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RELATIONSHIPS BETWEEN YIELD AND SOME YİELD COMPONENTS IN RAPESEED (*BRASSICA NAPUS* SSP. *OLEIFERA* L.) CULTIVARS BY USİNG CORRELATION AND PATH ANALYSIS

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Abstract

This research was carried out during 2000, 2001 and 2002 in Van, Turkey to investigate the relationships between yield and some yield components of 16 oilseed rape cultivars (*Brassica napus ssp. oleifera* L.) by using correlation and path coefficient analysis. The results revealed that there were statistically positive correlation between seed yield with the number of branch (r=0.219 **), with number of pods per plant (r=0.424 **), with the number of seeds per pod (r= 0.247 **), and with 1000-seed weight (r= 0.161*). Number of pods per plant, 1000-seed weight and number of seeds per pod have shown a considerable direct positive effect on seed yield. Positive direct effect of number of pods per plant, number of seeds per pod and number of branches per plant was associated with significant and positive correlation with seed yield. These yield components suggested good selection criteria to improve seed yield of rapeseed breeding.

Introduction

Rapeseed is a new crop for Turkey, but it is one of the first oilseeds for world agriculture. Rapeseed contains an average of 40-50% oil, 25% protein and 20% polysaccharides. Rapeseed has some more advantages than soybean and sunflower. Rapeseed resists cold weather and drought more than soybean and sunflower because it leaves field earlier for growing second crops by the farmers.

Most of the traits of interest to breeders are complex and are the result of the interaction of a number of components. Understanding the relationship between yield and its components is of paramount importance for making the best use of these relationships in selection (Sarawgi *et al.,* 1997). The path coefficient analysis helps the breeders to explain direct and indirect effects and hence has extensively been used in breeding experiments in different crop species by various researchers (Shalini *et al*., 2000; Ali *et al*., 2002 Ali *et al*., 2003; Akbar *et al*., 2003).

Seed yield is a complex character determined by several characters having positive or negative effects on this trait. It is important to examine the contribution of each of the trait in order to give more attention to those having the greatest influence on seed yield. Therefore, information on the association of traits with seed yield is of great importance to define selection criteria for rape breeding in terms of yield. Generally, correlation coefficients show relationships among independent characteristics and the degree of linear relation between these characteristics. However, path analysis is necessary to clarify relationships between characteristics deeply because correlation coefficients describe relationships in a simple manner (Korkut *et al.,* 1993). Path coefficient analysis separates the direct effects from the indirect effects through other related characters by partitioning the correlation coefficient (Dixit & Dubey, 1984). Many breeders were involved in analyzing the path coefficient. Usefulness of information obtained from correlation can be enhanced by partitioning them into direct and indirect effects for a set

of a prior cause-and- effect interrelationships (Kang *et al.,* 1983; Gravois & McNew, 1993).

High heritability estimates associated with high genetic advance for plant height, pods per plant and seed yield were reported by Sing & Singh (1997). Sheikh *et al.,* (1999), found positive and significant relationships between seed yield and primary and secondary branches, seed weight and pods per plant in rapeseed genotypes. Özer *et al.,* (1999) stated that number of seeds per pod, pod diameter and pod length would not be as good an effective selection criterion as 1000-seed weight and number of pods per plant.

Many researches determined that the number of pods per plant, the number of seeds per pod, harvest index and 1000-seed weight are the most important characters for yield of rapeseed (Algan & Aygün, 2001; Seifert & Boelcke, 1977; Singh, 1974; Çalışkan *et al.,* 1998). In the present study, we used 16 rapeseed cultivars to determine relationships between yield and yield components using correlation and path coefficient analysis.

Material and Methods

This study was carried out in irrigated conditions during 2000, 2001 and 2002 in the East of Turkey (38^0 18′ N, 43^0 07′ E, 14.6 C^o mean temperature, average rainfall 378.4 mm) (Anonymous, 2002). The study site had sandy-loamy-clay soil.

The experiment included 16 rapeseed cultivars (Jaguar, Marinca, Semu DNK 207 Na, Regent, Westar, Tobin, Semu 209/81, Tower, Liraspa, Lisonne, Lirawell, Prota, Spok, Kosa, Star, Helios). The field experiment was arranged in a randomized block design with three replications. Seven rows of four meter length and 40 cm apart were planted for each genotype in each replication. The experiment received all the agronomic and cultural treatments throughout the season for each experimental year. The data, 6 different characters, including plant height (cm), number of pods per plant, number of seeds per pod, number of branches per plant, 1000-seed weight, and oil content were recorded from randomly selected 10 plants (Ali *et al.,* 2003). Seed yield (kg/ha) was recorded from each experimental unit (Çalışkan *et al.*, 1998).

Phenotypic correlations among traits were calculated in the usual manner and 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. Hence, the path analysis plays an important role in determining the degree of relationship between the yield and yield components.

