Cumhuriyet Üniversitesi Fen Fakültesi
Fen Bilimleri Dergisi (CFD), Cilt:36, No: 3 Özel Sayı (2015)
ISSN: 1300-1949

Cumhuriyet University Faculty of Science
Science Journal (CSJ), Vol. 36, No: 3 Special Issue (2015)
ISSN: 1300-1949

Investigation the effects of cultivation season and genotypes on some of agronomic parameters of rape plant with delayed cultivation in Arak climate condition (Markazi province)

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Received: 01.02.2015; Accepted: 05.05.2015

Abstract. This investigation was carried out to evaluate the effects of cultivation season and genotypes on some of agronomic parameters of rape). The experiment was conducted as split plots in completely randomized blockdesign with three replications at the Agricultural Research Station of Islamic Azad University of Arak in 2007. Main plots were planting dates at two levels (September 18thandOctober 15th respectively) and sub plots were considered 11 genotypes of winter canola (LICORD, OLARA, SUNDAY, MODERN, SLM046, OPERA, OKAPI, ELITE, R.COBRA, EBONIT and MILLENA) respectively. Main parameters such as plant height, number of pod on main branch, number of pod on sub branch, number of pod on whole plant, number of grain in pod, podlength, grainweight, grain yield and oil yield were measured. Mean comparison results showed that the highest cultivation date in mentioned parameters has been obtained on october18th. as well asthe most genotypes were obtained in parameters such asplant height, dry weightandtotal plantbiomass yield, respectively (91.15cm, 70.33g and105.5kg persquare meter) in ELITEgenotype. The maximum grain yield was in SLM046 genotype(4479kg), the maximum number of pod on main branch and, number of pod on sub branch, number of pod on plant were in MODERN and ROCOBRA genotypes (33.22, 56.67 and 74) respectively,the maximum number of grains in podwere in LICORD genotype (27). The least oil yield was relatedto LICORDGenotype (1.74 kg/hg). The interaction effects between cultivation date and genotype on mentioned parameters showed significant differences.

Keywords: Winter rapeseed, cultivation season, genotype, grain yield, oil yield, delayed cultivation

1. INTRODUCTION

Rape (*Berassica napus* L.) is one of the major oilseeds in the world in last decades. Rapeseed cultivation has been increased from 2.8 million hectares in 1970 to more than 30.2 million hectares in 2007 (Fanaei *et al.,* 2008). Iran oil consumption has been increased due population growth. With per capita consumptio) 14 kg, every year around 980 tons of vegetable oil is required that more than 90 percent of it is imported (Al-Barrak, 2006; Shirani rad & Dahshiri, 2002). Cultivation and production rape have been reported 250 hectares and 1587 tons in 2009-2010 (Anonymous, 2009). Rape yield can be increased by using breeding principles. Therefore, in addition to introducing of varieties with higher yield, the maximum genetic capacity of the existing cultivars can be used in different weather conditions (Epplin *et al.,* 2000), which part of this goal is achievable under proper cultivation date.

The purpose of determining planting dates is finding the best time for planting date for cultivar or group of cultivars so that a set of environmental factors occurring at the time of emergence, and seedling settlement will be suitable , and each stage of plant growth have

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Special Issue: The Second National Conference on Applied Research in Science and Technology

optimal conditions (Khajepour, 2001). Lunt *et al.*, (2001) In a study of planting date (first and last of September) during the four years of study in London, England suggested that in late autumn cultivation dates, cold weather through canopy reduction causes the reduction in grain yield. According to diepenbrock (Diepenbrock, 2000), considering the leaves key role in plant photosynthesis, dry matter accumulation during the plant growth in seed filling stage with transferring to storage organs causes the saddlebag growth and seed filling. According to these researchers there is a linear relationship between dry matter accumulations until flowering time with number of saddlebag on the plant. So the delay in planting there are low opportunities for dry matter accumulation and the grain yield will be decreased. Based on Robertson *et al.*, (2004) it was shown that for every degree increase in temperature during flowering time and seed filling seed oil content will reduce 1.7 percent. Delayed planting has decreased the number of seeds in saddlebag, seed weight, saddlebag length and rape seed yield (Fathi et al., 2003). In investigation by Dadashi *&* Khajepour, (2004), the effect of planting date in summer cultivation (second cultivation) was significant on the grain yield without petal picking, so that The fourth planting date (18 June) and the third planting date (20 May) had the highest and the lowest yield respectively.

In a survey by Bagheri *et al.*, (2004) in Isfahan, they related planting date to synchronization seed filling with the cool air of September, that has been caused to the production and transportation of storage Photosynthetic material in seeds and ultimately yield increased. Ozar, (2003) stated that there is a linear relation between dry matter accumulation during the growth period until flowering and the number of saddlebag on plant. He expressed that the reason for the lowest number of saddlebag per plant in late planting dates is the plant weakness during flowering date. Plant that is the main reason for lowest grain yield. Tusar *et al.*, (2006) reported that there is a high correlation between the number of saddlebag in plant and plant yield. The results of other investigations show that delay in plant cultivation has the direct effect on dry matter division to plant economy tanks and causes to inefficiently of photosynthetic material transportation to seeds and harvest index reduction (Fanaei *et al.*, 2008). Pasban Eslam, (2008) showed that with delay in planting from September 16 to October 5, the number of leave on plant, stem diameter and dry weight will be decreased and due to unavailability to complete rosette stage, shrubs will be damaged faced to the cold weather and the genotypes frost percent will be 19.7. Christmas, (1996) observed that rape cultivars show a significant reaction to climate condition. He concluded that the cultivars reactions to the location are so different and numbers of cultivars have a high tolerance to climate change. In a study that Raiput *et al.*, (1991) carried out on Brassi Juncea and Brass Rap cultivar they reported that in planting date 10 October, 20 October, 30 October the yields were 2.57, 1.1 and 1.50 tons per hectare and they concluded that with delay in planting the grain yield will be decrease (Alhani, 2002). The purpose of this study was investigation the effects of planting date and genotypes on some rape parameters with delayed planting date in Arak climate condition.

