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The Effect of Planting Date on Yield, Yield Components and Morphophysiological Characteristics of Rapeseed Cultivars in Omidieh.

Seyed Davood Alavifard [1]*, Shirin Majdi [2], Babak Didehban [3]

[1] Master of Agricultural Engineering from Islamic Azad University, Science and Research Branch of Khuzestan, Iran.
[3] Master of Agricultural Engineering from Islamic Azad University, Sabzevar Branch, Iran.
[2] Master of Agricultural Engineering from Islamic Azad University, Yasouj Branch, Iran.

***Corresponding Author**

Abstract: *An experiment was done in the crop year 2011 in Jayezan, Omidieh using a factorial experiment in form of a randomized complete block design for one crop year with 9 treatments including three planting dates (November 11, 2011, December 11, 2011, and January 10, 2012) three cultivars (Hyola 401, Hyola 308, and RGS003) and four replicates to examine the effect of planting date on yield, yield components and morphophysiological characteristics of rapeseed (Brassica napus) cultivars. The results indicated that the effect of planting date on biological yield, seed yield, harvest index, number of pods per plant, number of grains per pod, thousand grain weight (TGW), oil yield, protein yield, stem diameter, plant height, pod length, LAI, CGR, RGR was significant at 1% and at 5% for SLA, but insignificant for oil, protein, leaf chlorophyll and LAD. The effect of cultivar on oil percentage and protein percentage was significant at 1% and on leaf chlorophyll at 5% with no significant differences in other traits. The interaction effect of planting date and cultivar only on TGW was significant at 1% level and insignificant on other traits. According to the experiment results, planting Hyola 401 on November 10, 2012 is better and recommended for rapeseed cultivation in the area.*

Keywords: *Rapeseed, planting date, cultivar, yield, yield components, morphophysiological characteristics*

INTRODUCTION

Rapeseed is a significant crop that is mainly planted for its edible oil. According to FAO in 2007, rapeseed is the second most important source of edible oil production in the world after soybeans (Yamaguchi et al., 2002).
The industrial significance of rapeseed cultivation and production in Iran is related to its oil production, which is the second most energizing food resource for the people of the world after cereals. The development of the cultivation of various Brasica napus L. cultivars in Iran should be based on the oil yield of cultivars if it is for more oil production. In this relation, seed yield alone cannot determine this index (Nabavi, 1997).

The specific characteristics of rapeseed and its adaptation to the climatic conditions in most parts of the country have extremely extended the planting of it; thus, selecting the right cultivar for successful crop production is significant. Regarding this, yield comparison experiments are used as one of the selection methods for high yielding varieties (Aeein, 2005).

As one of the significant agricultural areas for oilseed cultivation, Khuzestan can be considered as one of the significant areas of rapeseed oil production given the experiments done in research centers and obtaining proper yields in this province (Saheb Mohammadi, 1991). Hence, the study was conducted to examine the effect of planting date on yield, yield components and morphophysiological characteristics of rapeseed cultivars in Omidieh. Various studies have been conducted in this regard, some of which are discussed below.

Ebrahimi et al. (2013) stated that the highest seed yield was obtained at an average of 3031 kg / ha at 23.8 ° C (September 25) compared to October 25 (17.1 ° C) with an average of 2173 kg / ha and showed superiority yet no significant difference was found with planting date October 10 (22.5 ° C).

Sadat Mohajerani et al. (2010) reported that planting date could significantly affect seed yield at 1% probability level so that it reduced with delay in seed yield, which was because of a decrease in the number of seed in the pod and the number of pods in the whole plant. This is due to the shortening of the growth period, which comes from delay in planting, but overall, it seems that the seed yield reduces with distancing from the optimal planting date.

According to Fallah Haki et al. (2011), analysis of variance showed that the effect of planting date, cultivar, and interaction of planting date and cultivar on seed yield was significant at 1% probability level.

Bagheri and Safahani (2010) reported that the effect of planting date on a number of grains per pod was significant at 1% probability level, so that the first and fourth planting dates had the highest and lowest number of grains per pod, respectively, among the planting dates examined.

Jaafarnejadi and Rahnama (2011) stated that delay in planting significantly reduced the number of pods per plant so that decreased out of 88 pods per plant at the first planting date to 63 pods at the last planting date in the first year.

According to studies conducted, delay in planting implantation, poorer rosette reduces biological yield. Biological function is significant in several aspects. Moreover, as it involves straw yield, it can be economically attractive. This is because rapeseed fodder has good quality in terms of digestible protein. Physiologically, the biological yield is equivalent to total net production. Thus, those plants with high yield will have the best use of production factors given their growth conditions and accumulating more photosynthetic materials in their organs and have the highest net yield (Fanaei et al., 2008).

According to the results, stem diameter with 5% probability level was affected by planting date levels and with delay of planting date from June 14 to June 25, stem diameter decreased from 20.34 mm to 19.21 mm. There was a significant difference between the compared hybrids in stem diameter at 1% probability level (Farnia et al., 2011).

Omidian et al. (2012) stated that cultivar was the only factor affecting plant height and there was a significant difference between cultivars at 1% probability level in rapeseed plant height. Comparing the mean data showed that each of the rapeseed cultivars had a different height than the other cultivars. Zarfam and Hyola 308 rapeseed cultivars had the highest and lowest plant height, respectively. It seems that Zarfam cultivar has higher plant height than early cultivars due to its being autumn cultivar and having a longer growth period.

Annafjeh et al. (2011) showed that the growth rate curve of the crop showed that, by about 100 days of age, the growth of the plant was slow, which could be attributed to the inadequate vegetation cover and less light absorption. However, from day 100 on, the growth rate of the crop drastically increased, so that it reached its maximum value at flowering time (120 days after planting).

Azari et al. (2012) reported that in napus species, salinity stress was insignificant on all plant pigments; however, the effect on cultivar chlorophyll a total chlorophyll and carotenoids was significant. Claibra and RGS003 cultivars had the lowest chlorophyll a, which are considered as high and low yield cultivars, respectively.

Methodology

The study was conducted in November 2011 in farmland in Jayezan, Omidieh with the latitude of 30 degrees and 88 minutes, longitude of 49 degrees and 84 minutes and altitude of 157 meters above sea level. The soil was first examined to start the experiment (Table 1).

Table 1: Soil test results

Physical breakdown			
Texture	Sand	Silt	Clay
Silt loam	20%	75%	5%
Chemical breakdown			
Element	Value	unit	
pH	7.55	-	
Ec	2.4	ds / cm	
P	11	mg / kg	
K	220	mg / kg	
N	0.2	%	
Fe	4.5	mg / kg	
Cu	1.02	mg / kg	
Zn	0.62	mg / kg	
Mn	9.07	mg / kg	

1. Statistical design and experimental treatments

This experiment had 9 treatments and 4 replications with a total of 36 experimental plots using a factorial experiment with a randomized complete block design with three replications for each crop year. The treatment included planting dates November 10, December 10, and January 10, and cultivars Hyola 401, Hyola 308 and RGS 003.

Table 2: Schematic view of the distribution of the treatments used in the statistical design

Treatments

a1: Hyola 401 a2 : Hyola 308 a3 : RGS 003

b1: November 10 b2: December 10 January 10 b3:

Replication I	a1b1	a3b2	a1b3	a2b1	a1b2	a2b3	a3b1	a2b2	a3b3
Replication II	a2b3	a1b1	a3b2	a3b3	a2b1	a1b2	a3b1	a2b2	a1b3
Replication III	a1b1	a2b2	a3b3	a3b1	a1b2	a1b3	a2b1	a3b2	a2b3
Replication V	a2b2	a3b1	a1b3	a3b2	a1b1	a2b3	a1b2	a2b1	a3b3

2. Planting

In planting, after plowing by tractor and plough, the plots were crushed by two perpendicular disks. Then, the planting lines were formed as small ridges, and the surface of the ridges was smoothed by a shovel and the thin ridges were created on the ridges by a thin groove. Immediately after sowing, the seeds were irrigated and they greened after about 8 days, and the same operation was done for the other two planting dates.

