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GENETIC VARIABILITY COMPONENTS OF SOME QUANTITATIVE TRAITS OF WINTER OILSEED RAPE (*BRASSICA NAPUS* L.)

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Marinković R., A. Marjanović-Jeromela, and D. Vasić (2003): *Genetic variability components of some quantitative traits of winter oilseed rape (Brassica napus L.).* – Genetika, Vol. 35, No. 3, 199-205.

Analysis of genetic variance components for number of leaves and branches per plant and stem diameter was done according to the method of HAYMAN (1954). Heritability in narrow (h^2_a) and broad (h^2_b) sense was determined for the same traits, using the method of MATHER and JINKS (1971). Non-additive component of genetic variance was greater than additive component in all three studied traits. Dominant and recessive genes were not equally distributed in parent genotypes, with dominant genes prevailing. Ratio $(H_1/D)^{1/2}$ was higher than 1 in all three tested traits. Calculated values for heritability in narrow sense showed that stem diameter and number of branches per plant are traits with low heritability, and number of leaves per plant a trait with the high heritability. Heritability in a broad sense was high for all three tested traits.

Key words: cultivar, diallel crosses, heritability, additivity, dominance

INTRODUCTION

High adaptability of oilseed rape to environmental conditions has made this crop widely grown across the globe. In the past eight years, oilseed rape has

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been grown on an area ranging from 21,780,675 ha (1995) to 27,827,006 ha (1998) (FAO Stat.) and has become one of the four most important oil crops in the world (Table 1). At present, oilseed rape is perhaps the only crop that can be used as an alternative to sunflower in providing a further increase of oil production. Besides this, oilseed rape is an excellent preceding crop to many other crop species due to its growing technology, well developed root system, rapid growth of the above-ground plant mass, and early harvesting (MARINKOVIĆ and MARJANOVIĆ-JEROMELA, 2003).

An increase of acreage in oilseed rape in regions where this crop is already grown and its spread to regions where this not yet the case both depend first and foremost on cultivar and hybrid characteristics, most notably genetic potential for seed yield per unit area. Since yield is a complex trait that depends on a large number of factors and quantitative plant and seed traits and their interactions, it is necessary to know the mode of inheritance, gene action and heritability of these traits, because this type of knowledge is the basis for developing desirable genotypes of this species.

In view of this, the objective of our study was to investigate components of genetic variability, gene effects and broad and narrow sense heritability of leaf and primary branch number per plant and stem diameter using diallel crosses.

MATERIALS AND METHODS

Genetic materials used in the study consisted of five winter cultivars of oilseed rape, namely Falcon, Banaćanka, Sremica, Jet Neuf and Samuray. The cultivars were subjected to half dialell crosses. Plants used asthefemale parent were emasculated manually in the early morning hours to prevent self-pollination.

A trial with hybrid combinations and parents was established at the Rimski Šančevi Experiment Field of the Institute of Field and Vegetable Crops in Novi Sad. The experimental materials were sown by hand in a well-prepared soil in the first half of September. The materials were planted in four five-meter long rows 25 cm apart with a plant-to-plant spacing of 5-6 cm using a randomized block design with three replicates. During the growing season, the plants were hoed to suppress weed plants not destroyed by previous pesticide applications. Since several seeds were planted per hill, stand adjustment was made at the B3-B4 stage of plant development.

All three traits were analyzed during the growing season and the size of the sample used for analysis was 33 plants per treatment at trial level.

Analysis of variance was done according to HADŽIVUKOVIĆ (1973), components of genetic variability and gene action were determined according to HAYMAN (1954), while narrow (h^2a) and broad (h^2b) sense heritability were calculated according to MATHER and JINKS (1971).

Tab. 1. Area (ha) of the most importance oil crops in the World (FAO Stat.)

Plant	Years							
	1995./96.	1996./97.	1997./98.	1998./99.	1999./00.	2000./01.	2001./02.	2002./03.
Soybeans	61081657	66947742	70976129	71890029	74150573	76368403	76077867	79167520
Oilseed rape	21780675	23557519	25938245	27827006	26180348	24014608	22396754	22855090
Sunflower	20438029	18753578	20695661	23242545	20976949	18125807	18015858	19568213
Groundnuts in shell	22542515	22518051	23436940	23477490	23539668	25101680	25231880	25863695
Palma	8376885	8659721	8995229	9283499	9633501	9652801	10592940	10782450
Seed cotton	34533000	33868477	33426637	32570387	31876047	33885655	34433546	32281621

RESULTS AND DISCUSSION

The analysis of genetic variance components showed that the dominant component (H_1 and H_2) was greater than the additive one (D), indicating that the nonadditive component accounted for most of the genetic variance in the inheritance of all three traits looking at all the combinations (Table 2).