2. METHODS AND MATERIALS

In order to investigation the effect of planting season and different winter rapeseed genotypes on physiological index and yield with delayed cultivation in Markazi province a study has been carried out at research farm of Islamic Azad University of Arak in 2007. The farm has been located at longitude 34 degrees and 3 second and latitude 49 degrees and 48 second and height of 2192 meters above sea level. The region climate characteristic is mild summer and cold winter. Temperature change in this city is so high, so that during past years the absolute minimum temperature in 1981 was -31 and in 1987 the absolute maximum temperature was 44. And also cold weather starts from November and sometimes continues until May (table 1). Befor planting the soil sampling from 30 depths was done and the soil chemical and physical characteristics were determined in soil chemistry laboratory (table 2).

Table 1. Climatic characteristics of the Agricultural Experiment Station 2006.

Month	Year	The average minimum temperature (° C)	The average maximum temperature (° C)
February	2005	2.37	13.57
March	2006	5.03	17.83
April	2006	10.16	24.09
June	2006	14.06	30.03
July	2006	20.48	36.22

Table 2. Results of chemical analysis of soil testing.

Depth	EC ds/m	PH	T.N.V %	NO3 mg/kg	P mg/kg	K mg/kg	O.C %	Sand %	Silt %	Clay %	Texture
0-30	0.6	8	28	6.2	2.77	0.61	0.61	52	6	12	C-L

The experiment was conducted as split plots in completely randomized block design with three replications. Main plots were planting dates at two levels (September 18th and October 15th respectively) and sub plots were considered 11 genotypes of winter canola (LICORD, OLARA, SUNDAY, MODERN, SLM046, OPERA, OKAPI, ELITE, COBRA, EBONIT and ILLENA) respectively. sub plot were included 8 row with the distance 30 cm and the length of 5 meter that were cultivated in 2 lines on the furrow with the height of 60 cm and row distance of 3 cm. seed planting was carried out by hand at the depth of 2-3 cm. To achieve the density of 100 plants per square meter thinning operation was done in 6 and 4 leaves stage. Before starting the work germination percent of different winter rapeseed genotypes were determined at laboratory. The distances between two treatments were considered 1 planting line and the distance between two replications were 2 meters. The fertilizer were ammonium phosphate (150 kg/ha) and potassium sulfate (150 kg/ha) . One third of Nitrogen was consumed before planting according to soil test. 1381 kg nitrogen (300 kg urea) was used totally that a third of that was used during planting and a third of that was used after rosette stage and a third of that used before flowering stage. Irrigation during the experiment was done regularly. In order to controlling weed, Terflan herbicide (2.5lit/ha) was mixed with soil before planting and used in soil and also hand weeding was used. A week before harvesting, 10 plants from each treatment were harvested randomly with considering marginal effects. Main parameters such as plant height, number of saddlebag on main branch, number of saddlebags on sub branch, number of saddlebags on whole plant, number of grain in saddlebag, saddlebag length and thousand grain weight (TKW) were evaluated. The harvesting was done when the distal ends of plants were yellow and the saddlebags were dry and yellow-brown. Grain moisture was 15 percent. Harvesting plants were remained on the ground for 2 days and they were dried in sun and the moisture was decrease to 13 percent. Then the plants were threshed and the straws were separated from seeds. At maturity, the 4 central lines of each plot 4 after adjusting marginal effects were considered as the Final harvesting region. And after threshing the grain yield was measured and also oil yield was obtained by the oil percent and yield grain multiplication. At the end of this study data analysis was performed by the MSTAT-C statistical software and mean comparisons were done by the Duncan test at 5% probability level. And diagrams were plotted by Excel software.

3. RESULTS AND DISCUSSIONS

3.1. Plant height

The results of variance analysis showed that the effects of planting date were significant difference in probability level ($P\langle 0.05$) and the effects of different rape genotype, the effect of interaction between planting date and genotypes had significant difference in probability level ($P\langle 0.01$) (table 1). Mean comparisons showed that plant dating base on plant height were categorized in different statistical groups and the highest plant height was at planting date on September 18th planting date with mean (84.87 cm) and the lowest plant height was on October 15th planting date with the mean (78.28 cm). And also the highest and the lowest height of different rape genotypes were RCOBRA and ELITE with the mean (91.15 and 73.4 cm) respectively (table 2). Mean comparisons of interactions between planting date and different genotypes showed that they were located in different statistical groups so that OKAPI genotypes with the mean (65.30cm) on the September 18 planting date had maximum plant height and ROCOBRA and Okapi with the means(64.5 and 64.30) on the October 15 planting date had minimum plant height (Figure 1). It seems that the reason of this result is derived from planting date effect. This means that in late planting date the different rape genotypes height were decreased. Delyn in planting date and short growing season caused that the plant haven had enough time for food store and resulted in reduction the plant height (Norton *et al.,* 1991). Conversely soon planting date caused the more growth and formation the large plants and as a result stage of inflorescence initiation was earlier (Nuttal *et al.*,1992). Different BRASICA genotypes mainly have different in the average height of plant (Iqbal *et al.,* 2008 & Ozer, 2003). The reason of difference height in rape cultivars can be attributed to the difference of day numbers until ripening (Ozer, 2003). In plants like wheat (Rajaram *et al.,* 2008) and corn (Tollenaar & Brulsema,1998) with decreasing the plant height, the stem weight will be decreased and unused Photosynthetic material for stem growing in dwarf plants will be accumulated in other organs. Iqbal *et al.,* (2008) stated that all Hindi mustard Genotypes has the more average height that rape genotypes (B.napus).

