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# Evaluation of the Planting Dates Effects on Yield and Yield Associated Traits in Rapeseed Advanced Lines

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***Abstract* – In order to study the effects of the planting date on the plant height, yield components and seed yield of the spring breeding lines and cultivars of rapeseed, an experiment was conducted in the form of split plots based on randomized complete block design with three replications at the Baykola Agriculture Research Station during the 2010 and 2011 cropping seasons. Four planting dates including Oct 19 (D1), Oct 30 (D2), Nov 9 (D3) and Nov 19 (D4) were considered as the main factors and five rapeseed genotypes viz. L10 (G1), Sarigol (G2), L7 (G30), L4 (G4) and Hyola401 (G5) were detected as sub factors. Results of the analysis of the variance on the basis of the split plot design showed that the planting dates mean squares were significant for all the traits except seeds per pod. Genotypes had significant differences for all the traits except pods per plant. The interaction effects of the planting date and the genotypes (D ×G) mean squares were not significant for pods per plant, 1000-seed weight and seed yield, which indicating similar trends of change for these traits in the genotypes in response to different planting dates. In all of the cultivars, there was considerable deterioration in most of the traits as a result of delays in planting dates. All yield components had significant positive correlation with seed yield, which indicated that these traits and seed yield were affected in the same way by different planting dates. In general, the high means value of seed yield were belonged to G1 and G5 (3972.22 and 3638.89 Kg.ha$^{-1}$, respectively) when planted at the earliest planting date.**

**Keywords – breeding lines, correlation, main factors, rapeseed, yield components.**

## I. Introduction

Rapeseed (*Brassica napus* L.) is a valuable oil seed that has attracted the attention of many people in recent years. Determining suitable planting date has important role in conformation of plant growth stages with desirable environmental conditions which results in maximum yield. Planting date has a important effect on seed yield by influencing the yield components, therefore late planting decreases the most important traits i.e. days to flowering, duration of flowering, plant height and pods per plant which cause a remarkable reduction in seed yield [18, 20]. Fathi *et al*. [4] reported that seed yield decreased with delay in sowing date. Also Taylor and Smith [20] concluded that seed yield declined when sowing date is delayed. Johnson *et al*. [6] evaluated three canola cultivars at four sowing dates and found that seed yield was the highest at the first two sowing dates. Kirkland and Johnson [18] stated that seed yield was greater in the early sowing dates and smaller in the later sowing dates. Ozer [13] 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. Development of ideotype varieties with minimum reduction of yield components and seed yield in different environmental conditions such as planting dates is an imperative goal of rapeseed breeders. Seed yield is a complex character that can be determined by several components reflecting positive or negative effects upon this trait, whereas it is important to inspect the contribution of each of the various components in order to give more concentration to those having the greatest influence on seed yield [1, 2, 3, 7, 9, 10]. Therefore, knowing the relationship among the quantitative traits with the seed yield in different environmental conditions make breeding programs and their success more optimistic and secure [11, 12, 15]. In experiment with nine summer rapeseed cultivars, Chango and McVetty [3] observed that total dry matter and harvest index had a significant correlation with grain yield, but there was no correlation between chlorophyll or water use efficiency. Ali et al. [1] 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 [5, 7, 8, 16, 17]. Also a significant correlation was observed between pod number per plant and seed yield in species of *B. napus* and *B. juncea* [21]. 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 [22]
The objectives of the present study were to determine the planting date effects on yield associated traits and also to estimate the correlation between the traits to identify suitable selection criteria based on correlation analysis.

## Materials and Methods

In order to evaluation of planting dates effects on plant height, seed yield and yield associated traits in rapeseed varieties, a split-plot experiment based on randomize complete block design with three replications was conducted at the Baykola Agriculture Research Station located in Neka, Iran (53˚, 13′ E longitude and 36˚ 43′ N latitude, 15 m above sea level) during the 2010 and 2011 cropping seasons. Four planting dates including Oct 19, Oct 30, Nov 9 and Nov 19 were considered as the main factors and five rapeseed genotypes viz. L10 (G1), Sarigol

(G2), L7 (G30), L4 (G4) and Hyola401 (G5) were detected as sub factors. The soil was classified as a deep loam soil (Typic Xerofluents, USDA classification) contained an average of 280 g clay $kg^{-1}$, 560 g silt $kg^{-1}$, 160 g sand $kg^{-1}$, and 22.4 g organic matter $kg^{-1}$ with a pH of 7.3. Each sub plot was consisted of four rows 5 m long and 30 cm apart. Crop management factors like land preparation, crop rotation, fertilizer, and weed control were followed as recommended for local area. All the plant protection measures were adopted to make the crop free from insects. The data were recorded on ten randomly selected plants of each entry of each replication for plant height, pods per plant, seeds per pod and 1000-seed weight. Seed yield (adjusted to $kg.ha^{-1}$) was recorded based on two middle rows of each plot. Combined analysis of variance of split-plot experiment were done for all the traits and means comparison were done Duncan's new multiple range test [19]. All statistical analyses were carried out using SAS software (version 9) [14].

