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Determining relationships among seed yield and some yield components using correlation, regression and path analysis in canola (Brassica napus L.)

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ABSTRACT: Determination of the traits affects seed yield is very efficient in breeding of this trait in canola (Brassica napus L.). Seed yield is the quantitative trait that direct selection per se isn't effective for improvement this. Therefore, indirect selection through traits having higher heritability and correlated strongly with seed yield has more genetic efficiency than direct selection in genetic improvement of this trait. Hence, in order to determine the best indirect selection criteria for genetic improvement of seed yield in canola a split plot design in the layout randomized complete block design with three replications was conducted. Four planting dates 15 October, 22 October, 29 October and 5 November were considered as main factor levels in the main plot. Also, ten canola cultivars were used as sub factor levels and were arranged randomly in the sub plots. Step-wise regression of seed and oil yield revealed that 98.9% of total variation exists in seed yield accounted for by the traits grain filling rate, grain filling duration and biological yield. 95.7, 2.3 and 0.9% of seed yield variation accounted for by these traits, respectively. Path analysis for seed yield as dependent variable showed amongst the highest direct effect on seed yield belongs to grain filling rate. Grain filling duration and biological yield had the maximum indirect effects on seed yield. In conclusion, results revealed high efficiency of the trait grain filling rate as indirect selection criterion for genetic improvement of seed yield in canola cultivars especially in early generations of breeding programs.

***Keywords*:** Canola cultivars, step-wise regression, path analysis, indirect selection, selection criteria, genetic improvement

INTRODUCTION

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 (Falconer, 1998). Knowing about grain yield issue and its components plays an important role for being successful in evaluative programs. Success in breeding and having fruitful varieties of agricultural products with a higher quality depends on knowledge about genetic grain yield controlling and its relation with grain yield components, also to phenologic traits and forage quality (Jafari, 2001).

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 (Agrama, 1996). Path analyses that present by (Li ,1956) 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 (Li, 1956; Farshadfar et al., 1993).

According to the results of path coefficient analysis in Canola plant, it was illustrated that the duration of growth had the most direct and negative effects on oil grain percentage and the number of pod per plant had the most positive and direct effect on grain yield (Mirmousavi et al., 2004). (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 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. In other study, path analysis for seed and oil yield designed high efficiency of the traits plant height and days to physiological maturity as indirect selection criteria for genetic improvement of oil yield and the traits biological yield and no. grain/pod for seed yield improvement in canola cultivars (Golparvar and Karimi, 2012).

Hence, the present study was conducted to determine the dependence relationship between seed yield of canola cultivars and other traits as well as identify the best selection criteria for genetic improvement of this trait via indirect selection.

MATERIALS AND METHODS

This research was done at the agricultural farm station of Kaboutar-Abad, Isfahan, Iran, during 2011-2012 farming season. The experimental field was a piece of well drained high land with moderately even topography. The soil is neutral in nature with pH 7.8. There were four dates of planting viz. 15 October, 22 October, 29 October and 5 November as main factor levels that arranged in the main plots. Ten canola cultivars (Opera, Karaj3, KR4**,**GA096 x Zarfam ,Okapi x GA096 (2)(5),Orient x Modena (2)(4), Orient x Modena (5)(4) Okapix GA096 **)**GA096 x Zarfam (1) (2), Okapi x GA096 (2) (5), Orient x Modena (2) (4), Orient x Modena (5) (4) Okapi x GA096,GA096 xZarfam, GA096 x Zarfam (5) (1)**,**Okapi x GA096,Okapi x GA096) were considered as the sub factor levels that randomly arranged in the sub plots.

The treatments were arranged in a split plot design in the layout randomized complete block design (RCBD) with three replications having plot size 4m x 1.2m. All other fertilizers and ½ amount of the urea were applied during final land preparation; and the rest ½ of urea were applied at 15 days after seedling emergence. Weeding cum thinning, irrigation, and insect and disease control measures were done as per requirement. At maturity, 10 randomly selected plants were uprooted for data collection. Data were collected on traits such as number of silique per plant, seed per silique, 1000-seed weight, seed yield, biological yield, harvest index, grain filling duration and grain filling rate.

Relationships between traits were investigated 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 by using path coefficient analysis. In this study path analysis was carried out based on method given by Dewey and (Lu ,1959). Data analysis was done using SPSS, Minitab and Path2 soft wares.

RESULTS AND DISCUSSION

Correlation coefficient analysis showed positive and highly significant relationships of all the traits studied except traits plant height, days to flowering initiation, days to physiological maturity, flowering duration and no.pod/plant with seed yield. Correlation coefficient analysis also showed positive and significant relationships of oil yield with the traits plant height, no. seed/pod, 1000-seed weight, biological yield, seed yield, harvest index, biological yield, seed yield and oil percent. Efficacy of these traits as the effective selection criteria in order to genetic improvement of oil yield in canola cultivars have been emphasized by(Golparvar and Karimi, 2012) and (Khayat et al .,2012).

Step-wise regression analysis for seed yield as dependent variable (Table 1) revealed that traits grain filling rate, grain filling duration and biological yield accounted for 98.9% of variation exist in seed yield. Amongst, trait

grain filling rate accounted for 95.7% of total variation designated importance of this trait to explain variation of seed yield. Traits grain filling duration and biological yield accounted for 2.3% and 0.9% of variation of seed yield, respectively (Table 1).

Path analysis for seed yield (Table 2) based on traits entered to regression model indicated that trait grain filling rate has the highest and positive effects on seed yield. Therefore, this trait is introduced as the effective trait for indirect selection of genotypes having higher seed yield specifically in early generations.

Grain filling duration and biological yield have the lowest direct effects on seed yield while their indirect effects on seed yield especially via grain filling rate on this are high and considerable. Therefore, these traits also have potential as selection criteria but with lower than grain filling rate. In this cases, indirect effects are more important than directs.

(Golparvar and Karimi, 2012) showed the efficacy of plant height and days to physiological maturity as indirect selection criteria for genetic improvement of oil yield and the traits biological yield and no. grain/pod for seed yield improvement in canola cultivars especially in early generations of breeding programs.

(Bagheri et al., 2008) reported no. grain/pod as the best indirect selection criteria for genetic improvement of (seed yield in canola genotypes. (Fathi et al., 2003), (Tang et al., 1997) and (Rai et al. ,1993) determined the traits no. grain/pod, no. pod/plant and biological yield as the most efficient criteria for selection superior canola and linseed genotypes especially in early breeding generations. These results are consistent with finding given by my research. Also, the similar results reported by (Farhudi et al., 2008) in canola, (Arslan ,2007), Abolhasani and (Saeidi ,2006) and (Golparvar et al., 2009) in safflower.

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. Stepwise regression and path analysis indicated that the number of pods per plant had the highest direct effect on grain yield. In addition, total dry matter, 1000- grain weight, and flowering and maturity period also had a high direct effect on grain yield. Thus, direct selection for these traits was suggested (Khayat et al., 2012).

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 trait grain filling rate is the best indirect selection criteria for genetic improvement of seed yield in canola cultivars specifically in early generations. On the other hand, seed yield can improved increasingly by using indirect effects of the traits grain filling duration and biological yield via grain filling rate have good potential for this goal.

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