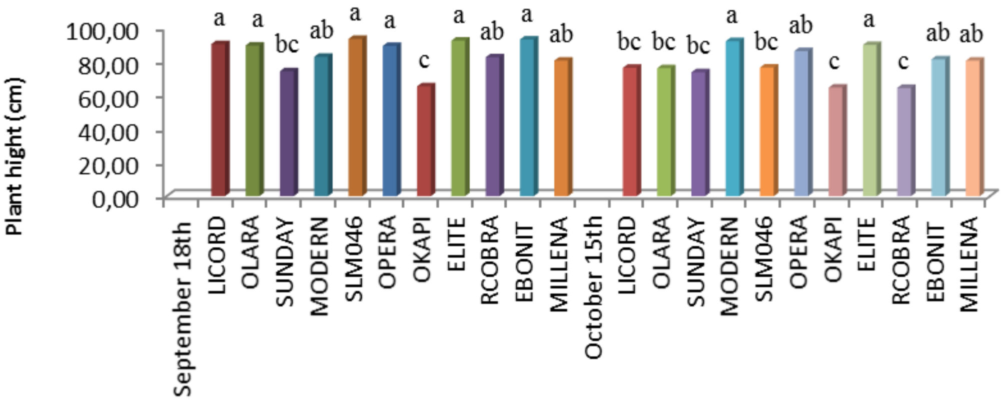

Figure 1. The interaction between planting date and plant height of winter rapeseed genotypes × columns with similar letters according to Duncan test**,** no differences were significant at the 5% level**.**

3.2. Number of pods per main branch

The effects of Planting date, genotype and the interactions between planting date had a significant difference on the number of saddlebag on main branch in ($P\langle 0.05$) probability level (table 1). Mean comparisons showed that planting date base on the number of pods per main branch were categorized in two statistical groups. So that September 18th planting date with mean (22.15 numbers) had the highest number of pods per main branch and October 15th planting date with the mean (17.45 numbers) had the lowest number of pods per main branch. Also different rape genotypes were located in different statistical groups. The MODERN and SLM064 genotypes with the mean (22.33 and 22numbers) had the maximum number of pods per main branch and RCOBRA with the mean (17.33 numbers) had the minimum number of pods per main branch.(table 2). Mean comparisons of interactions between planting date and different genotypes showed that they were located in different statistical groups so that SLM064 genotypes with the mean (27/66 numbers) on the September 18 planting date had maximum number of pods per main branch and ROCOBRA with the means(14.33) on the October 15 planting date had minimum number of pods per main branch (Figure 2).

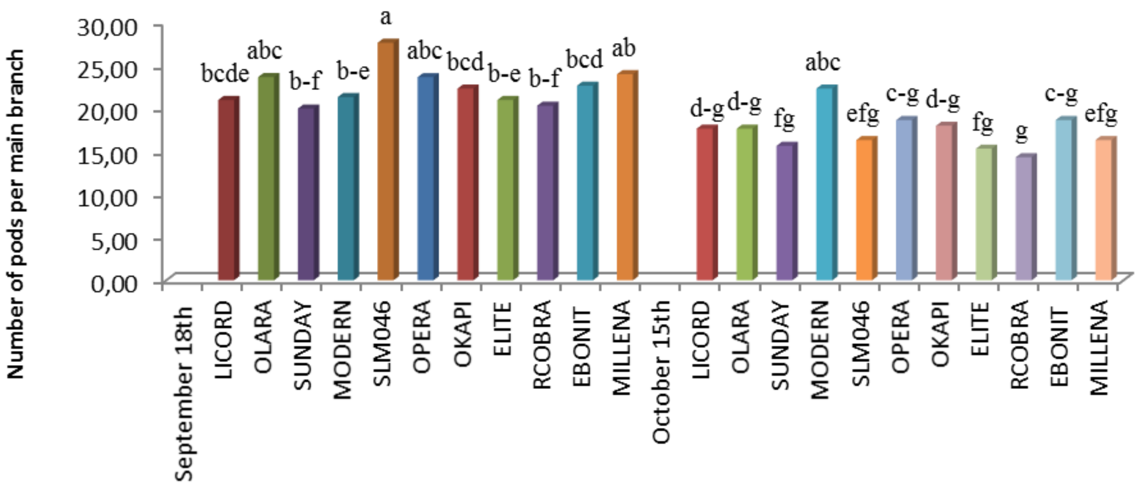

Figure 2. The interaction between planting date × winter canola cultivars on number of pods per main branch and columns with similar letters according to Duncan test**,** no differences were significant at the 5% level**.**

Table 3. Analysis of variance (**mean squares)** treatments winter canola crop season and genotypes on traits

