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Multivariate analysis for canola varieties in Sistan region of Iran

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ABSTRACT

To estimate the association between quantitative traits in canola using correlation and regression and the of direct and indirect effects particular traits on oil yield through the path analysis, Two cultivars of canola in two consecutive years 2011 and 2012 in a randomized complete block design was carried out Zehak Agricultural Research and 13 characters were measured. The results of compound experiment showed that there were significant differences between cultivars, between the years of testing and interaction between cultivars and years for most traits. That prefigures there is a high genetic diversity among varieties. Oil yield had significant positive correlation with grain yield, weight of 1000 seeds and oil content while had a negative correlation with number of days to flowering. Step wise regression showed that grain yield, oil content and days to flowering had the most effect on oil yield and justified 99.1% of regression model. The most direct effect on oil yield was belonging to oil content. Totally in breeding program for canola and based on stepwise results weight of 1000 seeds and grain yield are most important trait to selection canola cultivar for more oil content.

Key words: canola, oil yield, stepwise regression, path analysis

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INTRODUCTION

The cultivation of canola oil in Iran due to the high quality it`s edible oil is very important. Improved grain yield and thus the increasing of canola oil is the main issue of crop breeders.[1-3] Oil yield is a quantitative trait influenced by the environment and thus has a low heritability.[4, 5] Consequently, in response to direct selection for grain and oil yield and may be unpredictable unless well controlled environmental variation. [6] Simple Pierson correlations in such circumstances may well not clear relevance between traits and so the breeders use direct and indirect users of strategy selection and use for decision making. Path analysis is a statistical method that helps to explain the direct and indirect effects and so widely in breeding programs used by researchers in different plant species.[7-10] There are several studies on correlation between yield and agronomic traits in rapeseed oil. [2, 11-13] In a report has been shown that oil yield had significant and positive correlation with oil content, number of pods per plant, seed weight and seed yield. Their results also showed that seed yield and oil content respectively have maximum positive and significant effect on oil yield. Also Ozer with study on rapeseed cultivars in the two years showed that oil content had a significant positive correlation with days to flowering, plant height, number of seeds per pod, pod length and seed yield.[14] A study reported oil yield had significant negative correlation with lodging resistance, days to flowering, number of pods per plant, seed bag and plant height. Also they reported that vegetative period, weight of 1000 seeds and percentage of protein influencing grain weight and percent protein have a positive effect on oil percent of canola.[15] In another report, in a study on rapeseed varieties reported that there is positive and significant correlation with seed weight and oil percentage while these traits had a significant negative correlation

with grain yield, number of pods per plant, biological yield, number of branches and stem diameter. [16] Also the results showed that direct effects of oil on the grain yield were negligible. Khan et al 2006 reported grain yield per plant had a significant positive correlation with number of primary branches, number of pods per plant, seeds per pod, pod length and seed yield per plot. [17] Tuncturk and Çiftci (2007) showed that increasing in the number of pods per plant, seeds per pod, number of branches and sub-grain weight cause increases in grain yield and there is a significant and positive correlation between these traits with yield. [18] In another study has reported that grain yield had a significant positive correlation with number of pods per plant, seed per pod.[19]

Also Ivanovska and colleagues in their studies on rapeseed varieties at two locations indicated that grain yield had correlation with number of branches, number of pods, pod length, seed weight and seed weight per pod.[20] The most studies have shown that grain weight, grain yield, pod length and seed number and saddlebag highest positive correlation and effect on oil yield. Also weight of 1000 seeds and grain yield traits proposed for cultivar selection with high oil contents. The aim of this experiment was to determine effects on yield and oil characteristics, a better understanding of the relationships between the characters and also finding the relationship between the oil yields with related traits.

Finally, by calculating the direct and indirect effects of agronomic traits of canola on the oil yield and compare them together, we can use most effective and important trait as markers to selection in breeding programs.

MATERIALS AND METHODS

two cultivars including, Hyola401and RGS003 were obtained from agricultural research centers of Sistan province. This study was conducted in agriculture research station in Zehak city (lat=30.869 lon=61.666)Sistan region, Sistan and Balouchestan province of Iran. The plan was design based on complete random block with three replications in two years 2010 and 2011.Each plot was contain six cultivar rows with 25 cm in width ad totally it was 5 meters. Spaces between units replicate was 1 and 2 meters, respectively. Two times during season culture we used terfulan (3 liters per each hectare) to manage weeding. To improve soil quality and after chemical analysis of experimental soil, we used ammonium phosphate and potassium sulfate fertilizer. Handle sowing was in 25 October and for each unit 10 grams seed (1000grams per hectares) was used. During the growth season, traits such as days to flowering, pod initiation period and days to maturity were recorded. Grain yield was obtained in ten-percent humidity of seeds after removing half meters from the side and two rows of each plot. Measured traits were including plant height, number of branches per plant, number of pods per plant, number of seeds per pod, which on ten randomly selected plants from each plot were measured. Oil content from seeds was measured with NMR methods and after multiple in grain yield, oil yield were obtained. Normality test, ANOVA and multivariate analysis were performed in SPSS 21 using GLM proc.

RESULTS AND DISCUSSION

Before parametric analysis, Bartlet test was conducted to ensure that errors variances are homogenize. All analysis was carried out for two years data to separate interaction effect between years and cultivars and years was as random factor and cultivar as fix factor. ANOVA showed that interaction among levels of years and cultivars had significant difference.

