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Original scientific paper

INHERITANCE OF SOME MORPHOLOGICAL TRAITS IN HYBRIDIZATION OF GRAPEVINE CULTIVARS DRENAK CRVENI AND AFUZ-ALI

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The variability and mode of inheritance of young shoot tip, leaf, grape and berry morphological characteristics were investigated in F1 generation obtained by crossing of Drenak crveni and Afuz-ali. Based on seedlings description, considering investigated characteristics, grouping was done by applying O.I.V. method. The conclusions about inheritance of characteristics were obtained based on results of $\chi 2$ test. The consider able variability was expressed in hybrid population. For properties of leaf characteristics (largeness, shape, dividity, and incisions), exception from typical monogenic ratio was determined. The monohybrid inheritance was determined in density of leaf hairs and downs. The monohybrid mode of inheritance was not confirmed in grape characteristics (largeness, com pactness and stem length) and berry characteristics (largeness, shape and taste), while skin color is monogenic property.

Key words: variability, monogenic inheritance, morphological charac teristics, F_1 generation, grapevine

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INTRODUCTION

The Drenak crveni and Afuz-ali cultivars are standard table cultivars pos sessing very good traits, primarily those of quality grapes and high yield under optimum fertilization. The grapes are of favorable mechanical properties, trans portability, and can be kept stored throughout the winter. Functionally, the female flower characteristic of cv. Drenak crveni is often the reason for producing low yield due to poor berry setting which leads to meager bunches.

The aim of hybridizing those two cultivars was to develop a cultivar of Drenak crveni type of hermaphrodite flower, earlier maturation, better yielding properties and better quality grapes.

MATERIAL AND METHODS

Trials were carried out on Experimental field Radmilovac of Agricultural Faculty, Zemun. Trials comprised 130 seedlings of F_1 generation obtained by crossing Drenak crveni x Afuz-ali. The description of a leaf, bunch and berry was done using the OIV (1983) descriptor for characterizing cultivars and grape vine species. The description of a developed leaf included its size, shape, division, up per margins form, and density of lodged and erect hairs. The description of a bunch involved bunch size and compactness and stalk length, whereas that of a berry its size, shape, skin color and taste. Also, monitoring was done of parents' traits, rep resented by 10 grapevines each, in order to provide for making comparisons and genetic analysis of the observed traits.

In establishing the mode of inheritance of traits, such as developed leaf, bunch and berry, we started from the assumption that those were qualitative, monogenic traits. To describe the variability of studied traits in a hybrid progeny, seedlings were principally arranged into a larger number of categories as pre scribed by the OIV descriptor. However, in determining the mode of traits' inheri tance, the grouping of allied seedlings was done as well as formation of two or three phenotype seedlings classes, (Table 1).

The significance of differences between experimental and theoretical val ues for monogenic segregation levels was found by using χ^2 test. For a majority of traits studied herein, we set out from the assumption that they are characterized by the dominant–recessive type of inheritance, so that the segregation levels obtained in F_1 generation were tested as 3 : 1 or 1 : 1, depending on whether the parents' phenotype in respect of those traits was identical or different. For leaf size and number of lobes, bunch size and stalk length and berry size, we hypothesized that intermediary type of inheritance is their characteristic, therefore the expected seg regation levels in progeny were determined based on it.

RESULTS AND DISCUSSION

The crossing of cv. Drenak crveni that possesses a large-sized leaf with cv. Afuz-ali that has a medium-sized leaf produced the progeny, where 36.2% of seedlings had a small-sized leaf as well as 13.8% of seedlings with a large-sized

leaf and 50% of seedlings with a medium-sized leaf (Fig. 1). In both grapevine cultivars, parent partners possessed pentagonal-shaped leaf. In the progeny, pre dominant are also seedlings with pentagonal-shaped leaf (91.8%) compared to seedlings with round-shaped leaf (8.2%). Similarly, as to leaf shape, parent part ners did not differ in the number of lobes in a developed leaf either; they are char acterized by a five-part leaf. The highest number of F_1 generation seedlings (94.6%) also had a five-part leaf, however, seedlings (5.4%) with a seven-part leaf emerge too (Fig. 2, 3).