S.O.V	*df*	*Height*	*Number of pods per main branch*	*Number of pods per branch*	*The total number of pods per plant*	*Number of seeds per pod*	*Pod length*	*Weight 1000 seed*	*Grain yield*	*Oil yield*
Replication	2	103.78 ^{ns}	2.56 ^{ns}	2.24 ^{ns}	8.28 ^{ns}	5.17 ^{ns}	0.164 ^{ns}	0.243 ^{ns}	234144.3 ^{ns}	0.373 ^{ns}
Sowings (A)	1	716.10*	422.56*	2906.7 **	5882.56 **	4.37 *	0.463 *	0.812 ^{ns}	260.01 ^{ns}	0.046 **
Ea	2	30.82	9.74	20.18	16.015	6.78	0.188	0.05	112498.2	0.130
Genotype (B)	10	369.65**	16.41*	288.84**	196.27**	5.47**	0.095 **	0.249 **	299108.7 **	0.11 ^{ns}
A × B	10	114.78 **	15.49 *	147.29 **	137.96 **	4.11 **	0.340 *	0.16 **	180877.1**	0.133**
Eb	40	43.41	6.18	33.52	30.85	6	30.85	0.14	167474.8	0.039
CV%		8.08	13.07	2.65	8.45	10.09	7	9.85	10	9.76

***and*: In the order of significance in the probability area of 1 and 5 percent*

Table 4. Comparison of the average treatment effect of planting season and genotypes on traits of winter canola

Treatments	*Height*	*Number of pods per main branch*	*Number of pods per branch*	*The total number of pods per plant*	*Number of seeds per pod*	*Pod length*	*Weight 1000 seed*	*Grain yield*	*Oil yield*
Sowings									
September 18th	84.87 a	22.50 a	52.39 a	47. 9 a	24.54 a	7.08 a	3.81 a	4094.7 a	1.98 a
October 15th	78.28 b	17.45 b	39.12 b	56.16 b	24.03 b	6.92 b	4.03 b	4090.7 a	2.03 a
Genotype									
LICORD	83.33 ab	19. 3 abc	50 ab	69.33 ab	23.5 ab	7.14 a	3.74 b	4023.3 abc	1.74 c
OLARA	82.77 ab	20.66 abc	45.5 bc	66.16 bc	27 a	7.05 a	4.17 ab	4365.6 ab	1.97 abc
SUNDAY	73.95 c	17.83 bc	48.17 b	66 bc	24.3 ab	7.09 a	3.77 b	4016 abc	1.80 bc
MODERN	87.47 ab	22.33 a	43.67 bc	66 bc	24.17 ab	6.82 a	3.85 ab	3805 bc	2.09 a
SLM046	84.93 ab	22 a	33 d	83.54 b	24.3 ab	7.06 a	3.98 ab	4479 a	2.17 a
OPERA	87.75 ab	21.16 ab	39.67 cd	60.83 cd	23.6 ab	7.1 a	4.45 a	4018 abc	2.01 ab
OKAPI	64.9 d	20.16 abc	46.17 bc	66 bc	22.5 b	6.92 a	3.86 ab	3946 abc	2.04 ab
ELITE	91.15 a	18.16 bc	55.5 a	73 a	24.17 ab	6.84 a	3.99 ab	3788 c	1.99 ab
RCOBRA	73.4 c	17.33 c	58.6 a	74 a	24.17 ab	6.81 a	3.94 ab	4049 abc	2.13 a
EBONIT	87.22 ab	20.66 abc	45.5 bc	66.16 bc	24.3 ab	7.08 a	3.77 b	4237 abc	2.14 a
MILLENA	80.53 bc	20.16 abc	39.5 cd	59.66 cd	24 ab	7.09 a	3.54 b	4301 abc	2.01 ab

in every column and in every group of treatment averages with shared Latin letters there is no shared significant difference on the probability area of 5% based on Dunken ultiple-aspect test

3.3. Number of pods per branch

The results of variance analysis showed that the there was a significant difference between planting date and genotypes and treatment interaction in ($P\langle 0.01$) probability level (table 1). Planting date base on genotypes base on the number of pods per branch were categorized in different statistical group. So that September 18th planting date with mean (52.39 numbers) had the highest number of pods per branch. Also different rapeseed genotypes were located in different statistical groups according to the number of pods per branch and it was distinguished that ELITE and ROCOBRa with the means (55.5 and 56.7 numbers) had the highest number of pods per branch and the SLM064 genotype with the mean (33 numbers) had the lowest number of pods per branch. Mean of interactions between planting date and different rape genotypes according to mentioned parameter were in different statistical groups and totally MILLENA genotype with mean (27.67 number) on October 15th planting date was located at the bottom of the group (Figure 3). The result indicates that the number of pods per branch was affected by plant dating and delay in planting date decreased the number of pods per branch and in some genotypes a big difference was observed between the number of saddlebag on sub branch in two different planting date that it seems to be due the differences between the treatments firstly and secondly because of decreasing the growth length period that it is due to delayed planting. Sub branches play an important role in rape yield and yield compensation on the unfavorable situation such as low density and tensions (Angadi *et al.*, 2003). In past investigations it was noted to the sub branch reduction along with the delay in planting. (Allen *et al.,* 1971 ; Mendham *et al.,* 1981).

