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Sowing date evaluation on phenological traits of canola genotypes under warm and semi arid climate (Ahvaz region)

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Abstract

Evaluating the phenological traits of rapeseed crop provides the ability to manage planting based on optimal compatibility to the environmental condition. Thus, experiment on the basis of split plot arrangement in randomized complete block Design was conducted in 2005-2006 agronomic season. Experiment was done, with 4 planting date (Nov, 6 and 21, Dec, 6, 21) as the main plot and 4 rapeseed genotypes (Hyola 401, Pp401, R.G.S.003, Option 500) as the subplots. Because of being synchronous of main stage of development with final heart season in late planting, cause that first planting date made a better yield compare with other planting date. Hyola 401 Hybrid germinated in shortest time (7.9 day) had the highest flowering duration (21.3 day) and was the earliest ripening genotype (138.1 day). Finally according to the results of this research, sowing Hyola 401 Hybrid in 6 Nov as suitable planting date was recommended.

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Introduction

Canola cultivars appear to be best adapted to the conditions of Iran; however, some cultivars are less tolerant to environmental conditions (Sharghi *et al*, 2011). Early spring sowing of oil canola delayed flowering and reduced reflection of radiation during flowering which were important factors leading to the highest yields achieved by late sowing. Effect of sowing dates on yield, yield components and quality was studied by many investigators (Ahmed *et al*, 2011, Assey *et al*, 2006), Who reported that the early Sowing increase oil yield and oil percentage. Horton (2006) found that highest yield of canola was observed from earlier sowings. A number of studies have shown yield decline in canola with delay in sowing (Hocking *et al*, 2001). Ideal sowing date for one or more variety allows for availability of a set of environmental factors that favor a desirable greening, establishment and survival of the plantlet which as a result the plant encounters favorable environmental conditions and avoid unfavorable ones during each stage of its growth (MacKinnon and Fettel, 2003). Delayed planting causes a decrease in duration from time of planting to flowering or maturity. Therefore the decrease in yield, which occurs because of delayed planting, is basically as a result of decrease of biomass during the maturity period (Robertson and Holland, 2004). Studies have shown that low and high temperatures during flowering stage are the main factors decreasing grain crops through inoculating pollens (Sharief and Kheshta, 2002). Johnson *et al.* (1995) argued that high yield production in canola follows a long pod development and flowering period under the low daily mean temperature. Asgari and Moradie-Dalini (2008) after an investigation on sowing date reported that sowing date had a significant effect on traits such as day number to flowering, length of flowering period and length of vegetative growth. Diepenbrock (2000) after reviewing studies conducted on canola found that traits such as length of flowering stage and length of growth period play a significant role in improvement of grain yield of canola. Because planting date in comparison with other agronomic factors has more influence on phenologic characteristics of the plant, determining a proper planting date makes the maximum conformity between plant growth process and climate conditions (Solymanzadeh *et al*., 2007). The experiment conducted by Mendham *et al.* (1990) revealed that a delayed sowing accelerate growth and decrease day number from sowing to flowering by 50%. Khan *et al.* (1994) reported that delayed sowing led to decreased day number to flowering and maturity as well as grain yield. These results are in line with those reported by Mandal *et al.* (1994). Miralles *et al.* (2001) reported that late sowing of canola led to decreased grain yield and decreased growth. Si and Walton (2004) reported that every two weeks of delay in canola sowing resulted in decrease of roughly 1.1% oil and of 309 Kg/ha grain yield. Robertson and Holland (2004) reported that delayed sowing shortened the time to flowering and maturity by 50%. This research was conducted to study the phenological traits of rapeseed genotypes in different planting dates to determine the most suitable planting date from the aspect of conformity with climate conditions of regions and achieving the best yield.

Material and methods

Field and Treatment Information's

This research has been fulfilled during 2005-2006 growing season at split plot experiment based on Randomized Complete Block Designs (CRBD) with three replications, which was conducted at Experimental Field of Khouzestan Agricultural Research and Natural Recourses Organization (Ahvaz station), in south west of Iran with moderate winters and hot summers. Planting on November 6 and 21 as the customary sowing date and planting dates of December 6 and 21 as the delayed planting in the main plots and the subplots were with the four genotypes (Hyola401, Pp401, R.G.S003 and Option500). The texture of the soil in this region was silty clay loam; electricity conductivity of condensed saturation was 3.5 $ds.m^{-1}$ and acidity of the soil was 7.3. The average annual precipitation was 248 mm, long-term daily temperature (in 30 years) was 24-45

