Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 6, No. 3, p. 40-45, 2015
http://www.innspub.net

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RESEARCH PAPER OPEN ACCESS

Evaluation correlation between seed yield and effective traits and characteristic variations of promising spring canola genotypes under warm and semiarid climate condition in South West of Iran (Ahvaz Region)

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Article published on March 02, 2015

Key words: Canola, Seed Yield, Semiarid Climate, Correlation.

Abstract

Correlation coefficient analyses help researchers to distinguish significant relationship between traits. Step-wise regression can reduce effect of non-important traits in regression model, in this way traits accounted for considerable variations of dependent variable are determined. In order to determine the most important traits affecting grain yield in Canola a split plot experiment in Randomized Complete Block Design (CRBD) with three replications was conducted. Four planting dates (November 6th and 21st. December 6th and 21st) in main plots and four Genotypes (Hyola401, PP401, RGS003 and Option500) in subplots were studied. The evaluation of correlation coefficients illustrated that the total dry matter, harvest index, 1000- grain weight, the number of grains per pod, number of pods per plant, plant height; days to maturity and flowering period trait have a positive significant correlation with grain yield. In addition, total dry matter, 1000- grain weight, and flowering and maturity period also had a high effect on grain yield. Thus, direct selection for these traits is suggested.

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Introduction

Canola grain yield is dependent to on the capacity of variety yielding, climate conditions, the type of soil and agronomic management. Also genetic and agronomic factors determine growth of the plant and grain yield (Qulipor *et al*, 2004). One of the most important objectives of Canola plant breeding is to increase yield in a region. By having an increase in yield, we mean to increase physiological efficiency of the plant and to improve yield in a region. This is because many other objectives indirectly affect yield increase. Yield is the resultant of all parts of the plant, and it is considered as the final target of many characteristics. Correlation coefficient, which is used as a standard of measuring linear relationship between two variables, only has one mathematical interpretation, and does not refer to cause and effect relationships (Ozer *et al*, 1999, Ahmadi, 2000). Correlation coefficient analyses help researchers to distinguish significant relationship between traits. Step-wise regression can reduce effect of non-important traits in regression model, in this way traits accounted for considerable variations of dependent variable are determined (Agrama, 1996). Some statistical methods, such as correlation analysis, indicate partial role of each component of yield in the amount of yield; also, they provide necessary information for choosing indirect traits in superior genotypes to have yield breeding (Zemmer mann *et al*, 1994). Knowing the relationship among these processes and investigating other quantitative traits make breeding programs and their success more optimistic and secure (Diepenbrock, 2000).

Different statistical techniques have been used in modeling crops yield, including correlation, regression, path analysis, factor analysis, factor components and cluster analysis (Leilah and Al-Khateeb, 2005). By having Canola varieties evaluated, observed that grain yield has the most correlation with 1000- grain weight, biological yield, harvest index and oil yield. Accumulation of dry matter in plant causes better assimilate transfer, therefore the plant makes the best use of assimilate for grain filling (Robertson and Holland, 2004). Grain yield is considered to be a complicated trait, which can be affected by many factors, and usually as a result of insufficient yield heritability factor, direct -selection yield. Is not much effective for it; as a result, for yield breeding we would better use indirect selection (Angadi *et al*, 2003). Bagheri *et al.* (2008) reported positive and significant relation among oil yield and the traits seed yield, plant height and 1000-seed weight. Fathi *et al.* (2008) emphasized on importance of 1000-seed weight and no. seed/plant as efficient indirect selection criteria for genetic improvement of seed yield in Rapeseed cultivars. Farhudi *et al.* (2008) showed positive and direct effect of the traits no.seed/plant, seed yield, biological yield and 1000-seed weight on oil yield in Rapeseed genotypes. Safari and Bagheri, 2006 in a study introduced effective traits on the yield such as number of pods per plant, number of seeds per pod and thousand seed weights which number of seed per pod revealed the highest positive direct effect on the seed yield. Number of seeds per pod and thousand seed weight showed a significant correlation with the seed yield. Also, there was no significant correlation between numbers of seed per pod with yield (Faraji, 2003). Menapour *et al* (2006) reported that traits such as number of pods per plant and dry matter yield are effective in seed yield. The main objectives of this research were to analyze the correlation between seed yield and related traits in Rapeseed by applying sequential path analysis and identifying traits, of Cultivars, which may be useful in breeding higher-yielding Cultivars. Correlation between traits for evaluation and planning on breeding programs is useful. In other words, when an evaluation is conducted on a trait, knowing its effects on the other traits is totally important. Also by knowing if correlation exists between important traits, interpretation on previous results would become easier and the basis for effective future plans would be provided. Also correlation between important and non-important traits provides plant breeding experts with a significant assistance in indirect selection of important traits, through non-important traits which their measurement is easier (Rahnama and Bakhshandeh, 2005).