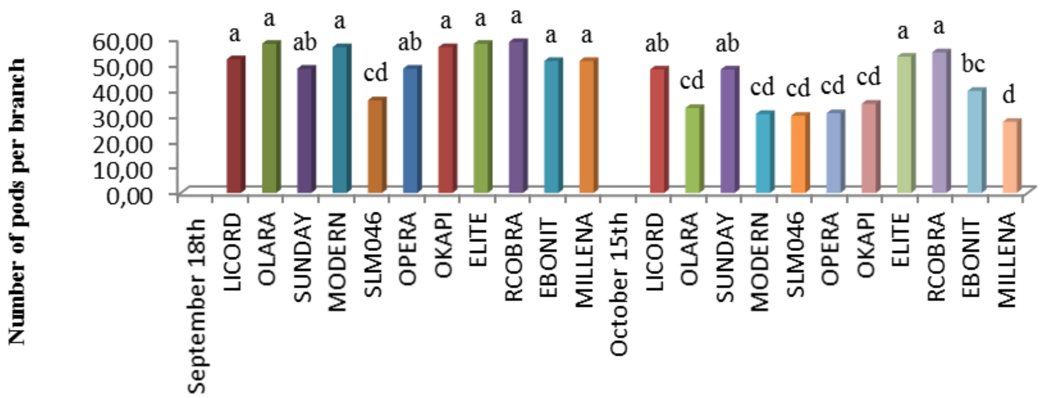

Figure 3. The interaction between planting date × winter canola cultivars on number of pods per branch and columns with similar letters according to Duncan, are the non-significant difference at the 5% level.

3.4. The total number of pods per plant

The results of variance analysis showed that the there was a significant difference between planting date and genotypes and interactions between plant dating and genotypes in probability level ($P\langle 0.01$) (Table 1). Mean comparisons of simple effects showed that planting date according to total number of pods per plant. September 18th planting date with the mean (74.90 numbers) and October 15thplanting date with the mean (56.156 numbers) had the highest and lowest total number of pods per plant respectively. Also different rapeseed genotypes were located in different statistical groups according to the total number of pods per plant it was realized that ELITE and ROCOBRA with the means(74 and 73 numbers) produced the maximum total number of pods per plant and SLM064 with the mean(54.83 numbers) produced the lowest total number of pods per plant (Table 2). Mean comparisons of interactions between planting date and different genotypes showed that they were located in different statistical groups according to mentioned parameter. Totally SLM064 and MILLENA genotypes with the means (36 and 44 numbers) on October 15th planting date allocated the lowest numbers to themselves (Figure 4). It seems numbers of saddlebag on whole plant that is affected by late planting, caused that plant has weak rosette situation during the winter so the seedlings were damaged by winter cold weather and on the other hand in the winter the flowering was done with the weak bushes and fewer florets turned to saddlebag. Ozar (2003) stated that there is a linear relation between dry matter accumulation during the plant growth period and the number of saddlebag on the plant. He related the reduction of saddlebag on the plant in late planting date to plant weakness during the flowering and this the main reason for yield reduction. Tusar *et al.*, (2006) reported there is a high correlation between the number of saddlebag and plant yield.

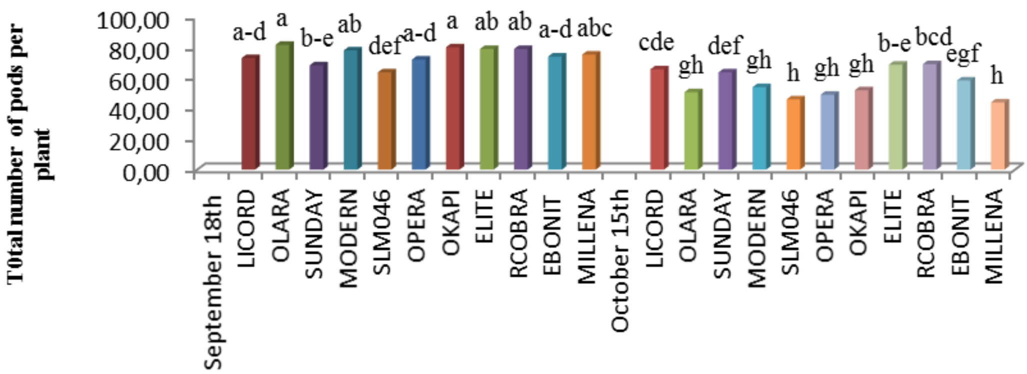

Figure 4. The interaction between planting date × winter canola cultivars on total number of pods per plant and columns with similar letters according to Duncan test, no differences were significant at the 5% level.

3.5. Number of seeds per pod

The results of statistical analysis showed that the there was a significant difference between planting date and genotypes in ($P\langle 0.05$) probability level and interactions between plant dating and genotypes in probability level ($P\langle 0.01$) (Table 1). Mean comparisons evaluation of planting date base on the number of seeds per pod indicated that the planting date treatment were in different statistical groups, September 18th planting date with the mean (24.54 numbers) and October 15th planting date with the mean (24.03 numbers) had the highest and lowest number of seeds per pod on whole plant respectively. Mean investigation showed that different rape genotypes had been located in three different groups. it was realized that OLARA Genotype with the mean (27 number) produced the maximum numbers of grain in the plant and OKAPI genotype with the mean(22.5 numbers) produced the lowest number of seeds per pod (Table 2). Mean comparisons of interactions between planting date and different genotypes showed that they were located in different statistical groups according to mentioned parameter. Totally OLARA with the mean (27.33 numbers) on September 18 planting date and OKAPI with the means (21.33 numbers) on October 15 planting date allocated the highest and lowest numbers to themselves (Figure 5). The number of seeds per pod in is affected by genetic factors and it isn’t affected by environmental factors (Anvare, 1996). Mendham *et al.*, (1981) reported that increasing the number of seeds per pod is a key factor in new genotype yield increasing in Australia . Roberston *et al.*, (2004) stated He related the reduction of grain weight reduction in late planting date to increasing the temperature during the plant filling period. So rape genotypes that had the more number of seeds per pod and larger size than thousand seed weight are more effective because the environment effect is less on them on the provided that grain yield that are irreversible aren’t reduced.

