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Full Length Research Paper

Investigation of correlation yield and yield components of 12 spring canola hybrids in Iranshahr climatic region

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In order to survey investigation of correlation yield and yield components of 12 spring canola hybrids in Iranshahr climatic region, an experiment was conducted in Agriculture and Natural Resources of Balouchistan Research Center, during 2009 to 2010 based on Randomized Complete Block Design (RCBD) with 4 replications. The experiment of 12 spring canola hybrids provided by Karaj Research Institute of Improvement and Provision of Saplings and Seeds includes; Hyola 43, Hyola 60, Hyola 308, Hyola 308.3, Hyola 308.8, Hyola 330, Hyola 401, Hyola 401.15E, Hyola 420,19-H,Syn-2, Syn-3. The characteristics considered in the present study were as follow: grain yield, oil yield, oil percent, 1000 seeds weight, number of: pods per plant, seeds per pod, days to flowering, days to harvest and the length of ripening period were seen among genotypes. The results of variant analyses showed that their characteristics in all of them had meaningful differences. Comparing average grain yield revealed that Hyola 401 had the most grain yield (4755 kg/h) and Hyola 308.3 had the least grain yield (1547 kg/h) in Iranshahr climatic region. Considering number of pods per plant Hyola 308.3, Hyola 420 with 104.3 and 87 pods respectively have the highest amount, but Hyola 330, H_19 with 43 and 43.25 average number of pods per plant have the lowest amount. Considering number of seed per pod Hyola 308, syn-3 with 34.25 and 33.75 have the highest number, but Hyola 308.3, Hyola 401.15E with 25 and 19.75 average number of seed per pod have the lowest one. Considering the number of seed per pod analyses of simple correlation between characteristics confirmed that the average of 1000 seeds weight and the length of ripening have a positive and meaningful correlation with the grain and oil yield; however, growth period has a negative and meaningful correlation with oil and grain yield.

Key words: Canola (*Brassica napus* L.), cultivar, correlation, yield, yield components.

INTRODUCTION

Oil seeds account for the second mostly used food reserves in the world. The first rank is assigned to corns. Such reserves include rich fatty acids resources in addition to protein. Utilization of plant proteins, instead of meaty products and introducing new oil seeds, such as canola in global markets made it one of the most important food product (Kumar et al., 2002). Meanwhile canola oil seeds are the most prominent ones and cultivated increasing in various countries. Regarding arid situation of Iran among other countries in the world, it is suggested to boost production ratio in unit area of the land instead of increasing the land area under cultivation. The share of canola oil production in 2009 was 12% Therefore analyses of effective yield factors of such plant are very important. Investigation into the functionality has been one of the outstanding methods that have been applied for a long period of time by breed and specific experts. Canola yield is a function number of pods per plant, number of seeds per pod and 1000seed weight (Clark and Simpson, 1998). Yield components of seed are affected by area genotype, ecosystem and agricultural management (Farre et al., 2002).

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Table 1. Names and origin countries of 12 spring canola hybrids.

Cultivar name	Origin
Hyola 43	Australia
60 Hyola	Australia
308 Hyola	Australia
Hyola308.3	Australia
Hyola 308.8	Australia
Hyola 330	Canada
401 Hyola	Canada
401.15E Hyola	Canada
420 Hyola	Australia
19-H	Pakistan
2-Syn	Canada
3–Syn	Canada

Canola oil yield is a function of grain yield and oil percent that spans in the range of 35 to 45% (Weiss, 2003; Abrahamson, 2000). Number of pods per plant is one of the main yield factors of canola. Considering canola seeds located in the pods, the more number of pods per plant, the better grain and oil yield will be achieved (Alen et al., 2000). High temperature of weather at the end of growth period may affect adversely on the number of pods per plant and subsequently oil yield (Kumar et al., 2002).The number of seeds per pod is one of the yield factors in canola. The decreases regarding high temperature at the end of growth period and subsequently oil content reduces (Bazzez et al., 2001). 1000 seeds weight is one of the main parameters that will increase or decrease at the end of growth season depending on the temperature. If the temperature is high the weight is low and consequently quantity and quality of oil yield would decrease (Abrahamson, 2000; Yaniv, 2001).The objective of the present study is to survey investigation of correlation yield and yield components of 12 spring canola hybrids in Iranshahr climatic region in order to select the most productive cultivar for such region and similar areas.