3. Measuring physiological traits

Sampling was done seven times every fourteen days until harvest. From every plot, 3 plants were sampled for measuring leaf area index and 3 for TDW and leaf dry weight (LDW) to calculate other physiological growth factors like crop growth rate, relative growth rate, leaf specific area, and leaf area durability. Sampling was done every 14 days from January 20 to April 13, 2012. The samples were dried using an oven for 48 to 72 hours and weighed using a precision digital scale. Samples were generalized to a ratio of one square meter.

4. Methods for measuring yield, yield components, and morphological traits

To measure the traits mentioned above, 3.33 m from the planting line with a margin of 1 m was taken from each plot, then seed yield, TGW, biological yield, harvest index, number of pods per plant, number of grains per pod, pod length, field height, and stem diameter were measured. Soxhlet was used to calculate oil percentage and Kjeldahl method was used to measure crude protein.

5. Statistical calculations

Data were analyzed in SAS software and mean comparison was performed by Duncan's multiple range test and SPSS software was used to plot the graphs and Excel software to draw graphs.

Results

1. Biological yield

Analysis of variance showed that the effect of planting date on biological yield was 1% but the effect of cultivar and interaction of cultivar and planting date on this trait was insignificant (Table 3).

The results of the mean comparison showed that planting date treatment had the highest biological yield with 1738 g / m^2 on November 10 planting date and the lowest with 549 g / m^2 on January 10 (Table 4). Delayed planting date seems to lead to poorer biological yield. Hyola 401 had the highest biological yield (Table 5) as given its higher altitude, optimum use of sunlight and higher growth rate it could produce more dry matter.

Moreover, biological yield was positively correlated with traits such as seed yield, number of pods per plant, number of grains per pod, stem diameter, plant height, pod length, oil yield, protein yield, and leaf area index at 1% probability level and with TGW at 5% probability level and negatively correlated with specific leaf area at the probability level 5% (Table 18).

Soleimanzadeh et al. (2007) reported that the biological yield of cultivars was statistically significant. This difference was in line with the increase in seed yield of the cultivars, with the strong positive correlation between the two, stating that biological yield had a significant role in increasing the seed yield of the cultivars.

2. Seed yield

The results of the analysis of variance showed that the effect of planting date treatment on seed yield was significant at 1% level, but the effects of cultivar and interaction of cultivar and planting date on this trait were insignificant (Table 3).

The results of the mean comparison showed that planting date treatments had the highest seed yield 541.42 g / m^2 on November 10 and lowest seed yield 144.33 g / m^2 belonged to the planting date on January 10 (Table 4). High seed yield in early planting was due to better and longer harvest because of available radiation, temperature and day length, which resulted in more leaf area and more dry matter production.

Furthermore, seed yield had a positive correlation with traits such as number of pods per plant, number of grains per pod, biological yield, stem diameter, plant height, pod length, oil yield, protein yield, and leaf area index at 1% and with TGW at 5 % level negative correlation at 5% with leaf specific area (Table 18).

In a study, Haj Mohammadnia Ghalibaft (1997) reported that the effect of planting date, cultivar and their interaction on yield was significant. Mendham et al. (1981) stated that delay in rapeseed planting and the negative effect on yield are well shown. Rahnama (2011) showed that Hyola 401 hybrid as a highly sustainable cultivar is recommended for cultivation in southern Iran.

Table 3: Analysis of variance of yield and yield components

Sources of changes	Degrees of freedom	Mean of squares					
		Biological yield (gr/m^2)	**Seed yield** (gr/m^2)	**Harvest index** (%)	**Number of pods per plant**	**Number of seeds per pod**	**TGW** (gr/m^2)
Replication	3	297905.2^{ns}	34870.593^{ns}	13.34^{ns}	687.583^{ns}	10.852^{ns}	0.277^{*}
Planting date	2	4541162.5^{**}	494317.194^{**}	126.197^{**}	79812^{**}	97.028^{**}	2.643^{**}
Cultivar	2	66467.03^{ns}	2181.778^{ns}	63.1^{ns}	910.083^{ns}	6.194^{ns}	0.022^{ns}
Cultivar × planting date	4	60113.82^{ns}	2953.736^{ns}	10.6^{ns}	927.583^{ns}	1.819^{ns}	0.497^{**}
Error	24	125800.576	12483.843	20.7	606.313	5.706	0.074
CV	-	33.72	35.07	15.31	13.97	9.29	7.27

ns: insignificant, Significant at the 5% probability level*, Significant at 1% probability level**

Table 4: The results of the comparison of mean yield and yield components in planting date treatment

	Biological yield(gr/m2)	**Seed yield (gr/m2)**	**Harvest index (%)**	**Number of pods per plant**	**Number of seeds per pod**	**TGW (gr/m2)**
November 10	1738.17 α	541.42 α	31 α	266.25 α	28.15 α	4.09 α
December 10	867.75 β	269.92 β	32.1 α	155.25 β	26 αβ	3.92 α
January 10	549.92 β	144.33 β	26 α	107.25 χ	22.75 β	3.21 β

Numbers with at least one letter in each column are not significantly different from Duncan's test at 5% level.

Table 5: Results of comparison of mean yield and yield components in cultivar treatment

	Biological yield(gr/m2)	**Seed yield (gr/m2)**	**Harvest index (%)**	**Number of pods per plant**	**Number of seeds per pod**	**TGW (gr/m2)**
Hyola 401	1030.75 a	303.33 a	29.1 a	170.33 a	26.5 a	3.79 a
Hyola 308	990.42 a	323.33 a	32.25 a	186.25 a	25.08 a	3.72 a
RGS003	1134.67 a	329 a	27.79 a	172.17 a	25.58 a	3.72 a

The numbers with at least one letter in each column are not significantly different from Duncan's test at 5% level.

3. Harvest index

The results of the analysis of variance showed that the effect of planting date at 1% level on harvest index was significant, but the effect of cultivars and interaction of cultivar and planting date on this trait was not significant (Table 3).

The results of the mean comparison showed that the effect of planting date, cultivar and interaction of cultivar and planting date on harvest index was insignificant (Tables 4, 5, 6). Harvest index is strongly affected by environmental changes so that in favorable climatic conditions, it is high and in unfavorable conditions, it reduces and is associated with a delay in planting.
Moreover, harvest index had a positive correlation with traits such as TGW and plant height at 5% probability level (Table 18).
Khayat and Lak (2011), Haj Mohammadnia Ghalibaft (1997) and Fallah Haki et al. (2011) stated that the harvest index decreased with delay in planting time. Planting date experiments showed that change in planting time had a significant effect on the ratio of plant dry matter to plant reservoirs. Khayat and Lak (2011) reported that the Hyola 401 hybrid was superior to other cultivars with the highest harvest index. The superiority of this hybrid over other cultivars is due to better use of this genotype in environmental conditions.

Table 6: The results of the comparison of the mean interaction of planting date and cultivar on yield and yield components

Cultivar	Planting date	Biological yield (gr.m2)	Seed yield (gr.m2)	Harvest index (%)	Number of pods per plant	Number of seeds per pod	TGW (gr.m2)
Hyola 401	**November 10**	1803 a	535 a	29.73 abc	245 b	28.75 a	4.05 abc
Hyola 401	**December 10**	725.75 c	230 bcd	32.17 ab	147 c	27.25 ab	3.76 cd
Hyola 401	**January 10**	563.5 c	145 d	25.36 cd	119 d	23.5 cd	3.55 de
Hyola 308	**November 10**	1650.5 a	535.25 a	32.21 ab	286 a	28.25 a	3.92 bc
Hyola 308	**December 10**	780 bc	271.5 bc	34.63 a	160.75 c	25.5 bc	3.87 bc
Hyola 308	**January 10**	540.75 c	163.25 cd	29.9 abc	112 de	21.5 d	3.35 e
RGS003	**November 10**	1761 a	554 a	31.06 ab	267.75 ab	28.28 a	4.3 a
RGS003	**December 10**	1097.5 b	308.25 b	29.51 bc	158 c	25.25 bc	4.12 ab
RGS003	**January 10**	545.5 c	124.75 d	22.8 d	90.75 e	23.25 cd	2.72 f

The numbers with at least one common letter in each column are not significantly different from Duncan's test at 5% level.