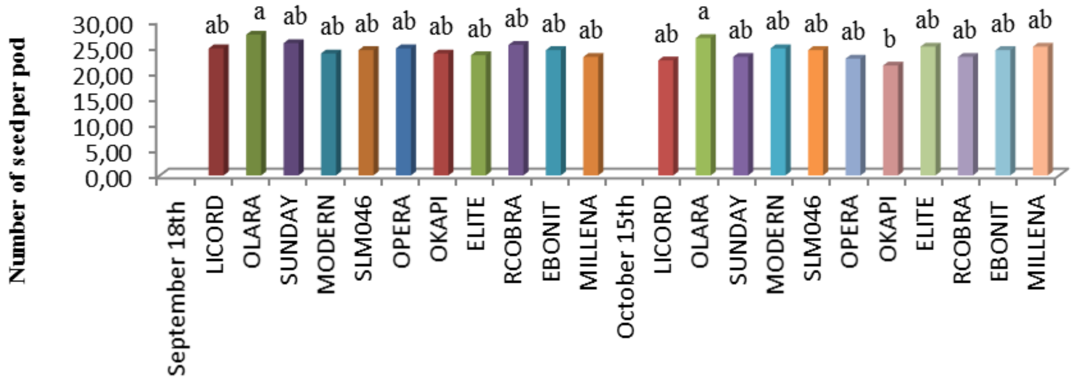

Figure 5. The interaction between planting date × winter canola cultivars on number of seeds per pod and columns with similar letters according to Duncan test, no differences were significant at the 5% level.

3.6. Pod length

The results of statistical analysis showed that the there was a significant difference between planting date in probability level ($P\langle 0.05$) and interaction between planting date and genotypes in probability level ($P\langle 0.01$) (Table 1). Mean comparisons evaluation of different rape genotypes base on the pod length indicated that treatment levels were in different statistical groups, September 18th planting date with the mean(7.98 cm) and October 15 planting date with the mean (6.92 cm) had the highest and lowest saddlebag length respectively (table 2). Mean comparisons of interactions between planting date and different genotypes showed that they were located in different statistical groups. Totally SUNDAY, RCOBRA and EBONIT with the means (7.29 and 7.33 and 7.24 cm) on September 18th planting date and RCOBRA genotype with the mean (6.30 cm) on October 15th planting date allocated the highest and lowest pod length respectively (Figure 6).

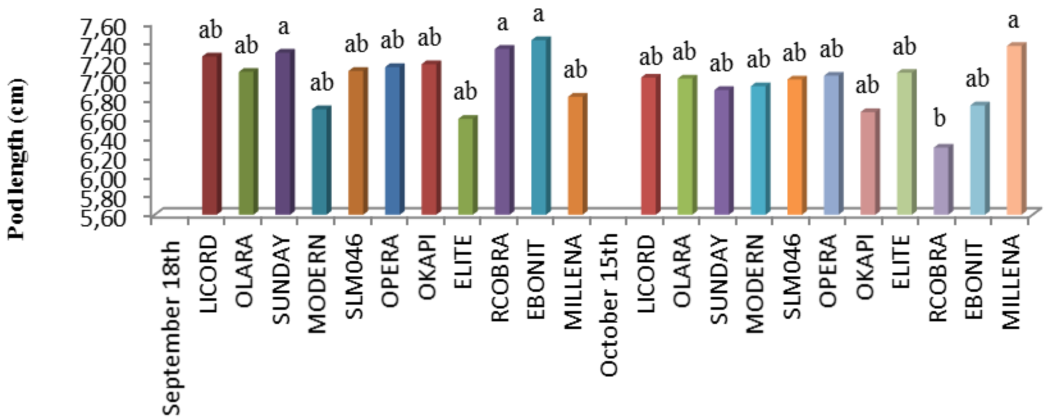

Figure 6. The interaction between planting date × winter canola cultivars on pod length and columns with similar letters according to Duncan test, no differences were significant at the 5% level.

3.7. Weight 1000 seed

The effects of planting date, genotypes and interaction between them on grain yield were evaluated and it was found that simple effects of planting g date on grain yield was significant on probability level ($P\langle 0.05$) and also the effects of genotype and interaction between planting date and genotype were significant in probability level ($P\langle 0.01$) (Table 1). Mean comparisons showed that planting date base on grain weight were located in different statistical group. The highest seed weight was stamped with the date of planting october 15th (3.40g) and sowing date of September 18th, with a mean (3.18 g), the lowest seed weight, respectively. Mean comparison showed that different genotypes of grain weight in the groups were not statistically different and OPERA genotype with the mean (4.45 g) produced the highest grain yield and also mean comparisons of interaction between planting date and different rape genotype indicated that they were located in different statistical groups. Totally OPERA genotype with the mean (4.71g) on october 15thplanting dateand MILLENA genotype with the mean (3.3 g) on September 18th planting date had the highest and lowest grain yield respectively (Figure 7). Since the grain yield is the last component of the yield the change process of that is affected by other yield components (Sarmadnia & Koucheki,1989). So it seems that grain production in saddlebag caused more photosynthetic material isallocate to grain yield and as thus grain yield is increased. It has been reported that there is a weak relation between final yield and grain yield(Diepenbrock, 2000). It seems that this factor is more affected by genetic factors those environmental factors. Rao & Mendham (1991) concluded that better environmental situation and moisture and temperature availability at the end of growing season and prolongation of the grain filling period caused the production of bigger grain and thus the grain weight will be increased. Also Hocking *et al.*, (2002) and Roberston *et al.*, (2004) found that delay in planting date causes the grain weight and yield reduction. Delay in planting season causesthat pollination and seed filling period is occurred in warmer temperature and as a result filling seed period and grain weight will be decreased (Scarisbrick *et al.*, 1981).