degrees centigrade, the average precipitation in agronomic year was 68-136 mm and the average temperature of the agronomic year was 20 degrees centigrade. Each plot consisted of 8 rows with 30 cm distance from each other and each plot was 6 meters long. The average distance between plants was considered to be 3 to 4 cm. using fertilizers in this land was according to information which was gained about the soil. Therefore manure the land using 100 kilogram urea fertilizer per hectare, 100 kilogram triple super phosphate fertilizer and 200 kilogram potassium sulfate per hectare as the basic fertilization, and during the growth period of stem, was 200 kilograms of urea fertilizer per hectare utilized.

Traits measure

In order to measure phenological traits: Days to Emergence: once approximately 50% of plants in a given plot are green. Day number to flowering: number of days from germination to start of flowering. Start of flowering: appearance of first flower in 50% of plants in a given plot. Length of flowering period: the length between start and end of flowering was calculated in days. The start of flowering is when at least 10% of the plants have flowered, whereas the end of flowering is when 95% of flowering has happened. Length of reproductive period: time length from the start of flowering to physiological maturity. Physiological maturity: when the plants are getting yellow colored and grains are hard enough not to be crushed when compressed between fingers. Total growth period: the time between germination and maturity after at least 45 to 50% of grains are incased with browned pods, which is calculated in day. In order to determine the growth process from January 1st to April 4th, samples were collected for seven times with interval duration of twice a week, and in each sampling, the leaf layer index and total dry weight were estimated in plots. The basic temperature in this research was considered +5°c (Madani *et al*, 2005, Rahnama and Bakhshandeh, 2005). In the final harvest, from each (one- squared meter land) plot, grain yield was calculated. In final harvest area, from each plot (one-squared meter land), grain and biological yields were calculated.

Statistical analysis

Data analysis was performed by the SAS (Ver. 8) software and average comparisons were fulfilled according to Duncan multiple rang test at 5 percent probability. All of the charts were drawn by Excel 2003 software.

Results and discussions

The results achieved from variance analysis indicated that differences between planting dates and genotypes according to their Days to Emergence, duration of flowering period and Days to Ripening were significant (Table 1). The first planting date (with average of 22.5 days) had the maximum flowering duration and the fourth planting date, (with average of 15.9 days) had the minimum flowering du-ration (Table 2).The maximum and minimum lengths of germinating time were respectively related to the first planting date on November 6th (with average of 6.8 days), and fourth plant-ing date on December 21st (with average of 11.6 days).

Hyola401 hybrid (with aver-age duration of 7.9 days), had the minimum germinating duration (Table 3). The flowering period is the most important period which affects Canola yield. As the flowering period in plants commences, the photosynthesis process decreases drastically and within this period, the plant shows extreme sensitivities to environmental tensions (Rahnama and Bakhshandeh, 2005). Hyola401 hybrid (with 21.3 days), had the maximum flowering duration, after that varieties of RGS003, PP401 and Option500, respectively (with 20, 19.2 and 17.7 days), devoted the minimum flowering duration to themselves (Table 3). Because of delayed planting, length of maturity period from the first to the fourth planting date decreased from 155.6 days to 127.9 days. In delayed plantings, heat caused by the end of the season leads to early maturity, decrease in length of the seed- filling period and preventing

transmission of photosynthesis materials to the seed (Dipenbrock, 2000, Ozer, 2003). R.G.S.003 variety (with average of 140.8 days), had the maximum duration from planting date to the harvest, while Hyola401 hybrid (with 187.4 days) embraced the minimum duration of that sort. RGS003 variety, (with 158.7 average stem height), had excellence over other genotypes (Table 3). The length of the flowering period was affected by planting date and genotype and the maximum amount of that was related to Pp401 varieties (with 24.5 days) at the first planting date. The maximum length of maturity period was that of Option500 variety, (with average of 155.8 days) at the first planting date (Table 4).

Table 1. Summary results of analysis variance of traits.