MATERIALS AND METHODS

An experiment of the present study took place in the farm of Baluchistan Agricultural Research Institute, City of Iranshar, Sistan and Baluchistan Province, Iran. Geographical positioning of the site is as follow (Statistics of Sistan and Baluchistan Province, 2008); Latitude: 40' and 28°; Longitude: 11' and 61°; Average yearly raining: 60 mm; Altitude: 490 meter above sea level; Maximum and minimum temperature: 50 and 7°C.

The Weather of the area based on Ambezhe evaluating method, was assessed to be hot and dry. 12 spring canola hybrids that were suitable and compatible with ecosystem conditions of south part of Iran selected and cultivated in a random format with a 4-riplication procedure on November 18th of 2009.

Each turn of the experiment included 4 lines of harvesting of 5 m length and 30 cm apart from each other. The cultivation land was ploughed and two times furrowed in November 2009.Considering results acquired from farm soil analyses, 100 kg phosphor (P_2O_5) from ammonium phosphate manure resources, 100 kg potassium from related manure (K_2O) and 130 kg nitrogen (N) were consumed in each hectare. All the phosphor manure, potassium manure and one third of nitrogen manure were used during plough and furrowing procedure. Remaining nitrogen manure was applied in two phases as follow:

1. Three weeks after planting.
2. At the beginning of stemming.

Seed planting method was manual. Depth of planting was 2 cm. Planting densities were 40 to 60 plants in each square meter and irrigation period was chosen for 8 to 10 days. The moment 50% of seeds per pods became brown, harvesting procedure started. Determining the yield of various yield components, 10 sample plants of matured products with margin cares is harvested and number of pods per plant, number of seeds per pod and 1000seeds weight was evaluated.

After drying the plant, separation of stubble and straw from seed became processed. Calculation of 1000seed weights was based on 4 random samples consists of 100 seeds of each treatment and average weight of them. Calculation of oil percent, 30 g samples were chosen and after grinding the oil content evaluated by Souksle apparatus (Karaj Research Institute of improvement and Provision of Saplings and Seeds).

Statistical analyses were made through (SAS) and (MSTAT_C) software (version 9.1). Comparisons among treatment averages were made by Dunkan multi-level test in 5% certainty level. Cluster analyses also made through average linkage method (Figure 1).

RESULTS

Grain yield

Grain yield based on results from variant analyses among parameters under considerations which is significant at 1% level in grain yield characteristics (Tables 1 and 2). The maximum grain yield related to Hyola 401 with an average 4755 kg/h and the minimum one grain yield revealed to be the Hyola 308.3 with an average 1547 kg/h (Table 3). Regarding numbers and parameters in the present study were correlated positively with number of seeds per pod, 1000 seeds weight, oil percent, the length of ripening and oil yield. Besides, grain yield is negatively correlated with number of pods per plant, the length of ripening period and the growth length period (Table 4).

Number of pods per plant

Considering results from variant analyses among various parameters related to number of pods per plant which is significant at 1% level (Table 2).The maximum number of pods per plant relates to Hyola 380.3 and Hyola 420 with an average pods number of 104.3 and 87 respectively. Minimum number of pods per plant related to 19-H and Hyola 330 with an average pods number of 43 and 43.25 respectively (Table 3). Based on the research results it has been revealed that there is a positive correlation

Table 2. Analysis of variance for studied characteristics of 12 spring canola hybrids in Iranshahr.