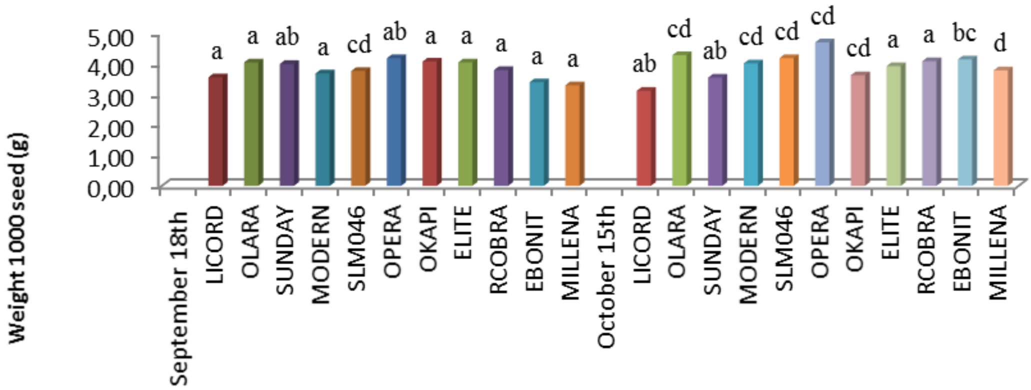

Figure 7. The interaction between planting date × winter canola cultivars on **weight 1000 seed** and columns with similar letters according to Duncan test**,** no differences were significant at the 5% level**.**

3.8. Grain yield

The results of variance analysis showed that there was a significant difference between planting date in probability level ($P\langle 0.05$) and simple effects of genotypes and interaction between planting date and genotypes on grain yield in probability level ($P\langle 0.01$) (Table 1). Mean comparisons of simple effects showed that planting date according to grain yield were located in different statistical groups. September 18th planting date with the mean (4094.7 kg/ha) and October 15th planting date with the mean (4090.7 kg/ha) had the highest and lowest grain yield respectively. and also mean comparisons of different rape genotypes showed that SLM046 Genotype with the mean (4479 kg) produced the maximum grain yield and ELITE genotype with the mean(3788 kg) produced the minimum grain yield in saddlebag (Table 2). Mean comparisons of interactions between planting date and different rape genotypes showed that they were located in different statistical groups according to mentioned parameter. Totally MILLENA genotype with the mean (4541.3 kg) on October 15th planting date and SUNDAY and MODERN genotypes with the means (3630 and 4402kg) allocated the highest and lowest grain yield (Figure 8). In this experiment it was shown that by delaying in planting date the grain yield was decreased that it was due to the decreasing the number of grain in saddlebag and the number of grain in whole plant .that it was also due to the reduction of growing season that it is caused by delay in planting. But totally it seems that delay in planting date will decreased the grain yield. In the investigation by Dadashi and khajepour (2004), the effect of planting date in summer cultivation (second cultivation) on grain yield without plucking petals was significant. So that fourth planting date (18june) and third planting date (20 may) had the highest and lowest yield respectively. in the study by Bagheri *et al.,* (2006) in Isfahan they related the planting date to Synchronization with seed filling by cool September weather that it causes to production and transport of photosynthetic material in grains and eventually the yield has been increased. Lunt *et al.,* (2001) In a study of planting date (first and last of September) during the four years of study in London, England suggested that in late autumn cultivation dates, cold weather through canopy reduction causes the reduction in grain yield. According to Diepenbrock (Diepenbrock, 2000), considering the leaves key role in plant photosynthesis, dry matter accumulation during the plant growth in seed filling stage with transferring to storage organs causes the saddlebag growth and seed filling. According to these researchers there is a linear relationship between dry matter accumulation until flowering time with number of saddlebag on the plant. So the delay in planting there are low opportunities for dry matter accumulation and the grain yield will be decreased. In the study that was carried out by Rajput *et al.,* (1991) on Brass Rap and Brassi genotypes they reported that planting date October 18th , October 20, October 30th had the 2.57 , 1.1 and 1.50 ton per ha yield and the concluded that by delaying in planting the grain yield will be decreased. In a study in Jiroft four planting date (October 18th, November 5th, November 25th and December 15th) were investigated and it was reported that by delaying in planting the grain yield will be decreased. (Alhani, 2002). Bilsborrow and Norton stated that delay in planting causes the plant growth reduction and decreases the photosynthetic material transport to grain during their growth that it is associated to grain weight an grain yield reduction.