[Place of Table 1]

## RESULTS AND DISCUSSION

### *1-Analysis of variance*

Significant mean squares of planting dates were observed for plant height, pods on main axis, pods per plant, 1000-seed weight and seed yield, indicating that means value of these traits were significant affected by planting dates (Table 2). The genotypes had significant differences for all the traits except pods per plant. Non significant mean squares of interaction effects of planting dates (D) and genotypes (G) were detected for pods per plant, 1000-seed weight and seed yield, indicating similar trends of change for these traits in the genotypes in response to different planting dates.

[Place of Table 2]

### *2-Means comparison of the traits*

Means comparison showed that the treatments of the first planting date (Oct, 19) and the second planting date (Oct, 30) with 168.7 and 163.7 cm of plant height, respectively, were classified as the same statistical group (Table 3). The mean value of this trait was considerably decreased in third and forth planting dates. The first planting date enjoyed the favorable conditions of the warmth present at the early stages of the growth of the plants, the fast and suitable vegetative growth before flowering, and the sufficient growing period; and hence it was able to produce the largest mean value of plant height. Pods on main axis was varied from 32.7 and 51.3 related to first and fourth planting dates, respectively. Due to limited effects of environmental condition in late planting condition, this trait was reduced in third and forth planting dates. Pods per plant as the important yield component was mainly decreased in the second and forth planting dates. The means value of this trait was varied from 169.6 and 100.8 in first and forth planting dates, respectively. Seeds per pod is mainly under genetic control, therefore planting dates had not significant effect on this trait. The means value of seeds per pod in four planting dates were classified the same statistical group. The highest mean value of 1000-seed weight (3.79g) was determined for first planting date and its means value for other planting dates (Oct 30, Nov 9 and Nov 19) were classified as the same statistical group. Most of yield components were decreased in late planting dates and hence seed yield was decreased in late planting dates. The means value of seed yield was exhibited for first planting date and other planting dates were classified in the same group. Johnson *et al.* [6] evaluated three canola cultivars at four planting dates and found that seed yield was the highest at the first two sowing dates. Kirkland and Johnson [8] stated that seed yield was greater in the early sowing dates and smaller in the later sowing dates. Fathi et al. [4] found that highest yield of canola was observed from earlier sowings. Means comparison of the genotypes for the traits are presented in Table 4. The genotypes including G4 and G1 with 174.1 and 163.4 cm of plant height had high means value of this trait. The highest mean value of pods on main axis was detected for G1 and the means value of the genotypes including G3, G4 and G5 for this trait were classified the same statistical group. Means value of pods per plant was varied from 135.8 to 150.3 in G5 and G1, respectively. The genotypes including G2, G4 and G5 with 136.5, 139.5 and 135.8 pods per plant had not significant statistical differences. The high means value of seeds per pod were determined for high yield potential genotypes including G1 and G5 (Table 4). The means value of the genotypes for 1000-seed weight ranged from 3.12 to 4.06g in G2 and G5, respectively. The genotypes regard to seed yield were classified in two groups. G1 and G5 with seed yield of 3223 and 3153 $kg.ha^{-1}$ were classified the same statistical group and also other genotypes were in the same group.

Means comparison of planting dates (D) ×genotypes (G) interaction effects for plant height and yield components and seed yield using Duncan's method are presented in Table 5. In all of planting dates, G4 and G1 had the high means value of plant height. For all the genotypes, by delay in planting dates, pods on main axis were decreased. Significant positive correlation was detected between this trait and seed yield, indicating that reducing of pods on main axis had considerable effects on seed yield reduction in delayed planting dates (Table 6). Pods per plant was decreased in late planting dates and G1 had high means value of this trait in most of planting dates. Pods per plant had significant positive correlation with plant height and seed yield, concluded that these traits were similar affected by planting dates. Seeds per pods was moderately affected by planting dates and G1 and G5 had high means value of this trait in most of planting dates. Among the yield components, 1000-seed weight was less affected by planting dates and G4 and G5 had high means value of this trait in all planting dates. Due to decrease of most yield components in late planting dates, followed by seed yield was decreased in late planting dates. Also a significant correlation was observed between pod number per plant

and seed yield in species of *B. napus* and *B. juncea* [7, 9, 20, 21]. 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 [15, 22].

