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Research Article

Correlation, Stepwise Regressionand Path Analysis of Traits Affecting Grain Yield of canola (*Brassica napus* L)

Mehdi Soltani Hoveize[1]*, Mohammad Moradi[2], Tayeb Saki-Nejad[3], Saeed Zaker Nejad[4] and Adel Etaa[5]

1- Department of Plant Breeding, Ahvaz Branch, Islamic Azad University, Ahvaz, Iran.
2- Department of Plant Breeding, Shoushtar Branch,, Islamic Azad University, Shoushtar, Iran.
3, 4 and 5- Department of Agronomy, Ahvaz Branch, Islamic Azad University, Ahvaz, Iran.
*Corresponding author: soltani.m@iauahvaz.ac.ir

ABSTRACT

The efficiency of a breeding program depends mainly on the direction of the correlation between yield and its components and the relative importance of each component involved in contributing to seed yield. This study was conducted to analysis the correlation among seed yield and some important traits in seventhin spring canola (*Brassica napus* L.) cultivars at the farm in safi abad, from 2014 to 2015. A randomized complete block design with four replications was used. Results analysis of variance showed that highly significant differences were detected among cultivars for all studied traits. The correlation coefficients among the seed yield and 1000-seed weight, number of seed per pod, duration of flowering, and days to physiological maturity were positive and significant (0.61**, 0.72**, 0.66** and 0.65**, respectively). According to stepwise regression seed yield trait is cosidered by dependent variable and other traits by independent variables. Model determination coefficient is R2=0.897. The most of determination coefficients there were for duration of flowering, number of seed per pod and days to physiological maturity (0.51, 0.54 and 0.38, respectively). Path coefficient analysis revealed that the number of seed per pod, duration of flowering and days to physiological maturity had the largest direct effects on the seed yield, its seams possible to use there traits as a selection criteria in breeding programs for improve seed yield of spring rapeseed cultivars.

Keywords: Correlation, Stepwise regression, Path analysis, Seed yield, Canola

INTRODUCTION

Due to health concerns regarding saturated fat in the human diet, canola (*Brassica* spp.) is becoming an increasingly important source of edible vegetable oil because of its low saturated fat content. Brassica oilseed species now hold the third position among oilseed crops and are an important source of vegetable oil. canola (*Brassica napus* L.) is the third most important edible oil source in the world, after soybean and palm. canola contains an average of 40-50% oil, 25% protein and 20% polysaccharides (Tancturk and Ciftci, 2007). Seed yield is combination of many traits, which are polygenic in nature and it is difficult to make direct selection for these traits.Correlation studies are of interest to plant breeders because traits that are correlated with main breeding objectives may be useful for indirect selection through associated component traits is possible to improve the seed yield. Selections based on simple correlation coefficients without regarding to interactions among yield and yield components may mislead the breeders to reach their main breeding purposes (Garcia del Moral *et al*., 2003).

Therefore, to separate correlation coefficients into components of direct and indirect effects, the path-coefficient analysis provides an excellent tool as it can measure the direct and indirect effects of interrelated components of a complex trait like yield (Tancturk and Ciftci, 2007). Therefore, the path coefficient analysis has been used by many reserchers (Ali *et al*., 2003, Ivanoveska *et al*, 2007, Tuncturk and Ciftci, 2007, Akbar *et al*, 2008; Naderi and Toorchi, 2012) in canola breeding, for complete determination of impact of independent variable on dependent one. The objective of this study was to analyze the correlation between seed yield and related traits in canola by applying path analysis and identifying traits with significant effects on yield for potential use as selection criteria.

MATERIAL AND METHODS

Plant Materials

The study was conducted at dezful in Khuzestan province, Iran (32°22′ N and 48°23′ E, 82 m above sea level) in the year 2010. The type of soil found at this location is clay loam, and its pH = 7.4 with EC = 1.2 mmhos/cm. The experimental material comprised seventhin spring canola (S-83, Hyola401, RG4403, Amica, RGAS0324, RGS006, Kimberley, RG405/02, RG405/03, Sarigol, Hysun110, RGS003, Hyola420, Hyola308, Hyola60, pF and Option500). A randomized complete block design with four replications was used.four rows of five meter length and 30 cm apart were planted for each genotype in each replication. The experiment received all the agronomic and cultural treatments throughout the season.