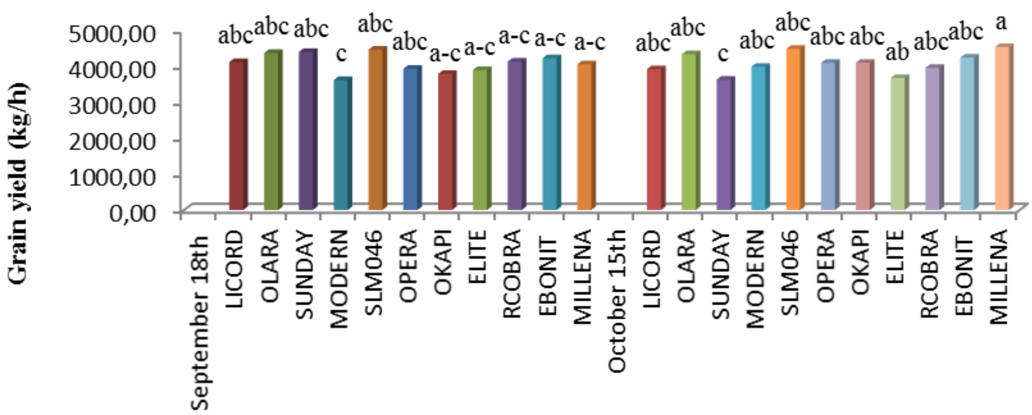

Figure 8. The interaction between planting date × winter canola cultivars on grain yield and columns with similar letters according to Duncan test, no differences were significant at the 5% level.

3.9. Oil yield

The results of variance analysis showed that there was a significant difference between genotypes and interactions between planting date and genotype planting date in probability level ($P\langle 0.05$) and simple effects of planting ate on oil yield weren't significant. Mean comparisons of simple effects showed that genotypes base on the oil yield were located in different statistical groups and MODERN, SLM046, RCOBRN and EBONIT genotypes with the means (2.09, 2.17, 2.13and 2.14 kg/ha) produced the maximum oil yield respectively and LICORD genotype with the mean (1.74 kg/ha) produced the minimum oil yield in saddlebag (Table 2). Mean comparisons of interactions between planting date and different rape genotypes showed that they were located in different statistical groups according to mentioned parameter. Totally MODERN and SLM064 genotypes with the mean (2.29 and 2.30 kg/ha) on october 15th planting date and SUNDAY with the means(1.55 kg/ha) allocated the highest and lowest grain yield respectively (Figure 9). Oil amount is a factor with high heritability that is slightly affected by environmental situation. Among the environmental factors effective on oil amount, temperature is the most important factor that by increasing it, extensive loss will be appeared on oil percent. The temperature effect on oil percent will be appeared more in late planting date (Fanaei *et al.,* 2008). Adamsen and Coffelet, (2005) stated the yield reduction due to the delay in planting date. In Rajput *et al.,* (1991) results the delay in planting increased the grain protein content and oil yield reduction that the reason of that was the increased temperature of last season.

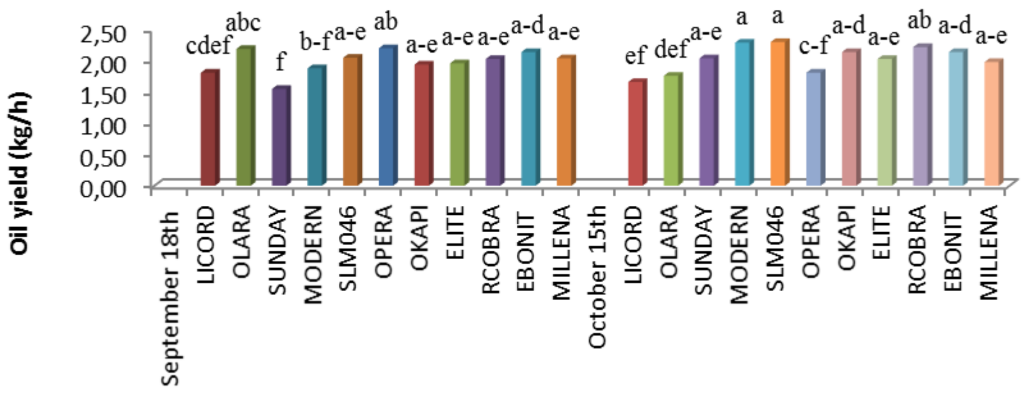

Figure 8. The interaction between planting date × winter canola cultivars on oil yield and columns with similar letters according to Duncan test, no differences were significant at the 5% level.

4. CONCLUSIONS

Climate situation in each region has the noticeable effect on actualizing the grain yield potential. So selecting the suitable planting date is one of the farming techniques by observing that the planting date share on yield will be close to its maximum. Since that the length of different growth stages is a function of temperature and day length. so the planting date can be changed in a way that different stages of plant growth will be adapted with temperature and day length during growing season and have the desirable vegetative and reproductive growth, from these results it can be concluded that the planting distance effect that have been clear here. Genotypes in proper planting date because of better establishment of plants in rosette stage have a better condition for overwintering. In this investigation it has been observed that grain yield have had suitable condition on proper planting date. In ordinary planting condition and in cold climate condition OLARA, MILLENA, EBONIT and SLM046 with the means (4356.6, 4301, 4237 and 4479 kg/ha) had the higher yield and ELITE genotype with the mean (3378 kg/ha) had the lower grain yield and this genotype isn't suitable for cold climate condition. Considering the results of this study fast growing, suitable, proper establishment after planting, prematurity, more flexibility for environmental damage compensation and yield stability rather that SLM046 genotype in case of planting date loss is recommended for cultivation in Arak region condition.

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