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Full Length Research Paper

The study of the quantity and quality of progressive canola varieties under saline conditions in Dalgan Region

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An experiment was performed by using 16 varieties and progressive line of canola during 2009 to 2010 on a farm near the city of Dalgan in Sistan and Balouchestan Provinces of Iran. The experiment was laid out in random complete block design (RCBD) in 4-replication and irrigated with saline water (EC=7.5 ds/m). The spring varieties used in this study includes Hyola60, Hyola308, Hyola330, Hyola401, Hyola420, Option500, Sarigol, PP-308.3, PP-308.8, PP-401.15E, PR-401.16, Kimberley, Amica, R.G.S.003, R.G.S.3006, and Syn-3. The parameters studied includes grain yield, oil yield, oil percent, 1000 seeds weight, number of pods per plant, number of seeds per pod, the length of flowering period, the length of ripening and number of days to harvest period. The comparison of the average grain yield indicated that among the treatments under study, variety Hyola420 produced the highest grain yield with the average of 3600 kg/h respectively and the variety PR-401/16 with the average of 2325 kg/h produced the lowest grain yield. As far as the 1000 seeds weight is concerned, Hyola401 with the average of 3.85 g has the highest and variety Option 500 with the average of 2.80 g has the lowest 1000 seeds weight. The oil percent Hyola308 with 45.36% was the highest and Amica with 40.49% was the lowest oil percent. Also, the study showed that Hyola420 with 1567 kg/h was the highest and Amica with 990 kg/h was the lowest rate of oil yield.

Key words: Canola, variety, saline, quantity yield, quality yield.

INTRODUCTION

Canola is one of the most important oil seeds in the world. Canola share in the oil production in 2009 was 12% of the total oil production (FAO, 2009). Therefore, the factors affecting the yield of this plant are important. Canola yield is subject to a number of pods per plant, number of seeds per pod and the 1000 seeds weight (Clarke and Simpson, 1998). Yield component is influenced by genotype, environment and the agricultural management (Krauss et al., 2000; Farre et al., 2002). The oil coming from the oil yield is used for nutrition and industry (Rao and Mendham, 1991). The oil is used for nutrition and energy which serves as one of the important sources of energy that is necessary for the production of fat acids in the body of human's (Rao and Mendham, 1991). In recent years, in order to supply the country's need of cooking oil, the selection of the proper genotypes according to the region is one of the important determining factors in the yield of cultivating plants (Rathke et al., 2005). Oil producing seeds, after grains, are the world's 2nd valuable source of nutrition in the

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Table 2. Analysis of variance for study characteristics of 16 canola varieties under saline condition in Dalgan region.

		Mean square						
S.O.V	**df**	**Number of pods per plant**	**Number of seeds per pod**	**1000 seeds weight (g)**	**Grain yield (kg/h)**	**Oil percent (%)**	**Oil yield (kg/h)**	**Length of ripening (day)**
Block	3	1.29	3.04	0.002	24672.56	1.66	3142.79	0.56
Treatment	15	65. 31**	67. 90**	0.45**	468663.29**	8.73**	116659.5**	57.89**
Error	45	3.51	2.09	0.002	37933.62	1.41	7946.67	0.89
C.V (%)	-	4.72	5.68	1.36	6.91	2.78	7.37	3.36

**Significant at 1% level.

Table 1. The names of the varietes used and their sources.

Variety	Origin
R.G.S.003	Canada
Amica	Australia
Sarigol	Iran
Option 500	Germany
Hyola401	Canada
Hyola60	Canada
Hyola420	Australia
Hyola330	Canada
Hyola308	Australia
Kimberley	Germany
R.G.S 3006	Canada
Syn-3	Canada
PR-401.16	Iran
PP-401.15E	Iran
PP-308.8	Iran
PP-398.3	Iran

world their products also contain rich sources of fatty acids (Althabet et al., 2004). The world reports indicate that saline water is being directly used to create jungles and add nutrition to pastures, planting trees and study or permanent plants, irrigation and grain vegetables (Mopper et al., 2003). Salinity limits the growth of the plants (Stanton et al., 2000). Typically; there are different plants that tolerate saline conditions (Rogers and McCarty, 2000). Usually canola at different stages of growth shows different resistance to salinity (Pan and Price, 2001). Resistance to saltiness has a valuable specification for plant products especially oil seeds (Ashraf et al., 1987). Canola is resistant against saline conditions. In Netherlands, canola is one of the first products that are cultivated in the lands that are separated from the sea or the water irrigating is saline (Allen et al., 2000). Canola varieties have different tolerance of salinity (Mopper et al., 2003). The genetic specifications can be effective in the tolerance of salinity and canola varieties are different from one another (Islam et al., 2001). The purpose of this research was to determine how canola varieties survive in saline conditions, that could be helpful for the expansion of canola cultivation in Dalgen region and also similar ones.