4. Number of pods per plant

Analysis of variance showed that the effect of planting date on number of pods per plant was significant at 1% level, but the effect of cultivar and interaction of cultivar and planting date on this trait were insignificant (Table 3).
The results of the mean comparison showed that planting date treatments had the highest number of pods per plant with 266 pods on November 10 and the lowest number of pods per plant with 107 pods belonged to December 10 planting date (Table 4). The late cultivation of Brasica napus L. caused the plant to enter the winter with poor rosette, thus damaging the flower buds. Additionally, flowering with weaker bushes was done after winter, and the number of flowers was reduced to pods.
The results of the mean comparison showed that the interaction effect of planting date and cultivar on number of pods per plant was significant at 5% Duncan test. The highest number of pods with 286 pods was related to Hyola 308 cultivar on planting date November 11, 2011, and the lowest was related to RGS003 on the planting date January 10, 2012, with 90 pods per plant (Table 6). Mean comparison results in cultivar treatment were insignificant and all cultivars were grouped in one group (Table 5).

Moreover, number of pods per plant had a positive correlation with traits such as seed yield, number of grains per pod, biological yield, stem diameter, plant height, pod length, oil yield, protein yield, and leaf area index at 1% probability level and with TGW at 5% and a negative correlation with specific leaf area at 5% probability level (Table 18).
Jafarnejadi and Rahnama (2011), Mirzaei et al. (2010), Ghobadi et al. (2006), Mozaffari (2010) and Fallah Haki et al. (2011) concluded that their planting dates and their interactions and cultivars affected the number of pods per plant and had a significant effect. Soleimanzadeh et al. (2007) reported a strong and positive correlation between pod number per plant and seed yield that shows that one of the main reasons for the increase in seed yield of the tested cultivars was increasing pod number per plant.

5. Number of grains per pod

The results of the analysis of variance showed that the effect of planting date on number of grains per pod was significant at 1% level, but the effect of cultivar and cultivar interaction and planting date on this trait was insignificant (Table 3).
The results of the mean comparison showed that planting date treatments had the highest number of grains per pod with 28 seeds on November 10 and planting date had the lowest number of grains per pod with 22 seeds on December 10 (Table 4). Delay in planting shortens the vegetative stage of the plant and thus the plant does not reach the desired leaf area index at the right time. Thus, besides reducing the value of dry matter produced at the vegetative stage, the plant cannot produce sufficient sap to fill the formed grains, especially the grains in the pods on the branch, and therefore the final number of grains decreased. On the other hand, the percentage of osteoporosis increases in late cultivation.
Additionally, the number of grains per pod has a positive correlation with traits like seed yield, number of pods per plant, biological yield, stem diameter, plant height, pod length, oil yield, protein yield and leaf area index at 1% probability level and at 5% level with TGW probability (Table 18).
Bagheri and Safahani (2010) reported a significant effect of planting date on number of grains per pod. Mirzaei et al. (2010) reported that the effect of cultivar and planting date and cultivar on number of grains per pod were statistically significant at 1% level and Hyola 401 hybrid was superior to other cultivars. Campble and Kondra (1987) stated that increasing the number of grains per pod is limited and depends more on the length of the pod, and this trait is affected by genetic structure.

6. TGW

Analysis of variance results indicated that the effect of planting date and cultivar interaction and planting date on TGW were significant at 1% level, but the effect of cultivar treatment on this trait was insignificant (Table 3).
The results of the mean comparison showed that the highest TGW with 4.09 g belonged to November 10 planting date that was statistically (a) grouped with December 10 planting date and the lowest TGW with 3.21 g belonged to January 10 of planting date (Table 4). Moreover, in the interaction of cultivar and planting date, the highest TGW with 4.3 g belonged to planting date of November 20 in RGS003 and the lowest TGW with 2.72 g belonged to planting date of 10th January in RGS003 (Table 6).
It seems that the late planting of Brasica napus L. causes the plant to enter the winter with poor rosette, resulting in damage to the plants due to winter cold.
Moreover, TGW has a positive correlation with traits like plant height and pod length at 1% probability level with seed yield, number of pods per plant, number of grains per pod, biological

yield, harvest index, stem diameter, oil yield, protein yield and leaf area index at 5% probability (Table 18).

Anvari (1997) stated that delay in planting reduces TGW, but their difference was insignificant. Khayat and Gohari (2009) reported that the effect of genotype on TGW was significant at 1% level so that Hyola 401 hybrid had the highest TGW among hybrids. Faraji (2003) reported that the high TGW of Hyola hybrids compared to other cultivars is related to the genetic potential of this genotype in producing larger seeds.

7. Oil percentage

The results of analysis of variance showed that the effect of cultivar on oil percentage was significant at 1% level, but the effect of planting date and interaction of cultivar and planting date had no significant effect (Table 7).

The results of the mean comparison showed that the highest oil percentage (48.92%) belonged to Hyola 401 and the lowest (44.17%) to Hyola 308 (Table 9). Studies have indicated that the percentage of seed oil is high heritability, partly affected by environmental conditions.

Oil percentage was not only positively correlated with other traits but negatively correlated with leaf chlorophyll content at 5% probability level (Table 18).

Sadat Mohajerani et al. (2010) stated that the effect of planting date on seed oil percentage was insignificant. Javanmard et al. (2007), Salehi et al. (2010), Ebrahimi et al. (2012) argued that the difference between the tested cultivars in terms of oil percentage was significant at 1% probability level.

Table 7: Analysis of variance of qualitative traits

Sources of changes	Degrees of freedom	Mean of squares			
		Oil percentage	**Oil yield**	**Protein percentage**	**Protein yield**
Replication	3	56.92**	5952.5νσ	21.8**	423.2νσ
Planting date	2	2.53νσ	91771.7**	0.00νσ	15999.7**
Figure	2	67.86**	724.7νσ	37.3**	310.33νσ
Number 2 planting date	4	0.86νσ	2282.5νσ	2.6νσ	264.33νσ
Error	24	4.083	4226.856	4.264	499.039
CV	-	4.35	45.73	11.31	39.19

ns: insignificant, Significant at the 5% probability level*, Significant at 1% probability level**

Table 8: The results of the comparison of mean qualitative traits in planting date treatment

	Oil percentage	Oil yield	Protein percentage	Protein yield
November 10	47 α	237.58 α	18.25 α	97.25 α
December 10	46.17 α	123.08 β	18.25 α	47.75 β
January 10	46.25 α	65.83 β	18.25 α	26 β

The numbers with at least one letter in each column have no significant differences with Duncan's test at 5% level.

Table 9: Comparison results of mean quality traits in cultivar treatment

	Oil percentage	Oil yield	Protein percentage	Protein yield
Hyola 401	48.92 α	149.58 α	20.25 α	62.83 α
Hyola 308	44.17 β	142.83 α	16.92 β	54.67 α
RGS003	46.33 αβ	134.08 α	17.58 β	53.5 α

The numbers with at least one letter in each column have no significant difference with Duncan's test at 5% level.