Table 2. Components of genetic variability in 5 x 5 diallel crosses in rapeseed

Components	Traits		
	№ leaves/plant	№ of primary branches/plant	Stem diameter (cm)
V_r	1.25	0.36	0.02
W_r	0.78	0.07	0.00
V_p	2.16	0.39	0.00
V_m	0.35	0.07	0.00
D	2.07	0.10	-0.001
H_1	3.81	0.80	0.06
H_2	3.40	0.56	0.05
F	1.09	0.15	0.01
E	0.09	0.30	0.01
u	0.66	0.77	0.71
v	0.34	0.23	0.29
$(H_1/D)^{1/2}$	1.36	2.85	10.40
$H_2/4H_1=uv$	0.22	0.18	0.21
$[(4DH)^{1/2}+F]/[(4DH_1)^{1/2}-F]$	1.48	1.75	4.29
h^2a	42.31	17.02	7.69
h^2b	94.37	43.73	74.36

The predominant role of the nonadditive component of genetic variance in the inheritance of number of primary branches per plant has also been reported by GUPTA *et al.* (1987) for *Brassica juncea* (L.) Czern & Coss. However, a number of studies have also reported the predominance of the additive component in the inheritance of this trait, namely SINGH *et al.* (2001) for *Brassica campestris* L. var. sarson Prain and SINGH *et al.* (1986), WANG and WANG (1986) and SINGH and CHAUHAN (1987) for *Brassica juncea* (L.) Czern & Coss. BADWAL and LABANA (1987) studied *Brassica juncea* (L.) Czern & Coss and found that both the additive and nonadditive components were highly significant in the inheritance of primary branch number per plant. They determined that both the components had importance in the inheritance of stem thickness as well.

Findings of RINGDAHL *et al.* (1986) differ from those reported in the present paper with respect to gene action in the inheritance of leaf number per plant. The said authors found the additive component of genetic variance to have played the predominant role in the inheritance of this trait in *Brassica napus* L.

All three F values were positive, leading us to conclude that dominant genes prevailed over recessive ones in the expression of the traits under study in the selected cultivars. This was further supported by the results of the K_D/K_R expression we calculated.

Dominant (*u*) and recessive genes (*v*) genes were not distributed equally in the parents ($H_2/4H_1$=0.22; 0.18; 0.21). When dominant and recessive genes are distributed evenly in a set of parents, the value of the above expression is 0.25. In our paper, the frequency of dominant genes was higher than that of recessive ones in the case of all three traits.

The calculated values of $(H_1/D)^{1/2}$, which indicate the average degree of dominance, were higher than the value of one in all three traits, suggesting we had superdominance in the inheritance of the traits in the F_1 generation with all the combinations considered.

The calculated values of narrow sense heritability for all three traits showed that the heritability was the largest (42.31%) in the case of leaf number per plant and the smallest for stem diameter (7.69%). This means that the pedigree and recurrent selection methods would provide a greater success rate with the former trait.

High broad sense heritability has been reported by SINGH and MISHRA (2001) for number of primary branches per plant and by RINGDAHL *et al.* (1986) for leaf number per plant.

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KOMPONENTE GENETIČKE VARIJABILNOSTI NEKIH KVANTITATIVNIH SVOJSTAVA OZIME ULJANE REPICE (*BRASSICA NAPUS* L.)

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Izvod

Analiza komponenti genetičke varijanse rađena prema HAYMAN (1954) i heritabilnost u užem (h^2_a) i širem (h^2_b) smislu rađena prema MATHER i JINKS (1971) urađeni su za broj listova i primarnih grana po biljci i prečnik stabla. Neaditivna komponenta genetičke varijanse bila je veća od aditivne komponente kod sva tri proučavana svojstva. Dominantni i recesivni geni nisu bili podjednako raspoređeni kod roditeljskih genotipova, a preovladavali su geni sa dominantnim efektima. Odnos $(H_1/D)^{1/2}$ je bio veći od jedinice kod sva tri navedena svojstva. Izračunate vrednosti za heritabilnost u užem smislu (h^2_a) ukazuju da su prečnik stabla i broj primarnih grana po biljci niskonasledna svojstva, a broj listova po biljci visokonasledno svojstvo. Heritabilnost u širem smislu (h^2_b) bila je visoka kod sva tri proučavana svojstva.

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