, Kondra ZP .1978. Relationships among growth Patterns, yield, yield components of Rapeseed. Canadian Journal of Plant science.58: 87-93.
6. Chay P, Thurling N .1989. Variation pod length in spring Rape (*Brassica napus*) and its effect on seed yield component. Journal of Agricultural Science, 113: 139-147.
7. Christmas, E.P., 1996. Evaluation of planting date for winter canola production in Indiana, pp: 139-147. In: J. Janhc, (ed.) progress in new crops. ASHS press, Alexandria, AV.
8. Clarke JM, Simpson GM .1978. Growth analysis of Brassica napus CV. Tower. Canadian Journal of Plant Science. 58: 587-595.
9. Crubbens, G.T.H. and O.A. Denton, 2004. Plant Resources of Tropical Africa. 2 Vegetables, PROTA foundation, Wageningen, Netherlands /Backhuys Publishers, leiden, Netherlands / CTA, Wageningen Netherlands, pp: 668.
10. Darby RJ .1994. Effects of methods of cereal straw disposal, seed bed preparation and sowing method on the establishment, yield and oil content of winter oil seed Rape (*Brassica napus*). Journal of Agricultural Science. 122: 393-404.
11. Degendayt DF, Kondra ZP .1987. The influence of seeding date and seeding rate on seed yeild and seed component of five genotypes of Brassica. Canadian Journal of plant Science. 67: 175-183.
12. Genkins PD, Leich MH .1986. Effect of sowing date on the growth and yield of winter oil seed Rape (B. napus). Journal of Agricultural Science. 105: 405-402.
13. Ghosh D, Mukhopadhyay D .1994. Growth and productivity of Indian Rapeseed (Brassica compestris L.) growth under short and mild winter condition of west Bengel. Indian Journal of Agricultural Research. 28: 239-244.
14. Gross ATH .1963. Effect of planting date on yield, plant height, flowering and maturity of Rape and Turnip Rape. Agronomy Journal, 56: 76-78.
15. Hocking, P.J., 2001. Effect of sowing time on nitrate and total nitrogen concentration in field-grown canola (*Brassica napus* L.) and implications for plant analysis. J. Plant Nutrition, 24(1): 43-59.
16. Hodyson AS .1979. Rape seed adaptation Northern New South Wales III. Yield, yield component and grain guality of Brassica compestris and Brassica napus in Relation to planting date. Australian Journal of Agricultural Research. 30: 19-27.
17. Horton, D.S., 2006. Determination of optimum planting date of seven species of winter oil seeds in Mississippi, The ACSSA-SSSA.

International Annual Meeting .http://a-c-s.confex.com/crops/ 2006am/techprogramstaticfiles/ banner.jpg.
18. Jansinka, Z., A. Kotecki; W. Malarz, A. Horodyski, B. Musnicka, C. Musnicki, M. Jodlowski, W. Budzynski, K. Majkowski; E. Wrobel and B. Sikora, 1989. Effect of sowing date and sowing rate on the development and seed yields of winter rape cultivars. Buile. Institi. Hodowli - I - Aklimatyzacji Roslin., 169: 111-119.
19. Johnson, B., K. Muckay, A. Schneiter, B. Hanson and B. Schatz, 1995. Influence of planting date on canola and crambe production. J. Prod. Agric., 8: 594-599.
20. Kirkland, K. and E. Johnson, 2000. Alternative seeding dates affect canola yield quality, Canad. J. Pl. Sci., 80: 713-719.
21. MahmudAbadi A, Azizi M, Gazanchian A .2008. The effect of planting date on the agriculture of different types of winter canola in the region of Bojnoored. The summary of the articles of the Tenth Congress of Agriculture and Plant Breeding Science of Iran, 1387 August 19th-20th, Karaj.
22. Miralles, D.J., B.C. Ferro and G.A. Slafer, 2001. Developmental responses to sowing date in wheat, barly and rapeseed. Field Crops Res., 71: 211-223.
23. Morrison M, Mcvetty BE, Scarth R .1990 a. Effect of row spacing and seeding rates on summer rape in Southern Manitoba. Canadian Journal of Plant. Science. 70: 127-137.
24. Nanda, R., S.C. Bhargava, D.P.S. Tomar and H.M. Rawson, 1999. Phenological development of *Brassica compestris*. Field crops Res., 46(1-3): 93-103.
25. Norton GP, Bilsborrow E, shipway PA .1991. comparative physiology of divergent types of winter rape seed. Proceeding of GCIRC congress. 1051-1055.
26. Ozer, H., 2003. Sowing date and nitrogen rate effects on growth, yield and yield components of two summer rapeseed cultivars. European J. Agronomy, 19(3): 453-463.
27. Saberi MH, Ramezani R, Decembermjuo M, Tajalli V .2008. The effects of planting date on the yield and yield components of canola types (*Brassica napus* L.) in the region of Birjand. The summary of the articles of the Tenth Congress of Agriculture and Plant Breeding Science of Iran, 2008 August 19th-20th, Karaj.
28. Schmidt WH .1992. " Canola, Ohio's newest crop". Proceeding institute of canola conference. Saskatoon, Canada. 53-64.
29. Shafique, M., M. Anwar, M. Ashraf and B. Moula, 1999. The impact of sowing time on aphid management of canola varieties, Pak. K. of Zool., 31: 361-363.
30. Singh S, Pannu RK, chand M .1996. Effect of sowing time on radiation characteristic and heat unit requirement of Brassica genotypes. Crop Research 11: 145-150.
31. Sun, W.C., Q.Y. Pan and Y.P. Yang, 1991. *Brassica* and *Brassica* related oilseed crops in Gansu, china. Pp1130-1135. In:Mc Gregor, D. I. (ed.) proceedings' of the Eighth International Rapeseed congress, Saskatoon, Canada.
32. Taylor, A.J. and C.J. Smith, 1992. Effect of sowing date and seeding rate on yield and yield components of irrigation canola growth on red-brown earth in South Eastern Australia, Aust. J. Agric. Res., 7: 1629-1641.
33. Yusuf RI, Bullock DG .1993. Effect of several production factors on two varieties of Rape seed in central of United States. Journal of Plant Nutrient: 1279-1288.