Table 10: Comparison results of mean interaction between planting date and cultivar on qualitative traits

Cultivar	Planting date	Oil percentage	Oil yield	Protein percentage	Protein yield
Hayula 401	**November 10**	49.75 a	268.5 a	20.75 a	113.5 a
Hayula 401	**December 10**	48.25 ab	110.5 bc	20.5 a	47.25 cd
Hayula 401	**January 10**	48.75 a	69.75 c	19.5 ab	27.75 cd
Haila308	**November 10**	44.75 cde	240 a	17.25 cd	90.75 b
Haila308	**December 10**	44.25 de	118.5 bc	16.75 d	46.25 cd
Haila308	**January 10**	43.5 e	70 c	16.75 d	27 cd
RGS003	**November 10**	46.5 bc	204.25 a	16.75 d	87.5 b
RGS003	**December 10**	46 cd	140.25 b	17.5 cd	49.75 c
RGS003	**January 10**	46.5 bc	57.75 c	18.5 bc	23.25 d

The numbers that have at least one letter in each column have no significant difference with Duncan's test at 5% level.

8. Oil yield

The results of the analysis of variance showed that planting date treatment had a significant effect on oil yield at 1% level, but cultivar interaction and cultivar interaction and planting date had no significant effect (Table 7).

The results of mean comparison showed that planting date had the highest oil yield with 2737.58 for planting date November 10 and lowest with 65.83 to December 10 (Table 8).

As the evidence shows, factors affecting grain yield are a determinant of oil yield, and improved nutrition and climate conditions will increase grain yield and increase oil yield, since under this study oil percentage influence of sowing date and interaction of sowing date and cultivar did not affect seed yield is the main factor in determining oil yield.

Moreover, oil yield had a positive correlation with traits like seed yield, number of pods per plant, number of grains per pod, biological yield, stem diameter, plant height, pod length, protein yield, and leaf area index at 1% probability level and at 5% probability with TGW and had a negative correlation with the specific leaf area at 5% probability level (Table 18).

Bagheri and Safahani (2010) stated that the effect of planting date on oil yield was significant at 1% level. Pasban (2009) found a positive and significant correlation between seed yield and oil yield, but the correlation between seed oil percentage and oil yield was weak.

9. Protein percent

The results of the analysis of variance showed that the effect of cultivar on protein percentage was significant at 1% level, but planting date and interaction of cultivar and planting date had no significant effect on this trait (Table 7).

The results of the mean comparison showed that Hyola 401 had the highest protein content (20.52%) and Hyola 308 had the lowest protein content (16.92%) that was statistically grouped in group (b) with RGS003 (Table 9).

Delay in planting to increase protein percentage is not recommended at all, but as there was no heat stress at the end of the planting period, protein percentage did not become a function of planting date, and Hyola 401 could obtain the highest protein likely to have high heritability. This trait was only positively correlated with oil percentage at the 1% probability level (Table 18).

Fallah Haki et al. (2011) stated that the effect of planting date on protein percentage of the seed was significant. Robertson et al. (2004) stated that delay in planting increased seed protein content and decreased oil percentage that was because of the increase in late season temperatures.

10. Protein yield

The results of the analysis of variance showed that the effect of planting date treatment on protein yield was significant at 1% level, but cultivar interaction and cultivar interaction and planting date did not have any significant effect on this trait (Table 7).

The results of the mean comparison showed that planting date treatments had the highest protein yield (97.25) at planting date November 10 and lowest at 26 planting date of 10th January (Table 8).

Protein yield decreased with delay in planting but the percentage of protein was not a planting date function. Hence, it was found that protein yield changes were mainly seed yield function and protein percentage had little effect on that.

Additionally, protein yield had a positive correlation with traits like seed yield, number of pods per plant, number of grains per pod, biological yield, stem diameter, plant height, pod length, oil yield and leaf area index at 1% probability level and at 5% with TGW and a negative correlation with the specific leaf area at 5% probability level (Table 18).

In this study, delay in plating, seed yield reduced and protein percentage increased. Robertson et al. (2004) reported that delay in planting, protein yield decreased due to a decrease in seed yield.

11. Stem diameter

The results of the analysis of variance showed that the effect of planting date on stem diameter was significant at 1% level, but cultivar and interaction of cultivar and planting date had no significant effect on this trait (Table 11).

The results of the mean comparison showed that the highest stem diameter (1.58 cm) belonged to November 10 planting date and the lowest (0.67 cm) planting date was January 10 (Table 12).

It seems that stem diameter in rapeseed is usually subject to plant density per unit area and is less affected by planting date and environmental conditions but rapeseed planting date November 10 had the chance to perform environmental conditions (radiation, temperature, and so on). Using enough photosynthesis and production of sap to produce stronger organs than other cultivation dates, which eventually lead to greater yield.

Moreover, stem diameter had a positive correlation with traits like seed yield, number of pods per plant, number of grains per pod, biological yield, plant height, pod length, oil yield, protein yield, and leaf area index at 1% probability level and at 5% with TGW a negative correlation with specific leaf area at 5% probability level (Table 18).

Sali et al. (2007) found that stem diameter was not affected by any of the treatments and experimental treatments had no significant effect on this trait. As stem diameter in rapeseed depends on plant density per unit area, it seems that there was no significant difference between cultivars or planting at different dates due to the uniformity of density in the experimental field.

Table 11: The results of the analysis of variance of morphological and chlorophyll traits

Sources of changes	Degrees of freedom		Mean squares		
		Stem diameter	Plant height	Pod length	Chlorophyll
Replication	3	0.037*	138.56νσ	0.082νσ	0.061νσ
Planting date	2	2.77**	3496.7**	3.57**	0.23νσ
Cultivar	2	0.004νσ	11.03νσ	0.07νσ	0.63*
Cultivar × planting date	4	0.013νσ	25.61νσ	0.16νσ	0.04νσ
Error	24	0.011	52.014	0.118	0.131
CV	-	10.35	6.81	5.21	8.43

ns: insignificant, Significant at the 5% probability level*, Significant at 1% probability level**

Table 12: The results of comparison of mean morphological and chlorophyll traits in planting date

	Stem diameter	Plant height	Pod length	Chlorophyll
November 10	1.58 α	120.3 α	7.09 α	0.5 α
December 10	0.86 β	110.4 α	6.66 α	0.23 α
January 10	0.67 χ	87.1 β	6.01 β	0.42 α

The numbers that have at least one letter in each column have no significant difference with Duncan's test at 5% level.

Table 13: The results of comparison of mean morphological and chlorophyll traits in cultivar treatment

	Stem diameter	Plant height	Pod length	Chlorophyll
Hyola 401	1.05 α	106.9 α	6.67 α	0.17 α
Hyola 308	1.04 α	105.9 α	6.56 α	0.62 α
RGS003	1.01 α	105 α	6.52 α	0.37 α

The numbers that have at least one letter in each column have no significant difference with Duncan's test at 5% level.

Table 14: The results of comparison of mean interaction between planting date and cultivar on morphological and chlorophyll traits

Cultivar	**Planting date**	Stem diameter	Plant height	Pod length	Chlorophyll
Hyola 401	**November 10**	1.65 α	118 αβ	6.97 αβ	0.3 βχ
Hyola 401	**December 10**	0.81 δ	112.5 βχ	6.8 βχ	0.1 χ
Hyola 401	**January 10**	0.68 ε	90.25 δ	6.25 δ	0.1 χ
Hyola 308	**November 10**	1.53 β	122 α	7.3 α	0.7 α
Hyola 308	**December 10**	0.93 χ	110 χ	6.5 χδ	0.5 αβ
Hyola 308	**January 10**	0.67 ε	85.75 δ	5.87 ε	0.67 αβ
RGS003	**November 10**	1.55 αβ	121 α	7 αβ	0.5 αβ
RGS003	**December 10**	0.83 χδ	108.75 χ	6.67 βχ	0.1 χ

RGS003	**January 10**	0.65 ε	85.25 δ	5.9 ε	0.5 αβ

The numbers with at least one letter in each column have no significant difference with Duncan's test at 5% level.

12. Plant height

The results of the analysis of variance showed that the effect of planting date on plant height was significant at 1% level, but cultivar and cultivar interaction and planting date had no significant effect on this trait (Table 11).

Mean comparison results showed that the highest plant height (120.3 cm) belonged to the planting date of November 10 and the shortest (87.1 cm) to January 10 of planting date (Table 12).