Table 1. Inheritance of leaf, bunch and berres traits

	Traits	Phenotype of parents		Segregation levels in F_1 generation			X^2
		Drenak crveni	Afuz-ali	Category	Obtained	Expected	
Leaf	Size	large	medium	large: medium: small	47:65:18	1:1:0	-
	Shape	pentagonal	pentagonal	pentagonal: round	119:11	3:1	18.96**
	Division	five-part	five-part	tree-part: five: seven-part	0:123:7	1:2:1	-
	Upper margins form	closed	closed	closed: open	122:8	3:1	24.63**
	Lodged hairs	presence	absent	presence: absent	76:54	1:1	3.72
	Erect hairs	presence	absent	presence: absent	72:58	1:1	1.51
Grape	Size	large	large	large: medium: small	43:70:17	1:0:0	-
	Compactness	compact	meager	compact: meager	98:32	1:1	33.51**
	Stalk length	medium	short	long: medium: short	0:78:52	0:1:1	5.20
Berry	Size	large	large	large: medium: short	84:43:3	1:0:0	-
	Shape	egg-shaped	oval	oval: round	127:3	1:1	38.16**
	Skin color	colored	uncolored	colored: uncolored	76:54	1:1	3.72
	Taste	tasteful	tasteful	tasteful: tasteless	108:22	1:1	4.52*

**P<0.01; * P<0.05

By crossing cv. Drenak crveni that possesses a closed upper margins form with cv. Afuz-ali that has a weakly overlapped upper margins form, the distribution

found for the obtained progeny was as follows: 6% of seedlings had open, 24% closed, 58% weakly overlapped and 10% markedly overlapped upper margins form.

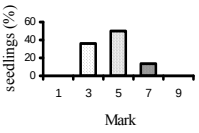

Fig. 1. Dimension of developed leaf

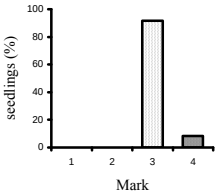

Fig. 2. Leaf shape

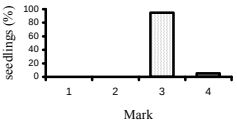

Fig. 3. Leaf division

Medium density of lodged hairs and low density of erect hairs on a leaf back side is characteristic of cv. Drenak crveni, whereas the absence of both types of hairs on a leaf back side is characteristic of cv. Afuz-ali. In the progeny devel oped by crossing those two cultivars, apart from seedlings grouped into identical categories based on the two traits just like their parents, seedlings with two differ ent types of hair density were also obtained (Fig. 4-6).

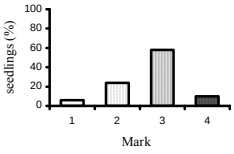

Fig. 4. Upper margines form

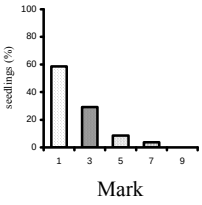

Fig. 5. Density of lodged hairs on the leaf

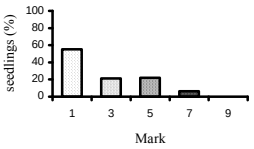

Fig. 6. Density of erect hairs on the leaf

One of the primary aims in selecting table grapevine cultivars is related to bunch and berry characteristics. It is therefore of importance to determine the mode of inheritance of those traits in order to find out how to select parents for hybridi zation i.e. for developing new cultivars.

The crossing of cv. Drenak crveni, characterized by large bunches, with cv. Afuz-ali, characterized by very large bunches, produced progeny where 4.7% of seedlings possessed a very small bunch, 8.5% a small bunch, 53.8% a medium-sized bunch, 31.5% a large bunch and 1.2% a very large bunch.

As to compactness of bunches, cv. Drenak crveni has a compact bunch, while cv. Afuz-ali a meager bunch. In their progeny, 2.5% of seedlings had a very meager bunch, 22.2% a meager bunch, 40.7% a medium-compact bunch, and 34.6% a compact bunch.