MATERIALS AND METHODS

An experiment was conducted in Chahshoor from the city of Dalgan in Sistan and Balouchestan Province of Iran. The geographical situation of the experiments site is 61° and 11' lengths eastern and 28° and 8' widths northern (the report of agriculture organization of sistan and balouchestan, 2008). The average annual rain was 53 mm and its climate was based on the warm and dry Amberzhe method. The altitude was 410 m above sea level and the maximum and minimum temperature was 51 and 7°C (The Statistics of Meteorology, 2008). This experiments were done by using saline water of (EC=7.5 ds/m). Sixteen spring canola (Table 1) that were suitable and compatible with ecosystem conditions of the southern part of Iran were selected and cultivated in a random format with a 4-replication according to randomized complete block design (RCBD) on the 25th of November 2009.

Each experimental plot with a length of 5 m and the width of 30 cm included 4 lines of cultivation. Taken into consideration the results of soil 100 kg/h P_2O_5, 100 kg/h K_2O with 210 kg/h. N fertilizer, consisting of fertilizer P_2O_5, K_2O and 30% N were applied before cultivation. 70% N fertilizer at the time of cultivation was added in 2 growing stages three weeks after the cultivation and at the start of stemming process. Plantation of the seed was manual. The depth of the seed was 2 cm and the density of the plantation was 40 to 60 plants per square meter. The irrigation period was between 8 and 10 days. To calculate the number of pods per plant, at the time of harvest 10 plants were randomly selected and the number of seeds per pod counted and its average was registered. The time of ripening was taken in to account when at least 50% of the seeds in the pods were turned brown. After the plant were dried, the operations of separating herbs from the seed started. To carryout calculation of 100 seeds weight randomly, four samples consisting of 100 seeds each, after each treatment were counted. Thereafter statistical analysis was done using (MSTAT-C) and SAS (vergan 9.1). The comparison of the means of the treatments by Danken test was done at 1% level. The cluster analysis was done by using the (Average Linkage) method.

RESULTS

Quantitative characteristics

Grain yield

The results from the analysis of the variance indicate that the varieties under study as far as the grain yield are

Table 3. Mean comparison of yield and yield components characteristics of 16 canola varieties in Dalgan region.

Varieties	Length of ripening	Growth length period	Oil yield (kg/h)	Oil percent (%)	Grain yield (kg/h)	1000 seeds weight	Number of seeds per pod	Number of pods per plant
R.G.S. 003	32^{bc}	145^{c}	1163^{d}	41.65^{cd}	2788^{bcde}	3.007^{h}	23.75^{ef}	37.5^{de}
Amica	26^{f}	151^{ab}	990.9^{f}	40.49^{d}	2446^{fgh}	3.247^{f}	19.5^{h}	38.5^{de}
Sarigol	35^{a}	158^{a}	1068^{def}	41.24^{cd}	2592^{efgh}	3.4^{e}	25.25^{e}	42.5^{bc}
Option500	33^{b}	155^{c}	1203^{cd}	43.86^{ab}	2746^{cdef}	2.8 ^{i}	21.25^{gh}	40.25^{cd}
Hyola401	22^{g}	141^{c}	1499^{a}	43.64^{ab}	3387^{a}	3.85^{a}	34^{a}	36^{e}
Hyola60	30^{d}	148 ^{b}	1362^{b}	44.11^{ab}	3088^{b}	3.51^{d}	25^{e}	37.25^{de}
Hyola420	30^{d}	147^{bc}	1567^{a}	44.51^{a}	3600^{a}	3.51^{d}	30.25^{b}	38de
Hyola330	30^{d}	146^{bc}	1366^{b}	44.99^{a}	3037^{bc}	3.21^{f}	28^{cd}	35.75^{e}
Hyola308	22^{g}	141 ^{c}	1327^{bc}	45.36^{a}	2925^{bcd}	3.1^{g}	30^{bc}	50.5^{a}
Kimberley	23^{g}	141 ^{c}	1126 ^{def}	41.56^{cd}	2705^{def}	2.83^{i}	30^{bc}	38de
R.G.S.3006	31.25^{cd}	151^{ab}	1194^{cd}	41.42^{cd}	2882^{bcde}	2.85^{i}	22^{fg}	33^{f}
Syn-3	26.5^{ef}	145 ^{c}	1019^{ef}	42.52^{abc}	2392^{gh}	3.68^{c}	22^{fg}	39.5^{cd}
PR-401.16	27.75^{e}	147 ^{c}	1012^{ef}	43.56^{ab}	2325^{h}	3.76^{b}	24.25^{e}	40.25^{cd}
pp-401.15E	27^{ef}	147^{bc}	1142de	42.2^{bcd}	2693^{defg}	3.49^{d}	20.5^{gh}	42.5^{bc}
PP-308.8	27.25^{ef}	144^{c}	1169^{d}	42.88^{bcd}	2759^{cdef}	3.21^{f}	27.5^{d}	43.5^{b}
PP-308.3	27.75^{e}	146^{bc}	1134de	41.67^{cd}	2724^{cdef}	2.99^{h}	24.75^{e}	42^{bc}

