Correlation Analysis in Different Planting Dates and Plant Density of Canola (*Brassica Napus* L.) Varieties in Astara Region

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Abstract: In order to determine of plant density and planting date on some production parameters and the correlation coefficient 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). Results from the analysis of variance showed that there were significant differences between varieties. Between planting date in all traits, significant differences were seen. Between plant densities in all traits, significant differences were seen. The interaction between plant density and varieties, planting date and varieties and locations for all traits was significant. %. Maximum yield per plant was measured at Global, which with variety Pf 7045 showed no significant difference. Late planting and high density, increased the 1000 grain weight. There was a significant difference with other varieties. The lowest this trait was obtained in the Falcon. Between number of pods per main stem with biomass per plot and yield per plant was positive correlation and significantly at 1% level. A significant negative correlation between thousand grain weight and oil percentage were obtained. A significant positive correlation between thousand grain weight and yield per plant were obtained.

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Introduction

Rapeseed (*Brassica napus L.*) is now one of the most important oil crops in the world. For improving of seed yield of rapeseed and other brassica species, the important breeding strategies are understanding and utilization of genetic, physiological and morphological basis of yield associated traits in different environmental conditions. Statistics indicating that canola had more annual production growth than soybean, cotton, sunflower and beanut and its world production evaluated from fifth order to third order. Increasing population followed by increasing consuming vegetable in recent years caused to more than 90% consumption oil of Iran supply via imports. Canola cultivars oil have higher nutrious value in compare with other oil seeds due to its high unsaturated fatty acids one way to increasing seed yield/m2 is using suitable cultivars compatible with climate conditions of any region in desired planting density in a manner with create minimum competition among plants. 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 Octobberr 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 Octobberr 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, Gilan, Iran. the purpose of this study was to understand morphological changes and correlation 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, the first pod Height, Number of pods per main stem, Days to maturity, 1000 grain weight, Harvest index, Biomass per plot, % Oil and yield per plant 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). Results from the analysis of variance showed that there were significant differences between varieties (Table 1). Between planting date in all traits, significant differences were seen. Between plant densities in all traits, significant differences were seen. The interaction

between plant density and varieties, planting date and varieties and locations for all traits was significant. Mean comparison showed that in the first pod height, Jerriss and Global with 62.19and 61.58 cm, maximum pod height and PF7045 with 50.40 cm pod height had the lowest (Table 2).between Global and PF7045 in the first pod height were not significant difference in5%. Falcon with a 31.25 maximum harvest index and Jerriss with 26.49 had the lowest harvest index. Between Falcon and Global and PF7045 in the harvest index were not significant differences in 5%. Maximum yield per plant was measured at Global, which with variety Pf 7045 showed no significant difference. Falcon was the lowest yield; there was a significant difference with other treatments. The maximum amount of biomass per plot was measured in global. There was a significant difference with other varieties. The lowest this trait was obtained in the Falcon. Biomass was increased by early planting, but in low density, biomass per plot was reduced. Between varieties Global had the most days to maturity and with all varieties showed significant differences. In the later planting date, maturity was increased and Largest maturity was obtained in the density of 43 plants per m^2 (Table 4). The highest number of pods per main stem, respectively, in the global, PF7045 and Jerriss obtained. Earlier planting date, and low plant density was increased this trait. The highest percentage of oil in the global and Jerriss obtained. Earlier planting date, and plant density of 42 plants per m^2, was increased of percentage oil. Maximum 1000 grain weight in the global and Jerriss obtained, Showed that significant differences with other varieties. Late planting and high density, increased the 1000 grain weight. The maximum first pod height in the global and Jerriss obtained, Showed that significant differences with other varieties. Early planting and high density, increased the first pod height. 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).

Between height of the first pod with number of pods per main stem, seed oil percentage and biomass per plots were significantly positive correlation at 1% level (Table 5)., And with yield per plant Showed that significant positive correlation at the 5% level. Between number of pods per main stem with biomass per plot and yield per plant was positive correlation and significantly at 1% level. A significant negative correlation between thousand grain weight and oil percentage were obtained. A significant positive correlation between thousand grain weight and yield per plant were obtained. Ali et al. (2003) also showed that pods per plant and 1000-seed weight had significant correlation with seed yield. Days to flowering and number of pods per plant were correlated significantly with seed yield (Khan et al., 2006). Also a significant correlation was observed between pod number per plant and seed yield in species of *B. napus* and *B. juncea* (Akbar et. al., 2007; Marjanovic-Jeromela, et. al., 2009). This showed that among yield component number of pods had greatest and seed per pod and seed weight had weak influence on seed yield. Significant correlations between yield and yield associated traits were also reported in other important crops (Alishah, et. al., 2008; Farshadfar and Farshadfar, 2008; Khalily, et. al., 2010; Azeez and Morakinyo, 2011; Belete, 2011; Hefny, 2011). Although in planting date studies of rapeseed and other brassica species, correlation among the yield associated traits were noticed but in a few studies the variations of correlations among the traits were stressed.