Results and Discussion

The genotypes differed significantly ($p<0.01$) except oil content ($p<0.05$) 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 912.0 – 1692.0 kg/ha and the highest yield were found as 1436.0 kg/ha and 1395.0 kg/ha in Westar and Marinca genotypes respectively. The highest plant height (109.6 cm) and number of branches (4.3) was recorded in Tobin cultivar. The cultivar Regent produced maximum pods/plant as 88.1. The highest seeds/pod was obtained from Marinca cultivar (25.9). The highest 1000-seed weight was recorded from Star and Waster cultivars as 4.05 g - 4.04 g respectively. Jaguar genotypes had the highest oil content (38.2%) in this experiment. The average of three years showed that the lowest C.V level was obtained from the oil content as 8.30%. The highest C.V level was obtained from the number of branches per plant as 23.14%.

Table 1. Range phenotypic variability, mean values with standard error, variety mean squares and CV values in 16 rapeseed cultivars.

	Range	Mean ± SE	Mean square	C.V (%)
Seed yield (kg/ha)	974.0 – 1436.0	1160 ± 1.23	1482.8 **	12.73
Plant height (cm)	90.0 – 109.6	100.7 ± 0.71	326.3 **	8.44
No. of branches/plant	3.1 – 4.3	3.4 ± 0.07	1.6 **	23.14
No. of pods / plant	64.2 – 88.1	75.9 ± 1.10	463.3 **	17.40
No. of seeds/pod	19.8 - 25.9	22.9 ± 0.20	16.8 **	10.63
1000-seed weight (g)	2.6 – 4.05	3.2 ± 0.01	1.7 **	14.76
Oil content (%)	34.0 – 38.2	36.8 ± 0.25	13.8 *	8.30

* p<0.05, ** p<0.01

Table 2. Correlation coefficient among the Characteristics 16 rape cultivars.

	1	2	3	4	5	6	7
1- Plant height	1.00						
2- Number of branches	0.145	1.00					
3- Number of pods per plant	0.045	0.387**	1.00				
4- Number of seeds per pod	0.096	-0.277**	0.209**	1.00			
5- 1000-seed weight	-0.180 *	-0.182*	-0.202*	0.086	1.00		
6- Oil content	-0.124	-0.003	0.044	-0.028	0.111	1.00	
7- Seed yield	0.136	0.219**	0.424**	0.247 **	0.161 *	0.002	1.00

** (p<0.01) * (p<0.05)

Table 3. Path coefficient for seed yield of some rapeseed cultivars

Özellikler	Direct effect	Indirect effects						Total indirect effect	Total effect
		1	2	3	4	5	6		
1. Plant height (cm)	0.127		0.022	0.017	0.017	-0.050	0.003	0.009	0.136
2. Number of branches	0.152	0.018		0.147	-0.048	-0.050	0.000	0.067	0.219**
3. Number of pods/plant	0.380	0.006	0.059		0.036	-0.056	-0.001	0.044	0.424**
4. Number of seeds/pod	0.173	0.012	-0.042	0.079		0.024	0.001	0.074	0.247**
5. 1000-seed weight	0.276	-0.023	-0.028	-0.077	0.016		-0.003	-0.116	0.161*
6. Oil content	-0.025	-0.016	0.000	0.017	-0.005	0.031		0.026	0.002

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 branches (r= 219 **), number of pods per plant (r= 424**), number of seeds per pod (r= 247**) and 1000-seed weight (r= 0.161*). The relationships between seed yield and plant height (r= 0.136) and oil content (r= 0.002) were found positive but non significant. These results confirm the finding of Singh (1974); Özer *et al.,* (1993); Çalışkan *et al.,* (1998); Algan & Aygün (2001).

The direct and indirect effect values from path analysis are shown in Table 3. Path analysis showed the highest positive direct effect of pods/plant on yield (p= 0.380). This character was followed by 1000-seed weight (p= 0.276), number of seeds per pod (p= 0.173), number of branches per plant (p= 0.152) and plant height (p= 0.127) (Table 3). Indirect effects of number of pods per plant via plant height, number of branches per plant and number of seeds per pod were moderate and positive. 1000-seed weight had moderate indirect positive effects on yield via number of seeds per pod. Indirect effects of seeds/pod via number of pods per plant were also positive and moderate to high. The number of branches showed high positive indirect effect via pods/plant. Plant height had positive and moderate indirect effect on seed yield via branches/plant, pods/plant and seeds per pod.

High values of direct effect of number of pods per plant approached the value of correlation coefficient of this character with seed yield. Therefore direct selection through pods/plant would be effective. 1000-seed weight and number of seeds per pod also had high direct effect on seed yield and these characters are also effective. Such similar reports have been made by Singh (1974); Seifert & Boelcke (1977); Özer *et al.,* (1999); Algan & Aygün, (2001) which confirmed our results.

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