It seems that the delay in planting and shortening the growth period makes the plant not have enough time to store food and consequently decreases plant height and on the other hand, early planting starts to produce strong seedlings and consequently long for better posture as well as for winter.

Moreover, plant height had a positive correlation with traits like seed yield, TGW, number of pods per plant, number of grains per pod, biological yield, pod length, stem diameter, oil yield, protein yield and leaf area index at 1% probability level and at 5% probability level with harvest index (Table 18).

Pasban (2009) reported that the plants from the first planting date were taller than the later planting date.

Mozaffari (2010) showed that plant height was significantly different at the tested planting date and cultivar at 1% probability level. The plants planted on 22 October and early were taller than the late planting date, November, which is due to strong seedlings production and better establishment for wintering on 22 October.

13. Pod length

The results of analysis of variance showed that the effect of planting date treatment on pod length was significant at 1% level, but cultivar interaction and cultivar interaction and planting date had no significant effect on this trait (Table 11).

Mean comparison results showed that the largest pods with 7.09 cm belonged to the planting date of November 10 and the lowest with 6.01 cm to 10th January (Table 12).

According to the reposts by other researchers, pod length in rapeseed is one of the cultivar-dependent traits less affected by agronomic factors and cultivars with longer pod lengths produce fewer pods per plant. Moreover, in contrast to cultivars with smaller pods, they produce more pods per plant, but in this experiment, pod length was affected by planting date, and sooner dates produced longer pod lengths. Additionally, according to the researchers, although pod length has no significant effect on yield increase, plants producing longer pod lengths have more yield as well.

Moreover, pod length was positively correlated with traits such as seed yield, TGW, number of pods per plant, number of grains per pod, biological yield, plant height, stem diameter, oil yield, protein yield, and leaf area index at 1% probability level (Table 18).

Varseh et al. (2011) reported that the comparison of mean interaction effect between planting season and cultivar showed that Option 500 cultivar in autumn planting season (October 1, 2008) with mean 6.65 cm had the highest and Sarigol cultivar in winter planting season (February 28, 2009) had the lowest pod length with an average of 4.8 cm.

14. Leaf chlorophyll

The results of the analysis of variance showed that the effect of cultivar on leaf chlorophyll was significant at 5% level, but planting date and interaction of cultivar and planting date had no significant effect on this trait (Table 11).

Comparison of results showed no significant effect of cultivar, planting date and interaction of planting date and cultivar on leaf chlorophyll content (Tables 12, 13, 14).

As elements like nitrogen, iron, and magnesium have a critical role in the chlorophyll structure, early cultivation, given the longer growth period and greater leaf area index has a greater chance of producing chlorophyll and seems that the supply of these elements is the main reason for the increase in leaf chlorophyll.

Moreover, this trait was not only not positively correlated with other traits but also negatively correlated with oil percentage at the 5% probability level (Table 18).

Gilani et al. (2009) reported that chlorophyll contents of rice were completely affected by planting date and the first planting date produced the highest chlorophyll. There was a significant difference between the hybrids in terms of chlorophyll contents at a probability level of 1%.

15. Leaf Area Index (LAI)

The results of the analysis of variance showed that planting date treatment was significant at 1% level, but cultivar and cultivar interaction and planting date had no significant effect (Table 15).

Mean comparison results showed that in planting date treatments, the highest LAI (3.39) belonged to November 10 planting and lowest (0.16) to January 10 (Table 16).

LIA is one of the most significant indices for determining plant growth and the changes in rapeseed LAI at different planting dates show that LAI development in rosette before planting was more than normal planting. Delayed cultivation is more than twice as much, but leaf area index development after the shoot stage has been more intense in delayed cultivation than usual cultivation. More leaves have more seed yield as well as they could use sunlight more efficiently with higher leaf area, and based on the regression line equation of these three cultivars, it was found that Hyola 401 with 1.6 line slope had faster LAI changes compared to other cultivars (Figure 1).

Moreover, LAI was positively correlated with traits such as seed yield, number of pods per plant, number of grains per pod, biological yield, plant height, pod length, stem diameter, oil yield and protein yield at 1% probability level with TGW at 5% and negatively correlated with the specific leaf area at 5% the probability level (Table 18).

Fernia et al (2011), Khayat and Gohari (2009) reported that LAI was significantly (at 1% level) affected by planting date levels.

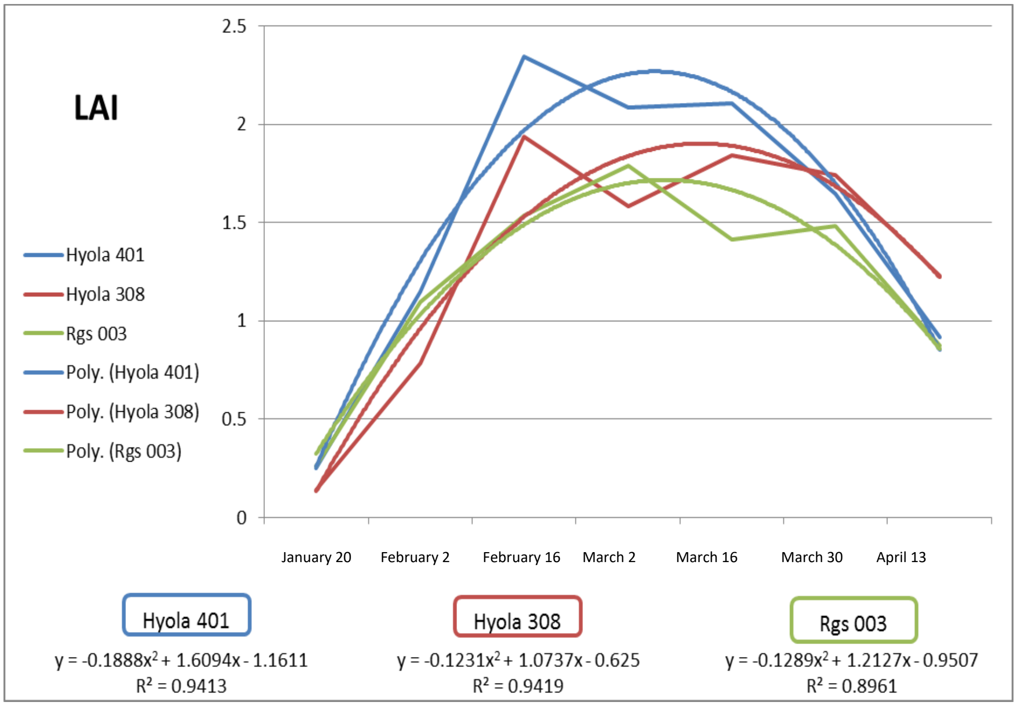

Figure 1: Diagram of LAI

Table 15: The results of the analysis of variance of physiological traits

				Mean squares		
Sources of changes	Degrees of freedom	LAI	CGR	LAD	SLA	RGR
Replication	3	ns0.2	ns 287	ns 1324713582	ns 19167	ns 17512
Cultivar	2	ns0.33	ns529	ns1270628128	ns15749	ns18172
Planting date	2	28**	** 7763	ns3730550132	* 242702	** 247657
Cultivar × planting date	4	Ns 0.23	ns337	ns2910815477	ns45305	ns19286
Error	24	0.24	605	3829474038	61432	15563
CV%		6.8	8.2	10.8	7.9	7.5

ns: insignificant, Significant at the 5% probability level*, Significant at 1% probability level**

Table 16: The results of comparison of mean of some physiological traits in planting date treatment

	LAI	CGR	SLA	RGR	Lad
November 10	3.39 a	53.9 a	573 a	593 a	263313 a
December 10	1.34 b	9.8 b	479 b	503 b	262111 a
January 10	0.41 c	9.8 b	293 c	311 c	262458 a

The numbers that have at least one letter in each column have no significant difference with Duncan's test at 5% level.