[Place of Table 4]
[Place of Table 5]
[Place of Table 6]

## CONCLUSIONS

The fact that the effects of the planting dates were significant for all the traits suggested that the planting date has a pronounced effect on all the traits, so that delays in planting often result in a decrease in plant height and plant stamina, a reduction in the yield components, and a decrease in seed yield. The interaction effects of the planting date and the cultivar were not significant for most of the traits. This shows that there is a similar trend in changes in the features of the cultivars studied resulting from differences in planting dates, so that most of the traits which influence seed yield deteriorated as a result of a delay in planting date (and this declining trend was observed in all of the genotypes). In our study, the highest seed yield (3972.22 $kg.ha^{-1}$) was that of the advanced line (G1) planted at the first planting date, and the lowest seed yield (1883.33 $kg.ha^{-1}$) was that of the genotype G4 planted at the last planting date.

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Table 1: The main and the sub factors of the study.

| D- The main factors | G- The sub factors |
|---|---|
| D1 = planting date at Oct 19, 2010 | G1 = breeding line F7 generation (L10) |
| D2 = planting date at Oct 30, 2010 | G2 = cultivar Sarigol |
| D3 = planting date at Nov 9, 2010 | G3 = breeding line F7 generation (L7) |
| D4 = planting date at Nov 19, 2010 | G4=breeding line F7 generation (L4) |
| | G5= cultivar Hyola401 |

Table 2: Analysis of variance of plant height and seed yield components as affected by the treatments of the planting date and the cultivars of rapeseed on the basis of split plot design.

| S.O.V | df | Plant height | Pods on main axis | Pods per Plant | Seeds per pod | 1000-seed weight | Seed yield |
|---|---|---|---|---|---|---|---|
| Replications | 2 | 52.9 | 124.5* | 466.2* | 20.8 | 0.01 | 1295324 |
| Planting date(D) | 3 | 2547.1** | 1067.2** | 12919.3** | 56.0 | 0.11** | 2629869* |
| Error a | 6 | 38.3 | 17.8 | 62.2 | 18.7 | 0.00 | 420075 |
| Genotype(G) | 4 | 2490.1** | 835.8** | 534.1 | 39.1** | 2.01** | 1743220** |
| G x D | 12 | 77.6** | 98.6** | 322.4 | 18.7** | 0.01 | 163947 |
| Error b | 32 | 7.8 | 34.4 | 259.1 | 4.9 | 0.01 | 119990 |

*and **: Significant at 5% and 1% probability levels, respectively.

Table 3: Means comparison of planting dates for plant height and yield components and seed yield using Duncan's method.

| Planting dates | Plant height (cm) | Pods on main axis | Pods per Plant | Seeds per pod | 1000-seed weight (g) | Seed yield (kg $ha^{-1}$) |
|---|---|---|---|---|---|---|
| 1-Oct 19 (D1) | 168.7a | 51.3a | 169.6a | 24.0a | 3.79a | 3348a |
| 2-Oct 30 (D2) | 163.7a | 49.8ab | 152.7b | 22.8a | 3.64b | 2860ab |
| 3-Nov 9 (D3) | 152.3b | 45.4b | 145.0b | 19.7a | 3.62b | 2563ab |
| 4-Nov 19 (D4) | 139.4c | 32.7c | 100.8c | 20.8a | 3.59b | 2392b |

Means, in each column, followed by at least one letter in common are not significantly different at the 1% level of probability.

Table 4: Means comparison of genotypes for plant height and yield components and seed yield using Duncan's method.

| Genotypes | Plant height (cm) | Pods on main axis | Pods per Plant | Seeds per pod | 1000-seed weight (g) | Seed yield (kg $ha^{-1}$) |
|---|---|---|---|---|---|---|
| 1-L10(G1) | 163.4b | 56.7a | 150.3a | 24.5a | 3.83c | 3223a |
| 2-Sarigol(G2) | 158.1c | 33.8c | 136.5c | 21.6bc | 3.12e | 2417b |
| 3-L7 (G3) | 148.2d | 44.3b | 147.9b | 20.4bc | 3.34d | 2713b |
| 4-L4 (G4) | 174.1a | 47.5b | 139.5c | 20.1c | 3.95b | 2449b |

| | | | | | | |
|---|---|---|---|---|---|---|
| 5-Hyola401 (G5) | 136.4e | 41.7b | 135.8c | 22.6ab | 4.06a | 3153a |

Means, in each column, followed by at least one letter in common are not significantly different at the 1% level of probability.

