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AMPELOGRAPHIC EVALUATION OF POPULATION AND CLONES OF MISKET VRACHANSKI VARIETY

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Abstract

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A comparative ampelographic evaluation of population and clones of Misket vrachanski variety through a model built of two statistical methods – factor and regression analysis is accomplished. The method of research gave analytical possibility to reduce the number of the indicators, studied, grouped, correlated and non-correlated indicators in different factors, which according to the individual team goals were objective assessed. The clones 52/8 and 34/24 differ the most from the population according to the factor distribution of the phenologic indicators; all studied clones – according to their potential and real fertility; 9/5, 34/24 и 52/8 – according to the yield; 9/5 и 34/24 – according to the mechanical analysis of bunch and grape.

Key words: vine, population and clones of Misket vrachanski variety, agro-biological and technological indicators, mathematical modeling

Introduction

The improvement of the economic characteristics of the grown in Bulgaria old local varieties through choice of valuable clones is an important task in the vine selection. By 1990 over 2400 clones of the most popular and grown vine varieties and pads are created in the world (Clarke and Rande, 2001). The clone selection of the wine vine varieties is more strongly developed and is connected with the increase of the quality requirements to both the grapes and wine obtained (Robinson, 2006). The Misket vrachanski variety is characterized with esteemed technological features and has to be widespread in more suitable for its growth micro regions in order quality and specific white misket wines to be produced (Roychev, 2012). This variety has no well known variations and clones so far. In order the efficiency of the individual choice for this variety to be increased it is necessary the use of methods which eliminate the strongly varying agro-biological and technological indicators with insignificant influence over its economic characteristic but with no significant loss of ampelographic information about various clones and population. The superiority of the chosen clones over the initial varieties according to one or more signs has to be confirmed through statistical processing of the experimental data. (Pogosyan et al., 1974; Soldatov, 1974).

The aim of this study is by the application of the factor and regression analysis to be estimated the influence of the various resulting ampelographic indicator known to be economically most significant for the population and selected clones of Misket vrachanski variety.

Materials and Methods

The study is carried out with 25 vines from the population and 25 chosen clones of Misket vrachanski variety, grown in the Viticulture and wine producing institute – Pleven. Biometric data for the different indicators has been gathering during four consecutive years (2008-2011).

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Through the applied factor analysis it is achieved a reduction of the variables number in the extract studied, grouping of the correlated ones in between into common factor and separation of the non-correlated into different factors (Bryant and Yarnold, 1994; Iliev et al., 2008a, 2008b; Gocheva-Ilieva and Iliev, 2009; Mokreva and Roychev, 2013). The studied indicators are differentiated in six groups and in each one an indicator is chosen as most dependent by the rest: phenology – budding – technological maturity; strength of growth – mass of one year shoot mature part; winter eyes potential fertility – potential fertility coefficient based on all buds; actual fertility – shoot actual fertility coefficient; yield – average grapes yield of a vine; cluster and berry mechanical and chemical analysis – 100 berries average mass. The strength of the correlation between them is estimated according to the following scale: 0–0,2 – presence of correlation; 0,2–0,4 – weak correlation; 0,4–0,6 – low correlation (moderate); 0,6–0,8 – significant correlation; 0,8–1,0 – strong correlation (Vundev, 1999; Naydenova, 2000). The statistical program SPSS for Windows is used for processing and analysis of the information obtained.

Results and Discussion

The obtained results from the phenologic data analysis show that during the period of budding – technological maturity mainly two factors influence over the population and almost all clones of Vraca misket variety and each of them embrace different indicators (Table 1). The weakest is the rate of budding to the population and 32/12. In the first factor (F_1) more indicators are included: inflorescence – interspersing (softening) of berries. The indicators for the clones 9/5, 32/1 and 32/12 are nearer to those of the population. The second factor (F_2) embraces budding (9/5 and 32/1); interspersing (softening) of berries (population and 32/12); budding – inflorescence (32/12); inflorescence – interspersing (softening) of berries (34/24) and interspersing (softening) of berries – technological maturity (34/24). In the clone 52/8 three factors with different indicators take part in the formation of the last indicator. In the group of clones 9/5, 32/1, 32/12 and the population, F_1 takes part in the formation of the indicators with 52% – 69%, and F_2 – with 18% – 27%. The greatest difference from the population show 52/8 и 34/24, in which F_1 is 39% – 51 %, F_2 is 36% – 39% and F_3 – 25%. The standardized coefficients (Beta) show the direct influence of the general factors (F_1, F_2, F_3) over the chosen as the most significant economic indicator in this group: budding – technological maturity (Table 2). With the most positive influence for the most of the clones is F_1 – from 0.367 (32/12) to 0.899 (population). Only for the clone 34/24, this factors is with negative direct impact (–0.082) over the dependent indicator. For F_2 this coefficient has greater values for 34/24 (0.875), 52/8 (0.596) and F_3 – 0.500. The coefficients of the regression model for F_1 are statistically significant for all variants as the levels of significance (Sig) are smaller than the mistake $\alpha = 0.005$. For the clones 9/5, 32/12 and 34/24 factor F_2 is with incidental regression coefficients and the indicators included in it are of no significance for the dependent variable studied. The plural coefficient of correlation (R) is biggest for clone 52/8 – 0.999, followed by 34/24 – 0.979 and the population – 0.921, which means strong positive correlation. Presence of weak correlation (0.369) is estimated for 32/12. Coefficients for determination (R^2) are in the limits of 0.998 (52/8) to 0.136 (32/12). For the population this indicator is also high – 0.849. When transformed into percentage the strongest influence show the factors F_1, F_2 и F_3 – 99,8 % (for 52/8), 77,2 % (for 34/24) and 84.9 % (for population) respectively.