Table 17: The results of the comparison of the mean of some physiological traits of the cultivars

	LAI	CGR	SLA	RGR	Lad
Hyola401	1.5 a	28 a	411 a	476 a	132414 a

Hyola308	1.8 a	27 a	420 a	468 a	131145 a
RGS003	1.8 a	27 a	411 a	470 a	130115 a

The numbers that have at least one letter in each column have no significant difference with Duncan's test at 5% level.

16. Crop Growth Rate (CGR)

Analysis of variance showed that planting date treatment was significant at 1% level, but cultivar and cultivar interaction and planting date had no significant effect (Table 15).

The results of the mean comparison showed that the highest CGR with 53.9 g/m² belonged to the planting date November 10 and the lowest CGR with 9.8 g/m² to planting date of December 10 and 10 January (Table 16).

CGR was slow in the early stages of growth because of incomplete vegetation cover, low light absorption percentage, short days and low ambient temperature. However, dry matter production per unit area increased after the rosette stage with an increase in LAI, increased radiation intensity, temperature and better sunlight yield. Consequently, CGR increased and reached its maximum value at flowering time, with maximum leaf area index at this time. When the plant had reached its final growth stage, CGR decreased quickly due to shading of the upper limbs on the leaves and decreasing photosynthetic and aging and shedding power. CGR showed an increase again as pods began to grow and pod growth rate decreased as pods approached maturity. According to the Crop Growth Index (CGR) linear regression equation of these three cultivars, it was shown that RGS003 with slope of 10.8 had a faster rate of change compared to other cultivars (Figure 2).

Arvin et al. (2009) found no significant differences between cultivars in maximum CGR.

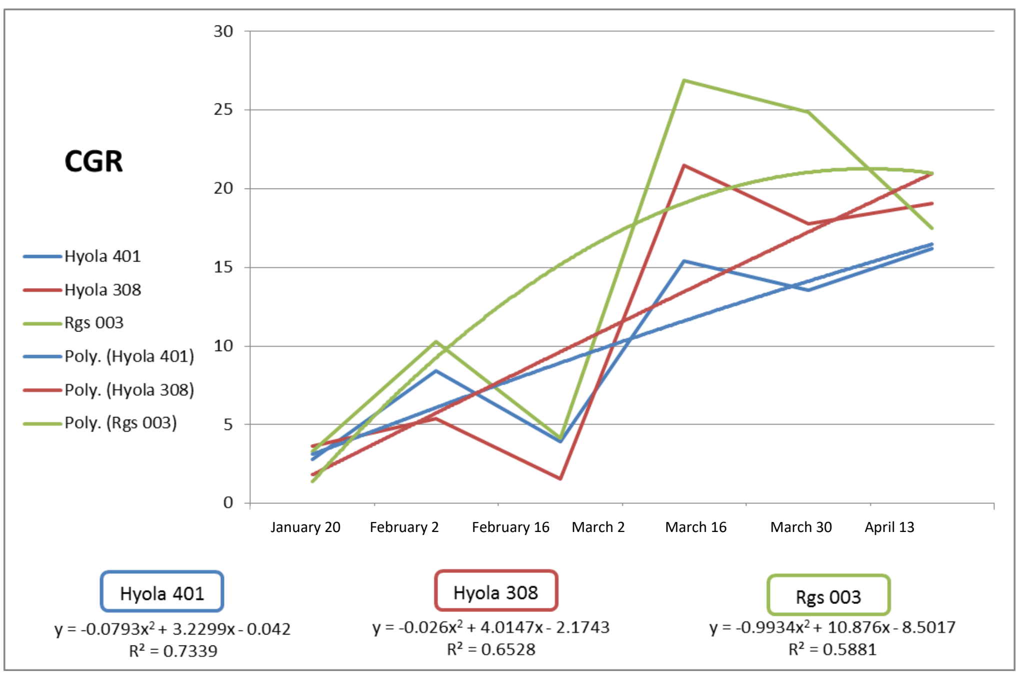

Figure 2: CGR (g / m ² / day) Graph

17. Relative Growth Rate (RGR)

The results of the analysis of variance showed that planting date treatment was significant at 1% level, but cultivar and cultivar interaction and planting date had no significant effect (Table 15).

The results of the mean comparison showed that the highest RGR with 593 g / g day belonged to November 10 and the lowest with 311 g / day to January 10 (Table 16).
In early growth stages and before stemming, as all dry matter is due to leaf production, RGR is high during this time (early stages of growth) and after this stage, it reduces because of increased structural texture and reduced production efficiency. Besides aging, shading of lower leaves and a decrease in their photosynthetic activity are other reasons for the slow RGR. As RGR is obtained from the natural logarithm of the dry matter over time, RGR is equal to zero when the total dry matter is at its maximum value.
According to RGR linear regression equation of these three cultivars, it was found that RGS003 with 20.32 slopes had more changes compared to other cultivars (Figure 3).
Anafcheh et al. (2011) found that in the early stages of growth and prior to stemming, as all dry matter is the result of leaf production, RGR at this time (early stages of growth) is high and reduces after this stage due to the increase in building texture and decrease in production efficiency.

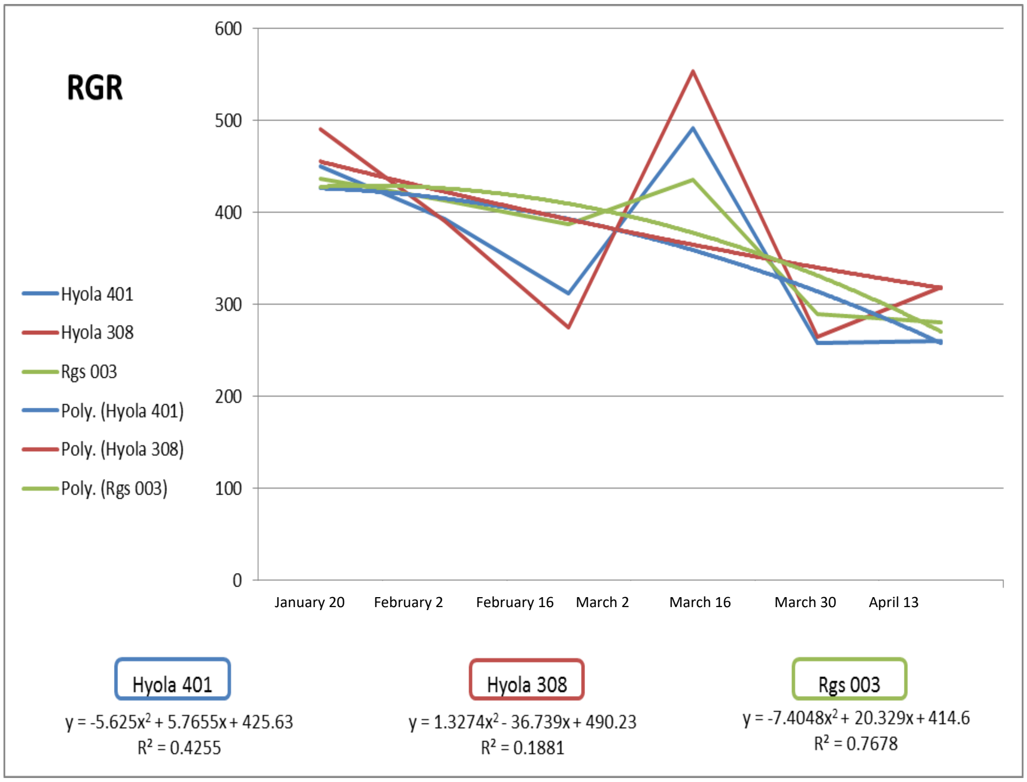

Figure 3: RGR (g / g / day) graph

18.4. Specific Leaf Area (SLA)

The results of the analysis of variance showed that planting date treatment was significant at 5% level, but cultivar interaction and cultivar interaction and planting date had no significant effects (Table 15).
Mean comparison results showed that in the planting date treatments, the highest SLA with 573 cm^2/g belonged to the first planting date and the lowest with 293 cm^2/g to the third planting date (Table 16).
According to SLA linear regression equation of these three cultivars, it was found that Hyola 308 with slope 411.19 had a faster rate of change compared to other cultivars (Figure 4).