SOV	DF	N.P.P	N.S.P	1000.S.W	GY	P.O	O.Y	V.L.P	L.R	G.L.P
Block	3	3.917	2.521	0.25	2.02	10557.13	5.834	118126.056	0.023	0.43
Treatment	11	1223.341**	76.142**	175.58**	467.17**	9262.73**	18.709**	5142690.924**	0.719**	145.3*
Error	33	11.235	1.566	0.35	0.57	29200.95	2.831	172513.101	0.011	0.34
CV%		4.83	4.31	2.6	0.89	16.21	4.12	16.09	2.83	23.6

* And** significant at 5 and 1% level. N.P.P: number pods per plant, NSP: number seed per pod, GLP: growth length period, 000.S.W: 1000 seed weight, P.O: percent oil, LR: length of ripening, VLP: vegetative length period, OY: oil yield and GY: grain yield.

Table 3. Mean comparison of yield, yield components and quality characteristics of 12 spring canola hybrids in Iranshahr climatic region.

Cultivar	N.P.P	N.S.P	1000.S.W	GY	P.O	O.Y	V.L.P	L.R	G.L.P
Hyola 43	82.75^{bc}	19.75^{f}	3.74^{cd}	1796^{e}	37.82^{d}	674.00^{d}	97.00^{a}	22.00^{d}	159^{a}
60 Hyola	80.00^{c}	25. 50de	3.51^{ef}	2194^{e}	38.03^{cd}	835.40^{d}	94.50^{b}	19.00^{f}	150^{ab}
308 Hyola	63.00^{ef}	34.25^{a}	4.36^{b}	4008^{b}	40.35^{bcd}	1617.00^{b}	71.00^{h}	32.75^{a}	144^{c}
Hyola308.3	104.30^{a}	26.00^{de}	3.24^{h}	1547^{e}	44.59^{a}	648.60^{d}	92.70^{cd}	24.25^{c}	159^{a}
Hyola 308.8	64.00^{ef}	31.75^{bc}	3.63^{de}	1751^{e}	38.66^{cd}	676.60^{d}	93.50^{bc}	16.00^{g}	146^{bc}
Hyola 330	43.25^{g}	27.25^{d}	3.42^{fg}	1548^{e}	43.03^{ab}	667.00^{d}	91.00^{e}	15.50^{g}	150^{ab}
401 Hyola	62.20^{f}	31.00^{bc}	4.63^{a}	4755^{a}	42.78^{ab}	2034.00^{a}	71.00^{h}	31.75^{b}	145^{c}
401.15E Hyola	67.70d^{e}	25.00^{e}	3.82^{c}	1576^{e}	42.20^{ab}	687.00^{d}	91.70^{de}	24.25^{g}	149^{b}
420 Hyola	87.00^{b}	31.50^{bc}	3.79^{c}	3835^{bc}	42.12^{ab}	1619.00^{b}	69.75^{i}	33.50^{a}	144^{c}
19-H	43.00^{g}	32.75^{ab}	3.59^{de}	1784^{e}	40.35^{bcd}	730.70^{d}	92.50^{cd}	20.75^{e}	155^{ab}
2-syn	72.00d	30.25^{c}	3.31^{gh}	3245^{cd}	39.08^{cd}	1264.00^{c}	88.50^{f}	20.00^{e}	149^{b}
3-syn	63.25^{ef}	33.75^{a}	3.30^{gh}	2938^{d}	40.64^{bc}	1194.00^{c}	77.00^{g}	24.75^{c}	146^{bc}

Means with significant differences at 5% level were denoted by different letters. N.P.P: number pods per plant, NSP: number seed per pod, GLP: growth length period, 000.S.W: 1000 seed weight, P.O: percent oil, LR: length of ripening, VLP: vegetative length period, OY: oil yield and GY: grain yield.

Table 4. Correlation coefficients among studied characteristics of 12 spring canola hybrids in Iranshahr climatic region.