Table 1

Factor distribution of phenological indicators (days) in the population and the clones of Misket vrachanski variety

Indicators	Misket vrachanski variety		Clone 9/5		Clone 32/1		Clone 32/12		Clone 34/24		Clone 52/8		
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_3
Budding				0.976		0.981			-0.933		-0.635		0.772
Inflorescence	0.806		0.909		0.967		0.762		0.707	-0.632		0.954	
Interspersing (softening)		0.954	0.892		0.832			0.891	0.905				0.925
Budding-Inflorescence	-0.963		-0.913		-0.911		-0.61	0.523	-0.905		-0.871		
Inflorescence-Interspersing (softening)	0.876		0.877		0.886		0.951			0.949	0.978		
Interspersing (softening)-Technological maturity	0.784		0.807		0.94		0.842			0.846		0.986	
Factor impact	**59%**	**27%**	**65%**	**19%**	**69%**	**18%**	**52%**	**24%**	**51%**	**39%**	**39%**	**36%**	**25%**

Table 2

Regression model coefficients of the phenological indicators for the population and the clones of Misket vrachanski variety

Variety	Factors	Regression coefficient B	Standard error	Standartized coefficient of regression Beta	Student's test (t)	Significance level (Sig)
Misket vrachanski population	Constant	163.6	0.141		1162.097	0.000
	F_1	1.167	0.146	0.899	8.007	0.000
	F_2	-0.263	0.146	-0.203	-1.808	0.096
	R = 0.921	R^2 = 0.849				
Clone 9/5	Constant	161.2	0.191		842.91	0.000
	F_1	0.642	0.198	0.683	3.245	0.007
	F_2	0.053	0.198	0.056	0.268	0.793
	R = 0.684	R^2 = 0.469				
Clone 32/1	Constant	165.067	0.173		952.783	0.000
	F_1	0.768	0.179	0.744	4.282	0.001
	F_2	0.302	0.179	0.292	1.682	0.118
	R = 0.799	R^2 = 0.638				
Clone 32/12	Constant	163.467	0.134		1221.071	0.000
	F_1	0.19	0.139	0.367	1.368	0.196
	F_2	0.017	0.139	0.034	0.126	0.902
	R = 0.369	R^2 = 0.136				
Clone 34/24	Constant	165.267	0.147		1127.99	0.000
	F_1	-0.091	0.152	-0.082	-0.597	0.562
	F_2	0.962	0.152	0.875	6.343	0.000
	R = 0.979	R^2 = 0.772				
Clone 52/8	Constant	163.000	0.008		19847.691	0.000
	F_1	0.474	0.009	0.627	55.769	0.000
	F_2	0.451	0.009	0.596	53.023	0.000
	F_3	0.378	0.009	0.5	44.44	0.000
	R = 0.999	R^2 = 0.998				

The results from the factor distribution of the indicators for the strength of vine growth show that during the formation of mass of one shoot mature part for the most clones and the population two general factors (F_1 and F_2) embracing various signs have impact (Table 3). Only for 34/24 third factor (F_3) is observed. In F_1 most frequently the shoot length and the length of the shoot mature part are included and for 32/1 and 52/8 – internode length and shoot thickness in the zone of the 5th internode. For 32/12 and 34/24 the constituted indicator is mature part compared to shoot total length. The third factor (F_3) for 34/24 is represented as internode length (5^{th}) and the rest are in F_2. In the formation of the collective indicator mass of one year shoot mature part, F_1 takes part with 34 % (32/1) – 47 % (32/12) compared to 39 % for the population, F_2 – 23 % (32/12, 34/24) – 33 % (32/1) and F_3 - 23 % (34/24). The data shows that in this case other factors have significant meaning. From the coefficients of regression model for the population, 32/1 and 52/8, factor F_2 has the biggest direct influence over the dependent indicator having the following values – 0,321; 0,129; 0,257 (Table 4). Factor F_1 is with smaller or negative values for 32/1, 32/12, 34/24 and 32/8, and F_2 – for 32/12. In all variations of the study, the two general factors are with unproved regression coefficients. The plural correlation coefficients between the formed factors and the dependent variables are low – from 0.026 (34/24) to 0.361 (population) – that mean weak correlation. Coefficients of determination are also low – from 0.006 (32/12) to 0.130 (population), which shows that only 0.6 % – 13 % of the shoot mature part mass change is due to the indicators from factors F_1, F_2 and F_3. The statistically insignificant correlation coefficients and the low determination coefficients mean that the shoots mature part mass in the clones studied is not mainly dependent on the reported indicators in the three general factors. Most probably shoots ma-