The purpose of this research is to identify the correlation between seed yield and agronomic traits, and identify the degree of changes in measured traits, we can recognize effective traits to achieve improvement on goals.

Material and methods

This research has been fulfilled at split plot experiment based on Randomized Complete Block Designs 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. 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. In order to determine grain yield components during physiologic maturity, 10 plants were chosen randomly from each plot. Then the traits of pods per plant, the number of grain per pod and 1000 grain weight were assessed in them. In the final harvest, from each (one- squared meter land) plot, grain and biological yields were calculated. 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

Simple correlation coefficients between traits These coefficients were estimated according to Pearson coefficient (Table 1).These coefficients were figured out by means of Pearson coefficient. The maximum positive and significant correlation was observed in; dry matter trait ($r=0.932^{**}$), harvest index ($r=0.810^{**}$), pod per plant ($r=0.955^{**}$) (Table 2), 1000- grain weight ($r= 0.909^{**}$), flowering duration ($r= 0.824^{**}$), plant height ($r= 0.715^{**}$) and maturity time trait ($r= 0.67^{**}$). The traits of grain per pod ($r=0.575^{*}$) and days to grow ($r=0.656^{*}$) had correlation with the grain yield (Table 2). Traits of days to flowering and days to maturity- have a significant and positive correlation with grain yield of Canola Varieties, therefore varieties with longer flowering duration would have a better chance for fertilizing flowers and turning them to pods (Solymanzadeh *et al*, 2007). In serotinal varieties or delayed-growing plants, the decrease of length in the growing period, poor environmental conditions (temperature and humidity) during the flowering period and fertilization and pod formation, decreases number of pods per plant, the number and weight of the grain finally lead to the a decrease in the of Canola yield (Rahnama and Bakhshandeh, 2005). Earning maximum correlation coefficient in grain yield by the number of pods per plant ($r= 0.955^{**}$) because it is assimilates supplier for the grains, therefore, there was a positive and significant correlation of grain per pod with grain yield, a natural thing. As a result, the more this trait is observed, the bigger sink plant would have for metabolic materials. The other researchers have mentioned the same results (Jorgeh, 2003 and Madani *et al*, 2005). The Increase of total dry matter and its direct relation with grain yield show the relations between photosynthesis efficiency of plant and grain yield, therefore varieties which gained more profit of the production factors according to growth conditions and they keep more photosynthesis materials in their sinks, had more efficiency. This status was in conformity with the other researchers have mentioned the same results (Qulipor *et al*, 2004). The significant and positive correlation between the harvest index and grain yield ($r=0.810^{**}$) indicates efficiency and kind of photosynthesis materials distribution in different parts of plant, especially in grain. The other researchers have mentioned the same results (Rahnamaee tak *et al*, 2007).

$$Y = -3507 + 25.1\ GD + 12.8\ GP + 17.6\ FI - 15.6\ EF + 30.5\ FD + 0.39\ MD - 1.52\ PH + 1.89\ PPP - 8.02\ GPP + 108\ SW + 131\ HI + 1.07\ TDM$$

Formula 1. Grain yield formula according to regression relations among all identified traits.

MD: maturity date, PPP: Pod per plant, SPP: grain per pod, SW: 1000 seed weight, TDM: Total Dry Matter, HI: harvest index, GD: growing duration, GP: germination percentage, FI: flowering initiation, EF: end of flowering,

FD: flowering duration, PH: plant height

A survey on the changes in the measured traits, comparing with 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 grain yield.

Table 1. Summary results of analysis variance of traits.

S.O.V	df	Days to Emergence	Percent of Emergence	initiation of flowering	End of flowering	Flowering duration	Days to ripening	Plant heights	Pod per plant	Grain Per Pod	1000 grain weight	Total dry matter	Harvest index	Grain yield
Replication	2	0.1	0.9	0.6	1.5	4.1	4.2	695.2	235.9	2.8	0.16	227.02	71.12	36548.1
Planting date	3	68.4**	50.8*	29.7*	45.9*	122.9**	2440.1**	13702.5**	3596.4**	82.0**	1.75**	174453**	86.95**	377812.7**
Error	6	1.6	6.5	3.2	1.4	5.6	18.0	65.3	28.5	0.7	0.03	33.43	0.0108	89643.1
Genotype	3	51.9**	26.7*	41.6*	39.3*	35.7**	20.5**	2379.6**	1517.2**	105.9**	1.16**	91498**	30.16**	237854.3**
Planting date × Genotype	9	1.8*	18.9*	1.5*	3.8*	3.8*	4.3*	374.7*	105.3*	5.9**	0.07*	6533.2**	11.47**	331796.9**
Error	24	0.7	3.2	1.2	2.6	1.8	1.6	180.8	47.1	1.7	0.03	26.1	0.0503	20513.8
CV (%)	-	9.3	5.5	6.1	8.2	6.9	1.0	9.1	8.8	7.8	6.8	3.65	4.08	7.0

ns, * and **: No significant and Significant at 5 and 1% Level of Probability, Respectively.