Means with significant differences at 5% level were denoted by different letters.

concerned, is significant at 1% level (Table 2). Comparison of the means between treatments indicate that highest grain yield is related to Hyola420 and Hyola401 in sequence with the mean of 3600 and 3387 kg/h and the least yield related to PR-401.16 with the average of 2325 kg/h (Table 3). The results from the table of the simple correlation indexes between the characteristics under study indicate that the grain yield in the treatments under study with the number of seeds per pod (r=0.553) the length of ripening (r=0.356) at the oil yield (r=0.964**) is significant at 1% level (Table 4).

Number of pods per plant

The results of the variance indicate that between the varieties of canola as far as the number of pods per plant is concerned (Table 2). There is a meaningful difference at the highest number of pods per plant to Hyola308 with the mean 50.5 and the least number to R.G.S.3006 with the mean of the numbers 33 (Table 3).

Number of seeds per pod

Based on the results from the analysis of variance between the numbers under study from the quantitative point of view in the pod there is a significant meaningful difference at 5% level (Table 2). The comparison of the means between treatments indicated that Hyola401 with 34 seeds in pod has the highest number and Amica with the amount of 19.5 seeds has the lowest number (Table 3). The results stemming from the table of simple correlation between the characteristics under review showed that the number of seeds per pod in the treatments under study with the growth length period (r=0.571*) and the oil yield (r =0.597*) is significant at 5% level (Table 4).

1000 Seeds weight

The results from the analysis of the variance indicated that between the items as far as the 1000 seeds weight is concerned (Table 2). The comparison of means of the treatments indicated that the highest of 1000 seeds weight is related to Hyola401 with the mean of 3.85 g and the lowest is related to Option500 with the mean of 2.8 g (Table 3).

Qualitative characteristics

Oil percent

The results from the analysis of variance indicated that between different items under study as far as the oil percent was concerned were significant at 5% level (Table 2). Hyola308 with 45.36% contained highest oil percent and Amica with 40.49% contained lowest oil

Table 4. Correlation coefficients among study characteristics of 16 canola varieties in Dalgan region.

Variable	Number of pods per plant	Number of seeds per pod	Growth length period (day)	1000 seeds weight (g)	Oil percent (%)	Length of ripening (day)	Vegetative length period (day)	Oil yield (%)	Grain yield (kg/h)
Number of pods per plant	1								
Number of seeds per pod	0.044	1							
Growth length period (day)	-0.115	-0.571*	1						
1000 seeds weigh(g)	-0.021	0.177	-0.145	1					
Oil percent (%)	0.165	0.41	-0.244	0.211	1				
Length of ripening (day)	-0.245	-0.421	0.79**	-0.211	-0.135	1			
Vegetative length period (day)	-0.047	-0.482	0.799**	-0.032	-0.418	0.398	1		
Oil yield (%)	-0.153	0.597*	-0.282	0.13	0.591*	-0.42	-0.112	1	
Grain yield (kg/h)	-0.223	0.553	-0.238	0.085	0.373	-0.356	0.68*	0.964**	1

*,** Significant at 5 and 1% levels.

percent (Table 3). Results showing the correlation between the characteristics under review indicated that the oil percent in the treatments under review with the oil yield (0.591*) was significant at 5% level (Table 4).

Oil yield

One of the main purposes of canola cultivation is attainment of high oil yield. On the basis of ANOVA results, there was significant difference at 1% level among cultivars in oil yield (Table 2). The mean comparison with Dancan multiple range tests showed that Hyola420 cultivar had the highest oil yield mean 1546 kg/h and Amica cultivar with the least oil yield mean 990.9 kg/h. There was a positive correlation between oil yield and number of seeds per pod (r=0.597*) and oil percent (r=0.591*) was significant at 5% level (Table 4). And all of genotypes are placed in two groups (Figure 1).