The objectives of the present study were to detect the planting date effects on yield associated traits and also to estimate the variations the correlation between the traits in different planting dates to identify suitable selection criteria based on correlation analysis.

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

variety	Harvest index	Yield / plant(g)	Biomass /plot(g)	Days to maturity	Number of pods per main stem	Oil%	1000 grain weight(g)	the first pod Height(cm)
Falcon	31.25^{A}	54.72^{C}	725.5^{D}	223.7^{A}	46.72^{B}	10.28^{B}	2.162^{C}	56.03^{B}
PF7045	29.58^{A}	81.98^{A}	917.5^{C}	224.2^{B}	62.5^{A}	11.29^{B}	3.035^{B}	50.40^{C}
Jerriss	26.49^{B}	68.14^{B}	1021^{B}	225.3^{C}	61.02^{A}	16.33^{A}	3.889^{A}	61.58^{A}
Global	29.87^{A}	84.16^{A}	1103^{A}	226.4^{D}	69.38^{A}	17.33^{A}	3.897^{A}	62.19^{A}

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

Table 2- Mean comparison traits in four varieties of canola

s.o.v	DF	Harvest index	Yield / plant	Biomass /plot	Days to maturity	Number of pods per main stem	Oil%	1000 grain weight	the first pod Height
Replication	2	3.517	0.084	2295.188	0.271	2.351	0.018	0.044	74.614
Variety	3	48.404*	8.229**	274014**	18.188**	271.85**	4.944**	0.044ns	365.009
Error	6	5.543	0.047	4457.438	0.188	18.871	0.008	0.077	5.359
Date	1	120.175**	0.002ns	92928**	623.521**	65.38*	1.613**	0.022^{ns}	483.616**
var*date	3	36.419**	10.001**	169574**	32.346^{ns}	8.801**	1.952**		
density	1	76.079**			17.41**	1.147^{ns}	3.162**	0.001^{ns}	15.549^{ns}
var* density	3	198.550**	0.169^{ns}	839523**	50.021**	42.538^{ns}	0.426**	2.841**	105.495*
date*density	1	197.681**	1.279**			3.597^{ns}	3.741**	0.009^{ns}	
date* density* var	3	91.68**	0.142^{ns}	26179**	4.354**	15.552^{ns}	1.744**	0.725**	1.058^{ns}
			0.830^{ns}	178608**	7.521**				11.233^{ns}
					3.187**				24.013
				57454**					
Error	24	6.362	0.162	4470.625	0.097	16.179	0.007	0.145	16.853
%CV		8.61	12.39	7.28	0.14	6.71	0.18	16.02	7.13

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

Table 3 - mean comparison of traits at different planting dates

planting dates	Harvest index	Yield / plant(g)	Biomass /plot(g)	Days to maturity	Number of pods per main stem	Oil%	1000 grain weight(g)	the first pod Height(cm)
08.10.13	30.88	3.282	992.5	221.292	62.24	48.795	2.358	60725
08.10.28	27.674	3.251	904.5	228.5	57.57	48.428	2.401	54.419

Table 4 - mean comparison of traits at different plant density

density	Harvest index	Yield / plant(g)	Biomass /plot(g)	Days to maturity	Number of pods per main stem	Oil%	1000 grain weight(g)	the first pod Height(cm)
84 plant/m^2	28.039	3.186	1080.75	223.875	59.6	45.355	2.385	59.075
42 plant/m^2	30.514	3.347	816.250	225.917	60.21	48.868	2.375	56.069

Table 5 - Simple correlations between traits

	the first pod Height	Number of pods per main stem	1000grain weight	Days to maturity	Oil%	Biomass /plot	Yield / plant	Harvest index
the first pod Height	1/00	0/295*	-0/018	-0/265	0/397**	0/54**	0/29*	-0/04
Number of pods per main stem		1/00	-0/145	0/028	0/17	0/489**	0/381**	-0/077
1000grain weight			1/00	-0/065	-0/37**	0/117	0/447**	-0/14
Days to maturity				1/00	0/078	-0/116	0/12	-0/262
Oil%					1/00	0/012	-0/052	0/072
Biomass /plot						1/00	0/441**	-0/202
Yield / plant							1/00	-0/122

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