Also main effect of year show significant differences which means two years did not have same effect on traits. Totally first year with good condition particularly early days of sowing cause to obtain higher rate for almost all calculated trait related to second year. All cultivars in first year had same growing pattern and relatively same time to ripening. (table1)Result of phenotypic correlation between traits is shown in table 2. Considering of this data showed that oil yield has significant and positive correlation with grain yield, oil percent and weight of 1000 seeds while had significant negative with number of days to flowering. Grain yield also had significant positive correlation with pod length and weight of 1000 seeds while had significant negative with days to flowering. Report of Basalma also confirms this result. [21] Correlation with oil yield was not significant in this study whilst some reports showed positive correlated with oil and grain yield. [13, 22] Rahnema reported that there are positive correlations between oil content and yield. [23] The reason for this difference in results may be due to Environmental effects or a low number of cultivars reducing the degrees of freedom resulting in lack of significant correlations. In general, according to the results, to achieve high-yielding varieties, it have sought to select the varieties with high pod length and high 1000 seeds weight and low in number of days to flowering. So with indirect selection for these traits can be achieved to high yield varieties and thus found varieties with more oil yielding. Correlation between Number of days to flowering, seed weight and seed yield was negative .Other researchers also reported a negative correlation. According to these results, it should be choose short maturity variety to obtain the higher yield.

Table 1: Some source of Analysis of compound variance for 5 canola cultivars for 8 traits

	Mean of squares						
S.O.V	Plant height	Grain yield	N. branch per plant	Length of Pod	N. Pods per plant	N. seed per pod	Weight of 1000 seeds
Years	4532.76**	65376537.8**	0.097^{ns}	66.234**	2096*	44.37**	2.725**
R*Years	18.06	134620.62	0.431	0.047	81.71	1.41**	0.082
Cultivars	409.147^{ns}	908511.44*	1.0355^{ns}	1.087**	3409.11*	25.49**	0.578^{ns}
Year* Cultivars	173.940**	238257.14*	0.898*	0.948^{ns}	657.21 *	2.96^{ns}	0.687**
Coefficient of variation	5.23	27.9	12.64	5.67	15.15	9.67	12.46

Table 2: Pierson correlation between yield and related traits

Traits	Plant height	Grain yield	N. Branch per plant	Pod length	N. pod per plant	N. seed per pod	Weight of 1000 seeds	Days to flowering	Days to ripping
Plant height	1								
Grain yield	-0.26^{ns}	1							
N. Branch per plant	-0.47^{ns}	0.52^{ns}	1						
Pod length	0.13^{ns}	0.55*	-0.02^{ns}	1					
N. pod per plant	-0.01^{ns}	0.52^{ns}	0.34^{ns}	0.16^{ns}	1				
N. seed per pod	0.38^{ns}	0.16^{ns}	-0.35^{ns}	0.82**	-0.12^{ns}	1			
Weight of 1000 seeds	-0.35^{ns}	0.61*	0.42^{ns}	0.02^{ns}	0.19^{ns}	-0.29^{ns}	1		
Days to flowering	0.68**	-0.28^{ns}	-0.34^{ns}	-0.15^{ns}	0.09^{ns}	0.02^{ns}	-0.01^{ns}	1	
Days to ripping	0.81**	-0.37^{ns}	-0.49^{ns}	-0.23^{ns}	-0.16^{ns}	0.03^{ns}	-0.12^{ns}	0.88**	1

Table 3: stepwise regression for oil yield (dependent variable) with other traits

Model		coefficients	coefficient definition
1	intercept	-134.98^{ns}	0.95
	Grain yield	0.66**	
2	Intercept	453.7^{ns}	0.98
	Grain yield	1.98**	
	Oil content	46.76**	
3	intercept	-65.98^{ns}	0.99
	Grain yield	1.43**	
	Oil content	76.4**	
	Days to flowering	536.94**	

To remove ineffective or less effective in the regression model parameters on oil yield (the dependent variable) Stepwise regression was used. Stepwise regression results are shown in Table 3. The results showed that seed yield, oil content and days to flowering had the greatest effect on the oil yield and 99% oil yield changes were justified. Mosavimirkalaee showed that period vegetative weight of 1000 seeds and percentage of protein affecting grain yield but coefficient of definition was very low related to this study. [24]In the next step every trait which previously interned in our model were used as dependent variables and other traits except oil content. Oil yield and grain yield were used as fixed variables. The results showed that the number of days to flowering, pod length and seed weight had the highest effect on grain yield and it justified eighty percent of variation in model. Weight of 1000 seeds was an effective trait on oil yield with 35% of coefficient of definitions. The coefficient of variance inflation factor ranged between 1 - 1.173 was variable and it is a factor which shows lack of a together line. The results of the analysis are presented in Figure 1. Results showed that grain yield had highest positive direct effect on oil yield

(0.94).Thus, the best appropriate selection criteria in canola for oil yield can be grain yield and after that oil content because of the direct effect and positive effect could be a criterion for selection of genotypes with high oil yield so that selection of genotypes with high oil content will increase the oil yield. In the next step, the results showed that seed weight had the high positive direct effect of on grain yield and oil content and therefore selection on these traits can indirectly be involved to increased oil yield. Because of increasing this trait increases yield and oil content and oil yield will increase. According to the results of a path analysis of grain yield and grain weight can be introduced as selection criteria to achieve a high yield of oil. Basically, if the correlation between the dependent and independent variables is approximately equal to the direct effect then right correlation can be shown and direct selection through this trait will be effective. In another study also showed that grain yield had most direct effect in oil yield which agrees with results of this research.[25] some report also confirmed results of this research which showed that the highest oil yield, followed by a direct effect on oil yield. [19]Given the high correlation coefficient and direct effect on seed yield, oil yield it almost perfect correlation between seed yield and oil yield per hectare per hectare showed. It is expected that the results of the oil yield per hectare is obtained directly from the yield per hectare. The most direct effect on yield of oil yield per hectare was estimated, while the influence of other traits in this study was very low on oil yield. Authors of this study appreciate from Agricultural Research Center Zehak provide the necessary funds.

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