Moreover, this trait was negatively correlated with traits such as seed yield, number of pods per plant, biological yield, stem diameter, oil yield, protein yield and LAI at 5% probability level (Table 18).

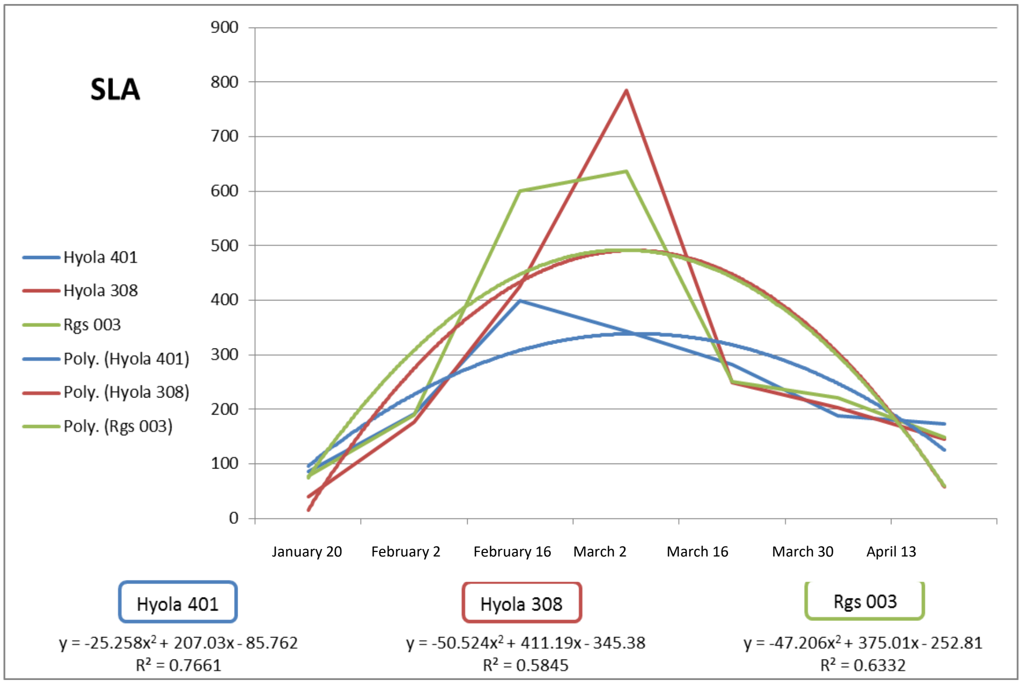

Figure 4: SLA (cm^2 / g)

19. Leaf Area Durability (LAD)

The results of the analysis of variance showed that treatments of planting date, cultivar and interaction of cultivar and planting date had no significant effects on this trait (Table 15).

According to LAD linear regression equation of these three cultivars, it was found that Hyola 308 with the slope of 146086 had a faster rate of change compared to other cultivars (Figure 5).

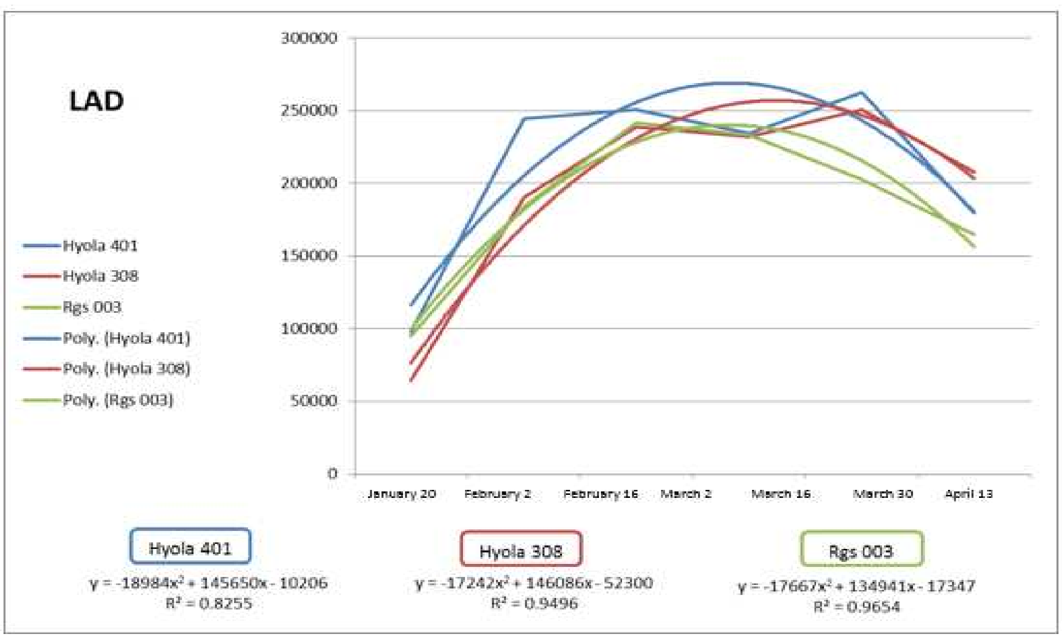

Figure 5: LAD (cm^2 / day) graph

Table 18: Correlation between the traits

	Pod per plant	Seed per pod	TGW	Yield	Biological yield	Harvest index	Stem diameter	Plant height	Pod length	Chlorophyll	Oil percentage	Oil yield	Protein percent	Protein yield	LAI	Special leaf surface
Pod per plant	1															
Seed per pod	0.875**	1														
TGW	0.756*	0.732*	1													
Yield	0.987**	0.873**	0.761*	1												
Biological yield	0.962**	0.856**	0.729*	0.990**	1											
Harvest index	0.521	0.514	0.697*	0.483	0.371	1										
Stem diameter	0.970**	0.865**	0.668*	0.981**	0.974**	0.418	1									
Plant height	0.893**	0.954**	0.856**	0.885**	0.843**	0.702*	0.834**	1								
Pod length	0.908**	0.950**	0.815**	0.882**	0.853**	0.589	0.836**	0.968**	1							
Chlorophyll	0.263	0	0	0.232	0.172	0.192	0.273	0	0	1						
Oil percentage	0.083	0.376	0.122	0.118	0.2	0	0.191	0.147	0.227	-0.716*	1					
Oil yield	0.950**	0.881**	0.720*	0.971**	0.972**	0.452	0.969**	0.867**	0.881**	0.154	0.221	1				
Protein percent	0	0.247	0	0	0	0	0.013	0.018	0.101	0	0.899**	0.086	1			
Protein yield	0.940**	0.894**	0.707*	0.966**	0.969**	0.432	0.979**	0.857**	0.861**	0.133	0.289	0.992**	0.145	1		

LAI	0.984**	0.873**	0.672*	0.978**	0.966**	0.441	0.980**	0.857**	0.891**	0.27	0.145	0.974**	0.002	0.965**	1	
Special leaf surface	-0.734*	-0.376	-0.494	-0.723*	-0.726*	-0.184	-0.743*	-0.399	-0.467	-0.385	0.001	-0.691*	0.201	-0.684*	-0.732*	1

** Significance at 1% probability level * Significance at 5% probability level

Conclusion

The results indicated that genotypes did not differ significantly in seed yield and planting date affected yield and November plating had the maximum seed yield. Planting dates of December and January ranked next and although yield differences were not significant, RGS 003 produced 5540 kg / ha seed yield in November which was slightly higher than the other two cultivars. Nonetheless, in terms of oil content, the difference was significant between the cultivars, with the highest oil percentage and oil yield produced by Hyola 401 at the planting date of December 48.92% and 149.58%, respectively. As oil percentage and seed yield are of the most significant economic factors in the production of rapeseed, Hyolla 401 cultivar planted on November 10 is better and recommended based on this experiment.