A medium-long bunch stalk is characteristic of cv. Drenak crveni, whereas a short bunch stalk is characteristic of cv. Afuz-ali. Their progeny is dominated by seedlings arranged into the same categories as their parents (40% of seedlings have medium-long bunch stalk and 33.8% have short bunch stalk), how ever, there emerge seedlings with a very short bunch stalk (26.2%).

Grapevine cultivars used as parent partners as well as the majority of F_1 generation seedlings (62.2%) had a large-sized berry. In addition, in hybrid prog eny 2.4% of seedlings had a small-sized berry, 32.9% a medium-sized berry and 2.4% a very large-sized berry.

The berry of cv. Drenak crveni is egg-shaped and of cv. Afuz-ali short-oval. Of their progeny, 2.4% of seedlings have a round berry, 67.1% an oval berry, 18.3% an egg-shaped berry, 7.3% a blunt oval berry and 4.9% a longish-shaped berry.

Berry taste is a prominent characteristic of table grapevine cultivars. Both parent partners are characterized by tasty berries. In seedlings developed by cross ing them, 83.1% have tasty berries and 16.9% possess berries of neutral taste (Fig. 7-13).

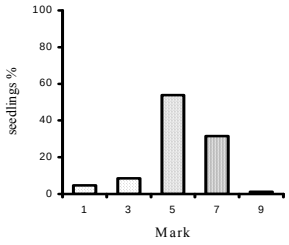

Fig. 7. Bunch size

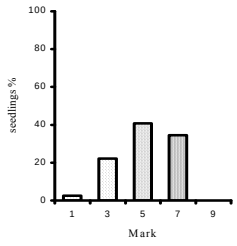

Fig . 8. Bunch compactness

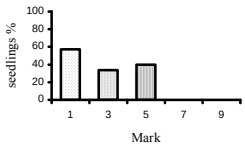

Fig. 9. Stalk length

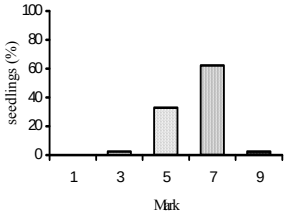

Fig.10. Berry size

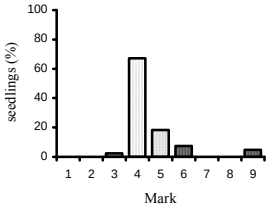

Fig. 11. Berry shape

Grouping of seedlings from allied categories was done through establish ing the mode of inheritance of bunch and berry traits. To check the hypothesis on intermediary type inheritance of leaf size, 130 seedlings of F_1 generation were clas sified into three categories (large, medium and small) within the ratio 47:65:18. Since a large leaf is characteristic of cv. Drenak crveni and a medium-sized leaf of

cv. Afuz-ali, in this case progeny is not expected to produce seedlings with small leaves. Therefore, χ^2 value was not calculated but it is assumed to be a monogenic trait immediately neglected. Due to the fact that in the progeny there emerged seedlings with small leaves, it can be assumed that the expression of this trait is conditioned by a larger number of genes.

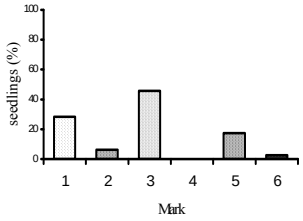

Fig.12. Skin color

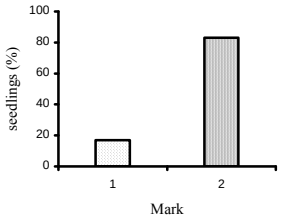

Fig.13. Berry taste

The hypothesis on monohybrid inheritance was not proved either for leaf shape, or number of lobes, or upper margins form, because the calculated χ^2 values for those traits were higher than tabular values for the 0.01 probability. To more accurately establish the mode of inheritance of those traits, they should be tested through a greater number of crossing combinations, where parent partners would be selected for all phenotype categories of the traits described in the OIV descrip tor.