S.O.V	df	Days to Emergence	Flowering Duration	Days to Ripening	Seed Yield	Harvest Index	Total Dry Matter
Replication	2	0.1	4.1	4.2	36548.1	71.12	227.02
Planting date	3	68.4**	122.9**	2440.1**	377812.7**	86.95**	174453**
Error	6	1.6	5.6	18.0	89643.1	0.0108	33.43
Genotype	3	51.9**	35.7**	20.5**	237854.3**	30.16**	91498**
Planting date × Genotype	9	1.8*	3.8*	4.3*	331796.9**	11.47**	6533.2**
Error	24	0.7	1.8	1.6	20513.8	0.0503	26.1
CV (%)	-	9.3	6.9	1.0	7.0	4.08	3.65

Table 2. Mean comparison effect of planting date on traits.

Treatment	Days to Emergence	Flowering Duration	Days to Ripening	Seed Yield (kg.ha^{-1})	Harvest Index (%)	Total Dry Matter (g.m^{-2})
Planting date						
6.11	6.8 ^{c}	22.5 ^{a}	155.6 ^{a}	2611.6 ^{a}	22.72 ^{a}	1271.25 ^{a}
21.11	8.8 ^{b}	20.4 ^{b}	142.4 ^{b}	2252.6 ^{b}	19.4 ^{b}	1165.91 ^{b}
6.12	8.0 ^{b}	19.3 ^{b}	131.9 ^{c}	1792.4 ^{c}	16.48 ^{c}	1068.5 ^{c}
21.12	11.6 ^{a}	15.9 ^{c}	127.9 ^{c}	1515.3 ^{c}	14.7 ^{d}	1025.1 ^{c}

Similar Letters in each column show non-significant difference according to 5% Level in Duncan Multiple Rang Test.

Table 3. Mean comparison effect of genotype on traits.

Treatment	Days to Emergence	Flowering Duration	Days to Ripening	Seed Yield (kg.ha^{-1})	Harvest Index (%)	Total Dry Matter (g.m^{-2})
Genotypes						
Hyola401	7.9 ^{bc}	21.3 ^{a}	138.1 ^{c}	2608.5 ^{a}	20.03 ^{a}	1248.91 ^{a}
Pp401	7.4 ^{c}	20.0 ^{b}	139.1 ^{b}	1874.4 ^{b}	16.97 ^{c}	1091.5 ^{b}
R.G.S 003	8.4 ^{b}	19.2 ^{b}	140.8 ^{a}	1942.0 ^{b}	17.61 ^{b}	1112.5 ^{b}
OPTION 500	11.4 ^{a}	17.7 ^{c}	139.8 ^{b}	1747.1 ^{c}	16.44 ^{c}	1046.0 ^{c}

Similar Letters in each column show non-significant difference according to 5% Level in Duncan Multiple Rang Test.

The first planting date, benefiting from environmental conditions and extreme photosynthesis, had the maximum yield (Table 2). Hyola401 hybrid, by having 2608.5 kg.ha^{-1} yields, had the maximum yield, and R.G.S.003, Pp401 and Option500 varieties respectively with yield of 1948, 1874 and 1747 kg.ha^{-1}, were categorized in the next stages (Table 3). The highest seed yield was observed in Hyola401 hybrid at the first planting date, and the lowest seed yield was in Option 500 at the fourth planting date (Table 4).

Table 4. Mean comparison interaction effect on traits.