References

1. Fanaei, H.R., Galavi, M., Ghanbari Bongar, A., Solouki, M., & Naruoei-Rad, M.R. (2008). Effect of planting date and seeding rate on seed yield and yield components in two rapeseed (Brassica napus L.) cultivars under Sistan conditions. *Iranian J. Crop Sci. 10*(2): 15-30.
2. Robertson, M.J., Holland, J.F., & Bambach, R. (2004). Response of rapeseed and Indian mustard to planting date in the grain belt of north-eastern Australia. Aust. *Expt. J. Agric*. 44: 43-52.
3. Yamaguchi-Shinozaki, K., Kasuga, M., Liu, Q., Nakashima, K., Sakuma, Y., Abe, H., & Shinwari, Z. K., (2002). Biological mechanisms of drought stress response. *Japan International Research Center for Agricultural Sciences (JIRCAS) Working Report*. 23: 1–8.
4. Ebrahimi, M., Akbari, G., Akbari, G., & Samadi Firouzabad, B. (2012). The Effect of Planting Date on Yield and Yield Components of Rapeseed Cultivars in Varamin Region, Journal of Seed and Plant Improvment, Volume 28-2, Number 1.
5. Omidian, A.S., Siyadat, R., Naseri, V., & Moradi, M. (2012) Effect of Zinc Sulfate Spraying on Yield, Oil Content and Seed Protein of Four Rapeseed Cultivars. Iranian Journal of Crop Sciences 14 (1): 16-28.
6. Anvari, M.T. (1997) Effects of Planting Date on Yield and Yield Components of Rapeseed Cultivars. Gorgan University of Agricultural Sciences and Natural Resources.
7. Azeri, A.S., Modarres Sanavi, A.M., Askari, F., Ghanati, A., Naji, V., M. & Alizadeh, B. (2012). Effect of salinity stress on morphological and physiological traits of rapeseed and rapeseed oilseed, *Iranian Journal of Crop Sciences, 14* (2) 121-135.
8. Aeen, A. (2005). Evaluation and Comparison of Yield of Advanced Rapeseed Cultivars in Jiroft Region. *Journal of Research and Construction in Agriculture and Horticulture, 77*, 120 to 124.
9. Bagheri, M., & Safahani, A. (2010). Effect of planting date and plant density on quantitative and qualitative traits of two rapeseed cultivars. Journal of Plant Behavioral Sciences, Second Year, No. 4.
10. Pasban, A. (2009) Comparison of yield of rapeseed autumn cultivars at different planting dates. Journal of Agricultural Research, Islamic Azad University, Tabriz Branch, Third Year, No. 10.

11. Pezeshkpour, P., Ahmadi, A., & Daneshvari, M. (2005). The Effect of Planting Date on Yield on Seed Yield Components and Leaf Chlorophyll Index and Light Infiltration in Plant Shading, First National Conference on Beans Research Institute, Ferdowsi University of Mashhad.
12. Jafarnejadi, A., & Rahnama, A. (2011). Investigation of the Effect of Delay in Planting on Rapeseed Yield and Nitrogen Use Efficiency, *Journal of Soil Research (Soil and Water Sciences) / a / 25*(3).
13. Javanmard, H., Shiranirad, A.H., Banitaba, S., & Naderi Darbaghshahi, M. (2007) Investigation of the Effect of Planting Date on Yield and Yield Components of Spring Rapeseed Cultivars in Isfahan Region, *New Agricultural Findings, 2*(1).
14. Haj Mohammadnia Ghalibaft, K. (1997). The Effect of Planting Date on Growth, Yield and Limited Components of Autumn Rapeseed Cultivars in Tabriz Environmental Conditions. Master thesis. Tabriz University, Faculty of Agriculture.
15. Khayyat, M. & Lak, Sh. (2011). Evaluation of Seed Yield, Leaf Area Index and Percentage Changes of Spring Rapeseed Cultivars in Early and Late Planting Date in Iran, Journal of Crop Physiology - Islamic Azad University - Ahvaz Branch - Vol. 12, No. 12.
16. Khayat, M., & Gohari, M., (2009) Effect of planting date on yield, yield components, growth indices and phenological traits of rapeseed genotypes in Ahwaz. *New Agricultural Findings, 3*(3).
17. Sadat Mohajerani, Sh., Madani, H., Naderi Darbaghshahi, M., & Shaabzadeh, P. (2010). Response of Different Rapeseed Cultivars to Delay in Planting Time in Arak, Fifth National Conference of New Ideas in Agriculture, Islamic Azad University, Khorasgan Branch, Isfahan, Iran.
18. Sali, A., Madani, H., & Shiranirad, A.H. (2007) Investigation of the Response of Rapeseed Cultivars to Delayed Cultivation under Karaj Climatic Conditions, *New Agricultural Findings, 1*(3).
19. Soleimanzadeh, H., Latifi, N., & Soltani, A. (2007). The Relationship between Phenology and Physiological Traits with Seed Yield in Different Rapeseed (Brassica napus L.) Cultivars under Dryland Conditions, *Journal of Agricultural Sciences and Natural Resources, 14*(5).
20. Saheb Mohammadi, V. (1991) Evaluation of Yield of 14 Rapeseed Cultivars in Dezful Weather Conditions, Oil Seed Development Institute.
21. Salehi, B., Mohammadi, J., & Khodadadi, M. (2010) Investigation of Cultivar, Density and Planting Arrangement on Yield and Yield Components of Rapeseed Autumn Cultivars, *Journal of Modern Sustainable Agriculture, 6*(20).
22. Anafjeh, Z., Alemi Saeed, Kh., Fathi, Gh., Gharineh, M.H., & Chaab A. (2011). Investigation of Growth Indices and Estimation of Economic Damage Threshold of Rapeseed Seed in Response to Different Rapeseed and Wild Mustard Seeds, *Iranian Journal of Crop Research, 9*(1), 1- 11.
23. Fernia, A. Karimi, K. & Jalilian, A. (2011). The Influence of Planting Date on Seed Yield and Important Traits of New Early Maize Cultivars in Temperate Areas of Kermanshah Province, First National Conference on Modern Agriculture in Islamic Azad University, Saveh Branch.
24. Fallah Haki, M., Yadvi, A., Movahedi Dehnavi, M., & Balouchi, H. (2011). Investigation of Oil, Protein and Seed Yield of Rapeseed Cultivars in Different Yields in Yasuj Region, *Electronic Journal of Crop Production Fourth Edition,* Issue 2, 222-207.
25. Gilani, A.A. Siyadat. Kh., Alemi Saeed, A., Bakhshandeh, F., Moradi, V., & Seyyednejad, M. (2009). Effect of Heat Stress on Yield Stability, Chlorophyll Content and Stability of Flag Leaf Cell Membrane in Common Rice Cultivars in Khuzestan Province. *Iranian Journal of Crop Sciences. 11* (1): 100-82.
26. Mozaffari, S., Predashti. M., Ismaili, A., Ramee, A. Heidarzadeh, V., & Mostafia, R. (2010). The Effect of Planting Date and Resource and Reservoir Restriction on Seed yield and Yield Components of Three Rapeseed (Brassica napus L.) Cultivars of Iran. 12 (4) 482- 498.

27. Nabavi Mahalli, A. (2007). *The effect of planting date on yield, yield components and growth characteristics of three autumn rapeseed cultivars in Mashhad*. Master thesis. Ferdowsi University of Mashhad, Faculty of Agriculture.
28. Varseh, H., Shiranirad, A, H. Nour Mohammadi, Gh., Delkhosh, B., & Varseh, B. (2011). Effect of Planting Season and Drought Stress on Quantitative Characteristics and Quality of Advanced Rapeseed Cultivars, *Journal of Crop Ecophysiology*, *3* (1).