In establishing the mode of inheritance of the density of lodged and den sity of erect hairs on a leaf back side, seedlings were grouped into two phenotype classes: seedlings having hairs and seedlings not having hairs on a leaf back side. The segregation levels obtained in F_1 generation for both traits were tested as 1:1 ratio because parent cultivars differed in those traits. By applying the χ^2 test, it was found that the obtained levels correspond to those expected, whereby it was proved that these are monogenic traits. Cv. Drenak crveni characterized by both types of hairs on a leaf back side is heterozygous for those genes, while cv. Afuz-ali, having no hairs, is in its genotype a recessive homozygote for those two genes.

On the basis of 17 different crossing combinations, MATEVSKA (1972) found that the presence of erect hairs on a leaf back side is a dominant trait com pared to cobwebby hairiness.

Deviations from the tested segregation level characteristic of monogenic inheritance (1:0:0, 1:1 and 0:1:1) were found for bunch traits studied in the present work, therefore they can be assumed to be polygenic traits. The influence of a lar ger number of genes on bunch size was also reported by GOLODRIGA *et al.* (1975). The phenomenon observed in the present work, where it was found that progeny developed by crossing two cultivars which possess large bunches is domi nated by seedlings with small bunches, was also reported by PEJKIĆ (1981) and MILUTINOVIĆ *et al*. (2000).

A great number of authors studied the mode of inheritance of berry traits. On the basis of crossing results, IVANOV and VLCHEV (1967), POTAPENKO and KOSTRIKIN (1972) and MATEVSKA (1972) point out that intermediary in heritance is characteristic of berry size. FILIPENKO and LEBEDEV (1969) report that numerous hybrid progenies obtained by crossing sp. *Vitis vinifera* x sp. *Vitis amuriensis* are dominated by a longish berry shape. ZANKOV and TODODROV (1985), using the results for 11 hybrid progenies, found that berry shape is a poly genic trait, and that berry taste has a high segregation level in the progeny. RASMUSON (1916, cit. after TROSHIN, 1990) considers that berry skin color is de termined by two major genes with the recessive epistasy type of interaction, while MAKIENKO (1975) points out that berry skin color is also conditioned by two genes but with the complementary type of interaction. HUSFELD (1932, cit. after PEJKIĆ, 1980) states that skin berry color is determined by a single gene with 4 alleles (multiple alleles).

In the present paper it has not been proved by the results of χ^2 test that berry size, shape and taste are monogenic traits, because there is a significant de viation between the obtained and expected values, therefore other explanations have to be looked for. The assumption that berry skin color is a monogenic trait was proved, since the obtained segregation level between seedlings with colored and non-colored berry skin corresponds to the level expected.

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NASLEĐIVANJE NEKIH MORFOLOŠKIH OSOBINA PRI HIBRIDIZACIJI SORTI VINOVE LOZE DRENAK CRVENI I AFUZ-ALI

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I z v o d

Praćene su varijabilnost i način nasleđivanja morfoloških osobina vrha mladog lastara, lista, grozda i bobice u F_1 generaciji nastaloj ukrštanjem sorti Drenak crveni i Afuz-ali. Na osnovu opisa sejanaca izvršeno njihovo grupisanje po posmatranim obeležjima primenom propisane metode O.I.V-a. Zaključci o načinu nasleđivanja posmatranih osobina doneti su na osnovu rezultata χ^2 testa. U hibrid nom potomstvu ispoljena je znatna varijabilnost svih proučavanih osobina. Za osobine razvijenog lista (veličina, oblik, izdeljenost, forma ureza) utvrđeno je od stupanje od odnosa razdvajanja karakterističnog za monogensko nasleđivanje. Za osobine lista kao što su gustina dugih i kratkih malja utvrđeno je da se nasleđuju monogenski. Od osobina grozda i bobice monogenski način nasleđivanja nije pot vrđen kod veličine grozda, zbijenosti bobica, dužine peteljke, veličine, oblika i ukusa bobica, dok se boja pokožice nasleđuje monogenski.

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