Table 5: Means comparison of planting dates (D) ×genotypes (G) interaction effects for plant height and yield components and seed yield using Duncan's method.

| Dates ×Genotypes | Plant height (cm) | Pods on main axis | Pods per Plant | Seeds per pod | 1000-seed weight (g) | Seed yield (kg ha$^{-1}$) |
|---|---|---|---|---|---|---|
| D1 ×G1 | 173.55b | 66.42a | 166.33ab | 26.80a | 3.93bc | 3972.22a |
| D1 ×G2 | 168.00bcd | 35.40f-j | 173.33ab | 23.17a-d | 3.20f | 2905.56b-e |
| D1 ×G3 | 165.22cde | 50.18b-f | 165.00ab | 20.83c-f | 3.53de | 2861.11b-e |
| D1 ×G4 | 183.99a | 62.11ab | 182.67a | 24.00a-d | 4.07ab | 3361.11abc |
| D1 ×G5 | 152.77gh | 42.60d-i | 160.50abc | 25.03abc | 4.19a | 3638.89ab |
| D2 ×G1 | 167.71bcd | 60.85abc | 158.33abc | 26.07ab | 3.88bc | 3238.89a-d |
| D2 ×G2 | 163.97c-f | 39.77e-j | 148.00a-d | 24.92abc | 3.11f | 2383.33def |
| D2 ×G3 | 157.98fg | 45.39d-h | 161.22abc | 19.17def | 3.22f | 3072.22bcd |
| D2 ×G4 | 181.21a | 46.84c-g | 140.25bcd | 20.37c-f | 3.97abc | 2461.11c-f |
| D2 ×G5 | 147.68hi | 55.97a-d | 155.78a-d | 23.70a-d | 4.03ab | 3144.45a-d |
| D3 ×G1 | 159.90ef | 55.65a-d | 154.50a-d | 23.63a-d | 3.73cd | 2944.44b-e |
| D3 ×G2 | 157.40fg | 33.98g-j | 142.00a-d | 20.63c-f | 3.07f | 2455.56c-f |
| D3 ×G3 | 148.35hi | 47.86b-j | 149.42a-d | 16.70ef | 3.31ef | 2483.34c-f |
| D3 ×G4 | 169.36bc | 52.33a-e | 138.34bcd | 16.00f | 3.90bc | 2088.89ef |
| D3 ×G5 | 126.30j | 36.98f-j | 140.67a-d | 21.50b-e | 4.10ab | 2844.44b-e |
| D4 ×G1 | 152.49gh | 43.75d-h | 122.00cde | 21.57b-e | 3.77c | 2736.67c-f |
| D4 ×G2 | 142.86i | 26.14j | 82.84e | 17.53ef | 3.10f | 1922.22f |
| D4 ×G3 | 121.33jk | 33.87g-j | 116.00de | 24.97abc | 3.29f | 2433.33def |
| D4 ×G4 | 161.65def | 28.75ij | 96.67e | 19.83c-f | 3.85bc | 1883.33f |
| D4 ×G5 | 118.82k | 31.14hij | 86.33e | 20.13c-f | 3.93bc | 2983.33b-e |

Means, in each column, followed by at least one letter in common are not significantly different at the 1% level of probability.
D1: Oct 19, D2:Oct 30, D3: Nov 9, D: Nov 19, G1: L10, G2: Sarigol, G3:L7, G4:L4, G5: Hyola401.

Table 6: Pearson correlation coefficients of seed yield and its components

| Traits | Plant height | Pods on main axis | Pods per Plant | Seeds per pod | 1000-seed weight | Seed yield |
|---|---|---|---|---|---|---|
| 1- Plant height | 1 | | | | | |
| 2- Pods on main axis | 0.58** | 1 | | | | |
| 3- Pods per Plant | 0.59** | 0.72** | 1 | | | |
| 4- Seeds per pod | 0.13 | 0.39 | 0.44 | 1 | | |
| 5- 1000-seed weight | 0.13 | 0.45* | 0.13 | 0.24 | 1 | |
| 6- Seed yield | 0.16 | 0.63** | 0.49* | 0.67** | 0.46* | 1 |

***, **** Significant at p=0.05 and 0.01, respectively