turity is defined mainly by the complex physical-biochemical processes and the histological changes of the anatomic structure related to them.

During the formation of the most economically significant for the group indicator – potential fertility coefficient based on all buds (winter eyes), take part two factors – F_1 and F_2 for the clones and only one – F_1 for the population (Table 5). There is some diversity in the two factors indicators distribution in different variations. As number they dominate in F_1 for the population, 9/5, 34/24 and 52/8, where

Table 3

Factor distribution of growth indicators in the population and the clones of Misket vrachanski variety

Indicators	Misket vrachanski variety		Clone 9/5		Clone 32/1		Clone 32/12		Clone 34/24			Clone 52/8	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_3	F_1	F_2
Shoot length, cm	0.977		0.959			0.929	0.875		0.619			0.986	
Internode lenth (5th), cm		0.714		0.724	0.722			0.678			0.863	0.933	
Length of the shoot mature part, cm	0.969		0.949			0.852	0.976		0.951				0.76
Mature part compared to shoot total length, %		0.618		0.808	0.898		0.784		0.795				-0.683
Shoot thickness in the zone of the 5th internode, mm		0.787						-0.769		0.877			0.652
Factor impact	**39%**	**31%**	**40%**	**29%**	**34%**	**33%**	**47%**	**23%**	**38%**	**23%**	**23%**	**40%**	**31%**

Table 4

Regression model coefficients of growth indicators for the population and the clones of Misket vrachanski variety

Variety	Factors	Regression coefficient B	Standard error	Standartized coefficient of regression Beta	Student's test (t)	Significance level (Sig)
Misket vrachanski population	Constant	1.249	0.005		269.722	0.000
	F_1	0.004	0.005	0.165	0.918	0.367
	F_2	0.008	0.005	0.321	1.789	0.085
	R = 0.361	$R^2 = 0.130$				
Clone 9/5	Constant	1.232	0.006		221.000	0.000
	F_1	0.003	0.006	0.09	0.472	0.64
	F2	0.002	0.006	0.06	0.315	0.755
	R = 0.109	$R^2 = 0.012$				
Clone 32/1	Constant	1.245	0.005		253.106	0.000
	F_1	-0.004	0.005	-0.135	-0.715	0.481
	F_2	0.003	0.005	0.129	0.682	0.501
	R = 0.187	$R^2 = 0.035$				
Clone 32/12	Constant	1.238	0.003		369.448	0.000
	F_1	-0.001	0.003	-0.058	-0.301	0.766
	F_2	-0.001	0.003	-0.049	-0.258	0.799
	R = 0.077	$R^2 = 0.006$				
Clone 34/24	Constant	1.233	0.004		333.872	0.000
	F_1	0.000	0.004	-0.001	-0.006	0.995
	F_2	0.000	0.004	0.02	0.101	0.92
	R = 0.026	$R^2 = 0.0007$	0.004	0.016	0.082	0.936
Clone 52/8	Constant	1.249	0.003		454.553	0.000
	F_1	0.000	0.003	-0.025	-0.132	0.896
	F_2	0.004	0.003	0.257	1.38	0.179
	R = 0.258	$R^2 = 0.066$				

Table 5

Factor distribution of winter eyes potential fertility indicators in the population and the clones of Misket vrachanski variety