Measured Traits

The data, 8 different characters, including,plant height (cm), number of pods per plant, number of seeds per pod, 1000-seed weight, duration of flowering, days to physiological maturity and oil content were recorded from randomly selected 10 plants (Ali *et al*., 2003). seed yield(kg/ha) was recorded from each experimental unit (Calıskan *et al*., 1998).

Statistical Analysis

Simple correlation coefficients calculated among all possible combinations of traits related to seed yield. Correlation coefficients among all pairs of variables, standardized regression coefficients and multi regression using stepwise method calculated by using MS-Excel and SAS software version 9 (SAS INSTITUTE INC, 2004) statistical canola. The path coefficient analysis was carried out according to the method of Dewey & Lu (1959). The path coefficient is known as a standardized partial-regression coefficient, and separates the direct and indirect effects of a correlation coefficient.

RESULTS AND DISCUSSION

The genotypes differed significantly ($p<0.01$) for all the traits (Table 1). Range values and mean values with their standard errors, mean squares and C.V levels are summarized in Table 1. Among these genotypes, seed yield ranged from 1792.0 – 3415.0 kg/ha Generally these results are similar to those reported by Aytac and Kinaci (2009), and Sabaghnia, *et. al*., (2010).

Simple correlation coefficients

Simple correlation coefficients calculated among the examined characteristics are given in Table 2. Highly significant and positive correlations were found between seed yield and number of seeds per pod (r =0.72**), 1000-seed weight (r =0.61**), duration of flowering (r =0.66**) and days to physiological maturity (r =0.65**). Tuncturk and Ciftci (2007) reported positive correlation between seed yield with 1000-seed weight in B. napus. The relationships between seed yield and plant height were found negative and significant (r= -0.37*). The relationships between plant height and number of seeds per pod were found negative and highly significant (r =-0.61**). number of seeds per pod was significantly correlated with duration of flowering (r= -0.47*) and days to physiological maturity (r= -0.69**). Akbar et al. (2007) found that number of seeds per pod had significant positive correlation with seed yield in B. Junceae. Number

of pod per plant was significantly correlated with duration of flowering (r= -0.63**) and Oil content (r= -0.37*). Significant positive correlation between plant height and seed yield per plant was reported by Khan and Khan (2003). Chaudhury *et al*. (1990) found positive correlation of plant height with number of seeds per pod. Jeromel *et al*. (2007) and Kumar et al. (1999) reported that in Brassica species, seed yield had positive significant correlation with plant height. 1000-seed weight was significantly correlated with duration of flowering (r= -0.42*), days to physiological maturity (r =0.41*). and Oil content (r= -0.53*). This findings is in agreement with Sabaghnia, *et. al*., (2010) who reported significant correlation of seed yield with plant height and pods per plant. Significant positive correlation was determined between days to physiological maturity and duration of flowering (r= -0.48*). These results confirm the finding of Singh (1974) , Tuncturk and Ciftci (2007) and Naderi and Toorchi (2012). Zhang and Zhou (2006) reported that pods per plant, seeds per plant and 1000-seed weight traits were positively correlated with seed yield. Jeromela *et al*. (2007) studied 30 rapeseed varieties and demonstrated that pods per plant have the highest correlation with seed yield. Khan *et al*. (2006) also reported the positive significant correlation between seed yield and plant height, pods per plant and seeds per pod.