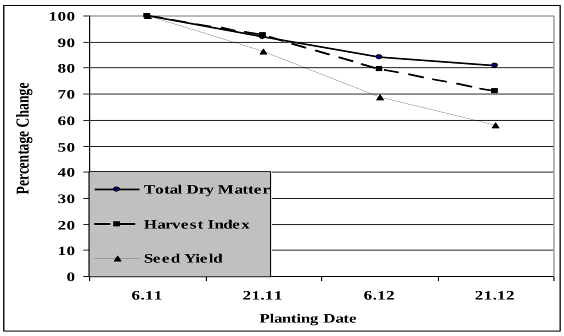

Fig. 1. Percentage change in total dry matter, harvest index and grain yield than the first planting date.

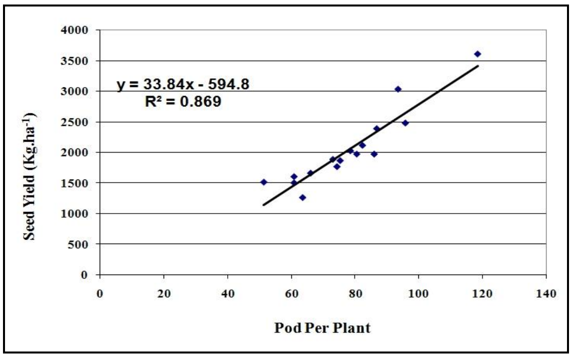

Fig. 2. Correlation between Seed yield and Pod per plant.

Table 2. Correlation Coefficients of Agronomic Traits of Canola Genotypes.

Traits	Day to emergence	Percent of emergence	initiation of flowering	End of flowe-ring	Flowering duration	Days to ripening	Plant heights (Cm)	Pod Per plant	Seed per pod	1000 seed weight (g)	Harvest index (%)	Total dry matter ($g.m^{-2}$)
Percent of emergence	-0.686**											
Initiation of flowering	-0.197 ^{ns}	^{ns} -0.88										
End of flowering	^{ns} -0.336	-0.184 ^{ns}	**0.962									
Flowering duration	**-0.861	*0.513	^{ns} 0.81	*0.523								
Days to ripening	*-0.544	^{ns} 0.130	**0.697	**0.755	**0.753							
Plant heights (Cm)	**-0.690	^{ns} 0.400	*0.572	**0.682	**0.823	**0.849						
Pod per plant	**-0.723	^{ns} 0.3210	^{ns} 0.400	^{ns} 0.41	**0.855	**0.764	**0.822					
Seed per pod	^{ns} -0.316	^{ns} 0.206	^{ns} 0.87	^{ns} 0.75	**0.637	^{ns} 0.65	*0.526	*0.620				
1000 seed weight (g)	**-0.655	^{ns} 0.195	^{ns} 0.25	^{ns} 0.66	**0.831	*0.581	**0.683	**0.863	**0.652			
Harvest Index (%)	*-0.617	^{ns} 0.1570	0.431 ^{ns}	^{ns} 0.45	**0.786	**0.653	**0.689	**0.907	*0.568	**0.886		
Total dry matter ($g.m^{-2}$)	**-0.720	^{ns} 0.294	0.414 ^{ns}	*0.485	**0.888	**0.729	**0.819	**0.943	*0.602	**0.886	**0.929	
Seed yield ($Kg.ha^{-1}$)	**-0.656	^{ns} 0.202	0.407 ^{ns}	0.430 ^{ns}	**0.824	**0.670	**0.715	**0.955	*0.575	**0.909	**0.810	**0.932

ns, * and **: No significant and Significant at 5 and 1% Level of Probability, Respectively.

Conclusion

According to the results of this research, traits of pods per plant, total dry matter and flowering duration, had the most positive-direct effects on Canola grain yield. Therefore better genotype evaluation according to grain yield can be made by direct selection of these traits. Some researchers also reported similar results about this research (Baradaran *et al*, 2006, Rabiee *et al*, 2004).

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