	N.P.P	N.S.P	G.L.P	1000.S.W	P.O	L.R	V.L.P	O.Y	G.Y
N.P.P	1								
N.S.P	-0.409	1							
G.L.P	0.421	-0.746**	1						
1000.S.W	-0.171	0.189	0.443-	1					
P.O	0.06	0.097	0.009	0.077	1				
L.R	0.256	0.412	-0.357	0.563*	0.194	1			
V.L.P	0.055	-0.647*	0.719**	-0.526	-0.236	0.841**	1		
O.Y	-0.02	0.493	-0.632	0.627*	0.105	0.799**	-0.864**	1	
G.Y	-0.007	0.490	-0.623	0.603*	0.25	0.790**	-0.844**	0.994**	1

*And** Significant at 5 and 1% level. N.P.P: number pods per plant, NSP: number seed per pod, GLP: growth length period, 000.S.W: 1000 seed weight, P.O: percent oil, LR: length of ripening, VLP: vegetative length period, OY: oil yield and GY: grain yield.

between numbers of pods per plant, the growth length period, oil percent and the length of ripening. However such attribute (number of pods per plant) is negatively correlated to number of seeds per pod, 1000 seeds weight, oil yield and grain yield (Table 4).

Number of seeds per pod

The number of seeds per pod based on results from variant analyses of different attributes such as number of seeds per pod, meaningful differences became revealed (Table 2). Hyola 308 and Syn-3 with an average seed number 34.25 and 33.75 respectively in each pod have the maximum seed numbers and Hyola 401.15E and Hyola 308.8 with an average seed number 25 and 19.75 respectively in each pod have the minimum seed numbers. Number of seeds per pod has positive correlation with 1000 seeds weight, oil percent, the length of ripening, oil and grain yield. Such attribute has also a negative correlation with number of seeds per pod, and

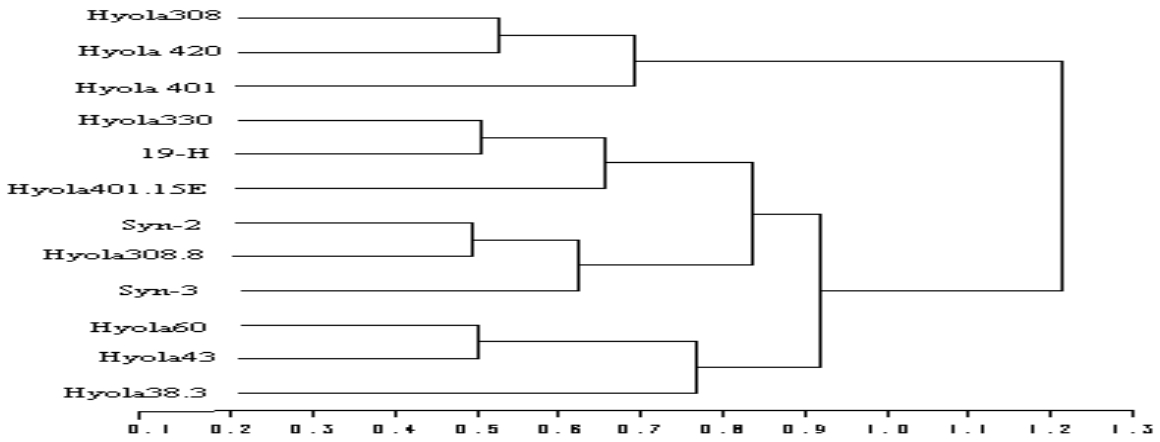

Figure 1. Average linkage (cluster analysis) between 12 spring canola hybrids in Iranshahr climatic region.

the growth length period (Table 4).

1000 seeds weight

The 1000 seed weight based on the results from variant analyses of numbers attributes which considered in the present study of 1000 seeds weight has revealed a semi-large meaningful difference (Table 2). The maximum 1000 seeds weight assigned to Hyola 401 with an average weight of 4.63 g and the minimum 1000 seeds weight assigned to Hyola 308.3 with an average weight of 3.24 g. The results indicate that 1000seeds weight has a positive and meaningful correlation with number of seeds per pod, oil percent, the length of ripening, oil and grain yield (Table 4).

