2011 International Conference on Environmental, Biomedical and Biotechnology
IPCBEE vol.16 (2011) © (2011)IACSIT Press, Singapoore

Evaluation of genetic variation and indirect selection criteria for improvement of oil yield in canola cultivars (*Brassica napus* L.)

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Abstract. A randomized complete block design with three replications was conducted in order to evaluate the genetic variation and determination of the best indirect selection criteria for genetic improvement of oil yield in canola cultivars. Correlation analysis for oil yield showed positive and significant relationship among this trait with all the traits except days to flowering initiation, flowering duration and no.pod/plant. Step-wise regression of oil yield as dependent variable and the other traits as independent variables revealed that 99.1% of total variation exists in oil yield accounted for by the traits seed yield, oil percent, plant height and days to physiological maturity. Path analysis for oil yield designed high efficiency of the traits plant height and days to physiological maturity as indirect selection criteria for genetic improvement of this trait in canola cultivars especially in early generations of breeding programs. For seed yield and oil percent, positive indirect effects of these traits on oil yield via the traits plant height and days to physiological maturity must be considered. Cluster analysis revealed considerable genetic variation and efficacy of selection among canola cultivars as well as progenies to be obtained from crosses between them to improve oil yield.

Keywords: Canola, Regression analysis, Path analysis, Indirect selection, Genetic improvement.

1. Introduction

Assessment of relationship using correlation coefficient analyses help breeders to distinguish significant relation 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 (Arslan, 2007). Path analyses have been extensively used for segregating correlation between oil yield and its components in oilseed crops. Path analysis is used to determine the amount of direct and indirect effects of the variables on the dependent variable (Farshadfar *et al.*, 1993).

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.* (2003) emphasized on importance of 1000-seed weight and no.seed/plant as efficient indirect selection criteria for genetic improvement of seed yield in canola 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 canola genotypes.

This study was undertaken in order to determine the dependence relationship between oil yield of canola cultivars and other traits and then identify the best selection criteria for genetic improvement of this trait via indirect selection.

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2. Materials and Methods

Canola cultivars entitled; Option 500, Hyola 300, Slm 046, Hyola 401, Sarigol, Modena, Hysun 110, Swc-Motshot, Echo, Parkland, Landrace, Rinbow, SLM 046, Opera, Zarfam, RGS 003 and Elite were planted at the beginning of November 2009 at the research field of Islamic Azad University in a randomized complete block design.

Each experimental unit comprising four rows were 5 m long and 0.3 m apart. Distance between plants with in rows was 0.06 m. Therefore, plant density was 555,000-plant ha^{-1}. In spring 2010 the trial was irrigated every 10 days. Amount of precipitation was 192 mm. Measurement for traits days to shooting, days to flowering initiation, days to full flowering, days to physiological maturity, flowering duration, plant height (cm), no.pod/plant, no. seed/pod, 1000-seed weight (g), biological yield (g), seed yield (g), harvest index (%),oil percent (%) and oil yield (g) were achieved on 10 normal plants randomly selected from two middle rows in each plot.

Investigation of the relationships between traits was conducted using simple correlation coefficient analysis. Step-wise regression was achieved for determination of the best model, which accounted for variation exist in plant seed and oil yield as dependent variables in separate analysis. Direct and indirect effects of traits entered to regression model were determined using path coefficient analysis. In this study path analysis was carried out based on method given by Dewey and Lu (1959). Using SPSS, Minitab and Path2 soft wares did data analysis.

3. Results and Discussion

Significant relationships of oil yield with the traits days to shooting, days to full flowering, days to physiological maturity, plant height, no. seed/pod, 1000-seed weight, biological yield, seed yield, harvest index and oil percent was revealed using correlation coefficient analysis. Efficacy of these traits as the effective selection criteria in order to genetic improvement of oil yield in canola cultivars have been emphasized by Bagheri *et al.* (2008) and Tang *et al.* (1997).

Step-wise regression analysis for oil yield as dependent variable (Table 1) revealed that traits seed yield, oil percent, plant height and days to physiological maturity accounted for 99.1% of variation exist in oil yield. Therefore, these traits were determined as the main oil yield components. Amongst, trait seed yield accounted for 75.2% of total variation of oil yield lonely, which designated importance of this trait to explain variation of oil yield. Traits oil percent, plant height and days to physiological maturity accounted for 4.9%, 14.4% and 4.6% of variation of oil yield, respectively (Table 1).

Path analysis for oil yield (Table 2) based on traits entered to regression model indicated that traits seed yield and oil percent has the high and negative direct effects on oil yield. On the other hand, these traits correlated positively and significantly with oil yield. Therefore, positive indirect effects of these traits on oil yield via the traits plant height and days to physiological maturity must be considered, simultaneously (Farshadfar, 2008; Chaudhaty *et al*., 1999).

Traits plant height and days to physiological maturity have the positive and high direct effects on oil yield. Also, indirect effects of plant height via days to physiological maturity and days to physiological maturity via plant height on oil yield are positive (Table 2). Thus, indirect selection for oil yield improvement through these traits and consider theirs direct and indirect effects on oil yield can be efficient in canola breeding programs. Therefore, these traits are introduced as the effective traits for indirect selection of genotypes having higher oil yield specifically in early generations. These results are inconsistent with reported by Bagheri *et al.* (2008) and Farhudi *et al.* (2008) in canola, Abolhasani and Saeidi (2006) and Arslan (2007) in safflower.

Classification of these canola cultivars using cluster analysis grouped the genotypes in four distinct clusters. Genetic distance revealed by clustering method emphasizes on existence the genetic diversity with in these genotypes. Therefore, selection of the superior canola genotypes has the high genetic gain in order to increase oil yield. Increasingly, crosses between the genotypes grouped in clusters 1 and 4 because of the highest genetic distance between them become more efficient to attain this goal.

In conclusion, we can suggest indirect selection in early generations via traits that have the highest direct effect on dependent variables. These traits usually determine by means of statistical procedure like correlation, regression and path analysis. In this research, revealed that traits plant height and days to physiological maturity are the best indirect selection criteria for genetic improvement of oil yield in canola cultivars.

Table 1. Step-wise regression for oil yield (dependent variable) in canola cultivars

Variable	$b_{(1)}$	S.E	R^2	t	Prob
Seed yield	0.68	0.01	0.752	68.23	0.000
Oil percent	24.98	1.64	0.801	15.23	0.000
Plant height	-1.33	0.49	0.945	-2.71	0.012
Days to physiological maturity	0.83	0.23	0.991	3.62	0.003
Intercept	-997.97	57.19		-17.45	0.000

(1): b values have been tested relative to zero.

Table 2. Path analysis for oil yield in canola cultivars

Variable	(1)	(2)	(3)	(4)	Sum of effects
(1) Seed yield	-2.65	-0.48	1.89	2.22	0.98
(2) Oil percent	-0.88	-1.45	1.05	2.15	0.87
(3) Plant height	-2.12	-0.63	2.36	1.24	0.85
(4) Days to physiological maturity	-2.20	-1.15	1.11	2.66	0.42
Residual effects	1.39				

4. Acknowledgements

This research project has been supported by Islamic Azad university, Khorasgan branch, Isfahan, Iran. This support is highly appreciated.

5. References

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