DISCUSSION

The grain yield in the treatments of the study had two positive and meaningful correlations with vegetative length period (r=0.68*) significant at 5% level and the oil yield (r=0.964**) significant at 1% level (Table 4). According to some of the researchers, the yield of the number of seeds per pod had a complicated characteristic and the result was the multiplication of the influence of its components such as number of pods per plant, the number of seeds per pod and the 1000 seeds weight and any changes in the yield must be done through these components (Johnston et al., 2001). Yield is a complicated characteristic that is controlled by a lot of gene and is influenced by the environment and if the environmental conditions are not proper, it will have a negative impact on the yield (Aarssen and Taylor, 2002). Canola varieties in connection with the production of pod have different capabilities. These characteristics are genetic which are influenced by the environment and are under stress (Burke et al., 2000). The number of pods per plant is considered to be one of the important yield components (Pan et al., 2001). It seems that the genetic characteristics in the saline conditions result in the creation of seeds per pod in Hyola401 (Althabet et al., 2004). The reason for the 1000 seeds weight in the above item, being saltiness (Kraus et al., 2000). The 1000 seeds weight is one of the determining yield and yield component, usually there is a positive correlation between the 1000 seeds weight and the yield (Rathke et al., 2005). The Research indicates that if there is high temperature and saline tension at the time of tending, the oil percent and the grain yield of it will go down (Mopper et al., 2003). The oil percent in different varieties of canola is almost permanent, but in stress conditions such as saline and high temperature we will see a reduction in different varieties and the reason is the created difference in metabolism and the absorption of elements by canola (Islam et al., 2001).

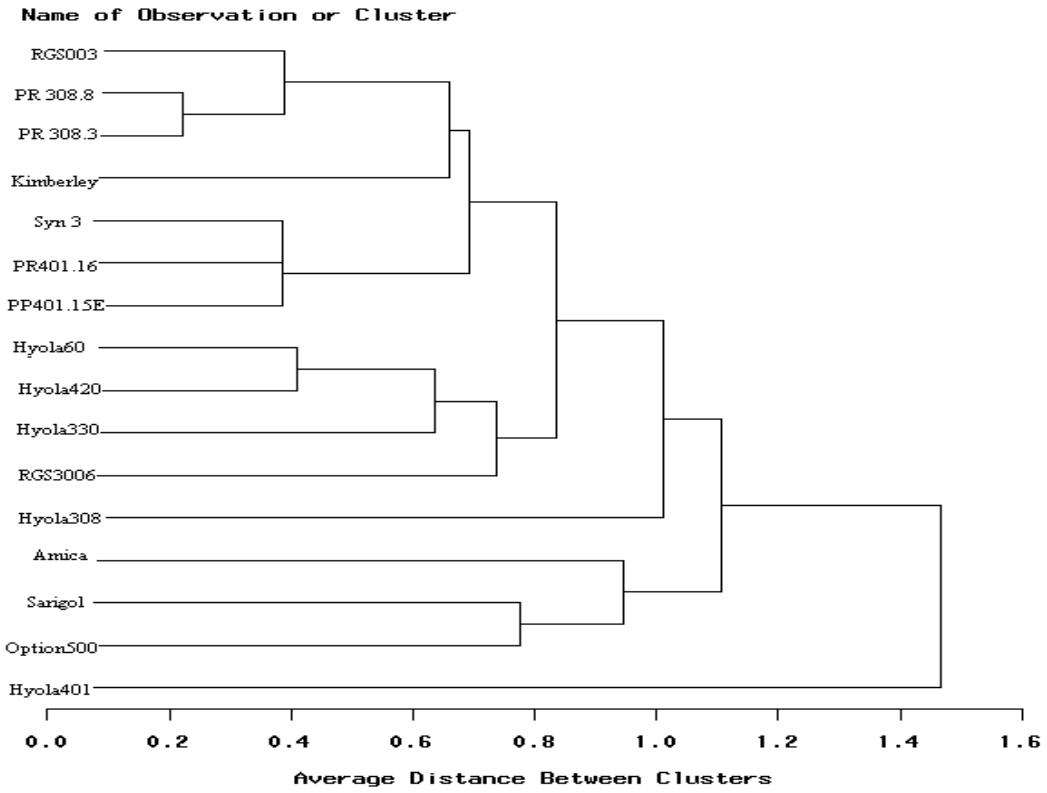

Figure 1. Average distance between clusters of 16 canola varieties under saline condition in Dalgan region.

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