DISCUSSION

In Iranshahr region Hyola 401 and Hyola 308 hybrids have the most grain yield and Hyola 308.3 and Hyola 330 have the least yield (Table 3). Regarding grain yield, oil yield, oil percent and 1000seeds weight. Hyola 401 hybrid showed yield compared to other samples. During a research made by Rathke et al. (2005) on various canola attributes, Hyola 401 revealed to be better than others. In the present study Hyola 401 (had the most yield) had less the length of ripening compared to others because increase in the length of ripening cause the conflict between seed enrichment and ripening in high temperature of end of season in such region which consequently causes decreases in grain yield and oil percent. Results from another research made by Rao Mendham (1991), also confirmed the afore-mentioned points. Grain yield was positively correlated with number of seeds per pod and 1000seeds weight (Table 4). It has been revealed that maximum number of pods per plant assigns to Hyola 308.3 and Hyola 420 with an average number of 104.3 and 87 respectively, besides, minimum number of pods per plant assigns to 19-H and Hyola 330 with an average number of 43 and 43.25 respectively (Table 3). Pod generation in a plant depends upon genetic attributes and ecosystem conditions such as temperature, radiation, density and so on (Alen et al., 2000). Hyola 308 and Syn-3 with an average number of 34.25 and 33.75 seeds respectively have the maximum number of seeds in each pod, while hyola 401.15E and Hyola 308.8 with an average number of 25 and 19.75 seeds have the minimum seeds in each pod (Table 2). Number of seeds per pod is one of the main determinants of reservoir volume (Bazzez et al., 2001). In other words the more number of seeds the more number of reservoirs and subsequently by increasing in number of reservoirs the yield would increase (Rowson, 1998). Increasing in number of seeds per pod is one the key factors affecting raise in oil yield of new cultivar in Australia (Adam, 1990).

Those canola cultivar that show more number and 1000seeds weight in each pod are more useful (Singh et al., 1996). Adams and Grafius (2000) report that if one of the yield factors decreases, other factors try to compensate. 1000 seeds Weight are usually less affected so maximum variations take place in number of seeds per pod (Singh et al., 1996). Rathke et al. (2005) also stated the same results. It was specified that number of seeds per pod is positively correlated with 1000seeds weight, oil percent, the length of ripening; oil and grain yield (Table 3); besides such attributes are negatively correlated with growth and the growth length period (Table 4). Such adversity is because of lingering the growth length period compared to procreative period. Mason and Brennan (1998) found the same results in this regards. In their experiment maximum 1000 seeds weight allocated to Hyola 401 with an average weight of 4.63 g and minimum weight of 1000 seeds weight allocated to Hyola 308.3 with an average weight of 3.24 g. 1000

seeds weight is one of the key factors that determines grain yield. Results from different researches revealed heredity property of 1000 seeds weight compared to other attributes and cultivar such as oil and grain yield (Bell and Sultan, 1999). Besides 1000 seeds weight are negatively correlated with the growth length period (Table 4) .Such adverse impact is due to longer period of the growth length period compared to procreative period. Therefore in tropical area there are no hazards of hot weather at the end of season and products would be harvested at that time. Existing attributes of Table 4 (number of pods per plant, number of seeds per pod, 1000seeds weight, oil percent, oil yield, grain yield, the growth length period) are used in cluster analyses and it's been revealed that Hyola 308, Hyola 401 and Hyola 420 are in same group and other cultivars used in the study locate in other groups. These three cultivars are similar to each other in view of their growing, the growth length period and the length of ripening is located in the same group. It seems those cultivars in which leaf expansion takes place faster than others, has smaller the growth length period or simply are immature and are suitable for cultivating in tropical areas (Figure 1).

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