Stage regression

In order to gives a better understanding of the interrelationships among the various variables and also to determine entered traits into regression model. The stage regression analysis was conducted by considering yield-related traits as pridictor variables and seed yield as the response variable. In stage regression analysis entered traits. Duration of flowering, number of seeds per pod, days to physiological maturity and plant height with partial-regression coefficient (0.457, 0.215, 0.123 and 0.102 respectivly) into regression model and accounted for more than 89.7% of observed variation (Table 3). In earlier studies (Khayat et al., 2014; Mohammadjani Asrami et al., 2014, Rameeh and Amoli, 2015) based on stepwise regression analysis, reported that pods per plant and plant height had important role for seed yield prediction it was in rapeseed genotypes. Rameeh (2013) reported that the stepwise regression analysis revealed that plant height and pods per plant significantly had more decreasing and increasing effects respectively on seed yield.

path analysis

path coefficient analysis was performed in order to obtain and interpret information on the nature of interrelationships between seed yield and yield-related traits was conducted (Table 4). Path analysis showed the highest positive direct effect of duration of flowering (p= 0.51), number of seeds per pod (p= 0.54), days to physiological maturity (p= 0.38 and plant height (p= 0.26) on seed yield. duration of flowering had high indirect positive effects on yield via number of seeds per pod. Indirect effects of duration of flowering via days to physiological maturity and plant height on yield was low negative and positive respectively. number of seeds per pod had moderate indirect positive effects on yield via days to physiological maturity and number of seeds per pod, but this trait showed high positive indirect effect via plant height on seed yield. Plant height had high negative indirect effect on seed yield via number of seeds per pod.

Table 1. Range phenotypic variability, mean values with standard error, variety mean squares and CV values in 17 rapeseed cultivars.

	Range	Mean ± SE	Mean square	C.V (%)
Seed yield (kg/ha)	1792.0- 3415.0	2417.2±352.4	8860.4**	12.64
Plant height (cm)	66.0-162.0	97.4±13.0	89.5**	10.63
No. of pods/plant	162.3- 435.4	265.4±47.8	235.7**	18.62
No. of seed /pod	4.3-28.2	21.2±1.5	125.9**	7.38

1000-seed weight (g)	2.1-4.5	2.8±0.4	59.75**	10.71
Duration of flowering	24-39	31±2.57	6.36**	5.16
Days to physiological maturity	160-166	163±2.97	25.17**	2.97
Oil content (%)	32.4-44.5	41.3±2.5	83.14**	4.92

* p<0.05, ** p<0.01

* And ** Significant at 0.05 and 0.01 probability levels, respectively

Table 2. Correlation coefficient among the characteristics 17 rapeseed cultivars

	1	**2**	**3**	**4**	**5**	**6**	**7**
1. seed yield (kg/ha)	1.00						
2. Plant height (cm)	-0.37*	1.00					
3. No. of pods/plant	0.32	0.39*	1.00				
4. No. of seed /pod	0.72**	-0.61**	0.23	1.00			
5. 1000-seed weight (g)	0.61**	-0.26	0.07	-0.31	1.00		
6. Duration of flowering	0.66**	0.12	0.63**	0.47*	0.42*	1.00	
7. Days to physiological maturity	0.65**	0.09	0.19	0.69**	0.41*	0.48*	1.00
8. Oil content (%)	-0.31	0.12	0.37*	0.21	0.53*	0.15	0.25

* p<0.05, ** p<0.01

* and ** Significant at 0.05 and 0.01 probability levels, respectively

Table 3. The results of stepwise regression analysis of studied traits

entered traits into regression	partial-regression coefficient	standard error	F	R^2
Duration of flowering	0.457	19.81	98.13**	0.457
No. of seed /pod	0.215	20.15	56.04**	0.672
Days to physiological maturity	0.123	9.62	36.52*	0.795
Plant height	0.102	17.80	28.07	0.897

* and ** Significant at 0.05 and 0.01 probability levels, respectively

Table 4. Direct(ondiagonal) and indirect effects between seed yield and some related traits in canola

	Duration of flowering	No. of seed /pod	Days to physiological maturity	Plant height	Correlation coefficient	residual effects
Seed yield	**0.51****	0.32	-0.02	0.17	0.66**	
No. of seed /pod	0.36	**0.54****	0.26	0.19	0.72**	
Days to physiological maturity	0.01	-0.03	**0.38***	0.06	0.65**	
Plant height	-0.12	-0.37	-0.03	**0.26**	-0.37*	0.116

* And ** Significant at 0.05 and 0.01 probability levels, respectively

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