Treatment		Day to Emergence	Flowering Duration	Days to Ripening	Seed Yield (kg.ha^{-1})	Harvest Index (%)	Total Dry Matter (g.m^{-2})
6.11	Hyola401	5.8 ^{gh}	24.0 ^{ab}	154.0 ^{b}	3603.5 ^{a}	26.5 ^{a}	1225.95 ^{a}
	PP401.15E	5.5 ^{h}	24.5 ^{a}	157.0 ^{a}	2387.9 ^{c}	21.6 ^{b}	1210.35 ^{bc}
	RGS003	5.5 ^{h}	22.5 ^{bc}	155.5 ^{ab}	2480.3 ^{c}	23.3 ^{ab}	1205.45 ^{b}
	Option500	10.3 ^{c}	19.0 ^{eg}	155.8 ^{ab}	1974.6 $^{d-f}$	19.5 ^{b}	1195.0 ^{b}
21.11	Hyola401	7.3 ^{ef}	22.3 ^{bc}	141.0 ^{d}	3030.9 ^{b}	22.1 ^{ab}	1185.25 ^{df}
	Pp401.15E	7.5 ^{ef}	20.8 ^{ce}	141.8 ^{d}	1974.5 $^{d-f}$	18.2 ^{c}	1125.16 ^{cd}
	RGS003	8.5 ^{d}	19.8 ^{df}	144.3 ^{c}	2116.9 ^{d}	20.4 ^{bc}	1160.15 ^{bc}
	Option500	12.0 ^{b}	19.0 ^{eg}	142.8 ^{cd}	1888.2 ^{ef}	17.1 ^{d}	1110.11 ^{de}
6.12	Hypola401	7.3 ^{ef}	21.0 ^{cd}	130.3 ^{f}	20209.0 ^{de}	17.9 ^{d}	1080.96 ^{ef}
	PP401.15E	6.8 ^{fg}	18.5 ^{fg}	131.0 ^{f}	1868.3 $^{e-g}$	16.3 ^{de}	1041.9 ^{de}
	RGS003	8.0 ^{de}	19.3 ^{dg}	133.3 ^{e}	1664.7 $^{g-i}$	16.5 ^{de}	1063.65 ^{ef}
	Option500	10.0 ^{c}	18.5 ^{fg}	133.3 ^{e}	1607.7 ^{hi}	15.2 ^{e}	1015.3 ^{gh}
21.12	Hyola401	11.5 ^{b}	17.8 ^{gh}	127.3 ^{g}	1170.6 $^{f-h}$	15.9 ^{e}	1049.30 ^{fg}
	Pp401.15E	10.0 ^{c}	16.3 ^{hi}	126.8 ^{g}	1266.8 ^{j}	14.6 ^{f}	1015.42 ^{ef}
	RGS003	11.5 ^{b}	15.3 ^{ij}	130.3 ^{f}	1506.2 ^{i}	14.8 ^{f}	1022.66 ^{de}
	Option500	13.5 ^{b}	14.3 ^{j}	127.5 ^{g}	1517.9 ^{i}	13.8 ^{g}	1009.74 ^{h}

Similar Letters in each column show non-significant difference according to 5% Level in Duncan Multiple Rang Test.

A survey on the changes in the measured traits, along time

In order to identify the degree of changes in the measured traits and comparing them with each other, the degree of changes in them was estimated and then diagrams were drawn for them indicating changes percentage in ratio to time. The horizontal axis included first to fourth planting dates, and the vertical axis encompassed changes percentage of traits which measured. In Fig. (1), the biological yield reaction rarely decreased by the passage of time, in comparison with seed yield. Also the harvest index was affected more which led to a decrease of that and delay in planting time. Among yield components, 1000 -seed weight, the number of seed per pod, and the number of pods per plant respectively had fewer changes in ratio of delayed planting (Fig. 2).

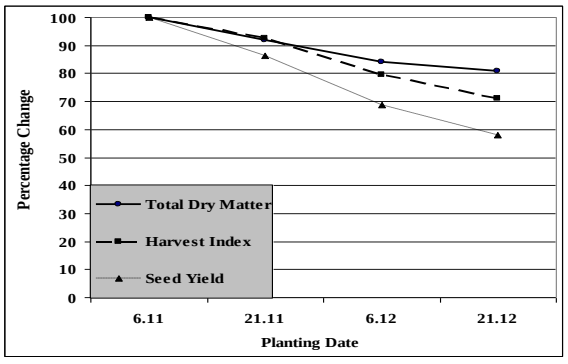

Fig. 1. Percentage change in total dry matter, harvest index and seed yield than the first planting date.

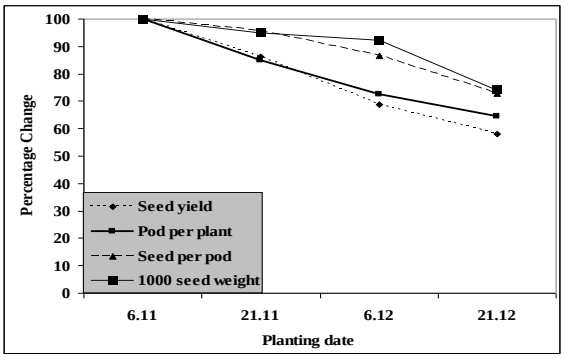

Fig. 2. Percentage change traits of pods per plant, seed per pod, seed weight and seed yield than the first planting date.

Conclusion

Hyola401 hybrid due to its genetic characteristics such as better yield potentialities, early maturity and optimum usage of environmental conditions, has excellence over other varieties. Delayed sowing, is seen to encounter an increase of temperature and some humidity tensions during March and April, which are the most sensitive time of its growing process. This can cause negative effects on seed yield. According to findings of this research sowing Hyola401 hybrid in middle of November in southwest regions of Iran is suggested.

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