Indicators	Misket vrachanski variety	Clone 9/5		Clone 32/1		Clone 32/12		Clone 34/24		Clone 52/8	
	F_1	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
Decayed main buds, %	-0.087	-0.726	-0.585	-0.544	-0.667	-0.524	-0.61		-0.851	-0.761	-0.597
Ratio on the base of healthy buds	0.09	0.802	0.578	0.936		0.761	0.612	0.742	0.66	0.876	
Fruitless buds, %	0.091	0.861	0.501	0.988		0.877		0.683	0.711	0.879	
Fruit buds with 1 flower, %	-0.09	-0.543	-0.836	-0.956		-0.889		-0.64	-0.767	-0.803	-0.56
Fruit buds with 2 flowers, %	0.09		0.9	0.958		0.974		0.543	0.835	0.839	
Fruit buds with 3 flowers, %		0.903			0.731		0.906	0.936			0.904
Flower clusters with length to 350 µm, %	-0.09	-0.912			-0.996		-0.912		-0.923	-0.698	-0.707
with length 350–550 µm,%	0.088		0.901		0.909	0.92		0.91		0.985	
with length 550–750 µm,%	0.083	0.981			0.844		0.949		0.911		0.891
with length above 750 µm,%		0.874					0.988	0.76			0.764
Winter eyes volume, mm^3	0.08	0.93			0.95	0.733	0.609	0.855		0.674	0.713
Rudimentary shoot length, mm	0.081	0.929			0.976	0.756	0.621	0.87		0.797	0.572
Number of rudimentary leaves	0.084	0.986			0.949	0.579	0.695	0.834	0.545	0.697	0.645
Factor impact	**91%**	**66%**	**28%**	**64%**	**29%**	**48%**	**43%**	**51%**	**43%**	**55%**	**39%**

Table 6

Regression model coefficients of winter eyes potential fertility indicators for the population and the clones of Misket vrachanski variety

Variety	Factors	Regression coefficient B	Standard error	Standartized coefficient of regression Beta	Student's test (t)	Significance level (Sig)
Misket vrachanski population	Constant	1.117	0.024		45.932	0.000
	F_1	0.297	0.026	0.978	11.437	0.000
	R = 0.978	R^2 = 0.956				
Clone 9/5	Constant	1.291	0.003		421.973	0.000
	F_1	0.302	0.003	0.813	92.273	0.000
	F_2	0.216	0.003	0.582	66.121	0.000
	R = 0.997	R^2 = 0.996				
Clone 32/1	Constant	1.247	0.021		59.711	0.000
	F_1	0.304	0.022	0.886	13.606	0.000
	F_2	0.151	0.022	0.439	6.742	0.001
	R = 0.989	R^2 = 0.979				
Clone 32/12	Constant	1.261	0.036		34.665	0.000
	F_1	0.193	0.039	0.684	4.955	0.004
	F_2	0.186	0.039	0.661	4.789	0.005
	R = 0.951	R^2 = 0.905				
Clone 34/24	Constant	1.175	0.02		59.184	0.000
	F_1	0.245	0.021	0.734	11.523	0.000
	F_2	0.221	0.021	0.664	10.435	0.000
	R = 0.990	R^2 = 0.980				
Clone 52/8	Constant	1.208	0.019		64.388	0.000
	F_1	0.261	0.02	0.831	12.933	0.000
	F_2	0.168	0.02	0.537	8.396	0.000
	R = 0.990	R^2 = 0.980				

they form the variable indicator with 91%, 66%, 51% and 55%. For the rest of the clones they exceed F_2 according to their influence – 64% (32/1) and 48% (32/12). The second factor takes part in the general indicator formation with 28% (9/5) – 43% (32/12 and 34/24). It can be definitely stated that according to this indicator there are differences expressed in the more complex dependence of the general indicator for the clones, compared to Misket vrachanski population. The standardized coefficients for all the variants are higher for F_1 – from 0684 (32/12) to 0.978 (population) and the indicators included in it influence directly most strongly over the winter eyes potential fertility (Table 6). The indicators from F_2 influence more weakly but positively over this process (0.439 – 0.664). All coefficients of the regression model are statisti-

Table 7

Factor distribution of actual fertility indicators in the population and the clones of Misket vrachanski variety

Indicators	Misket vrachanski variety		Clone 9/5		Clone 32/1		Clone 32/12		Clone 34/24		Clone 52/8	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
Developed eyes – average per vine, %	-0.856	0.516	-0.557	-0.997		-0.555	-0.997		-0.555	0.832	0.559	0.829
Fruit shoots – average per vine, %	-0.999				-0.994			-0.994		0.922	0.683	0.73
Fruit shoots with 1 clusters, %	-0.988		-0.919	-0.945			-0.945			0.99		-0.873
Fruit shoots with 2 cluster, %	0.988		0.908	0.864	0.503		0.864	0.503		-0.928	-0.805	0.594
Fruit shoots with 3 clusters, %			0.941	0.986		0.556	0.986		0.556	-0.831	0.935	
Developed eyes along fruit cane – 1 eye	-0.569	0.822		-0.999		-0.911	-0.999		-0.911			0.997
Developed eyes along fruit cane– 2 eye	0.751	0.66		-0.986		0.986	-0.986		0.986		0.965	
Developed eyes along fruit cane – 3 eye		0.991	-0.999	-0.743	-0.669		-0.743	-0.669		1.000		1.000
Developed eyes along fruit cane – 4 eye	-0.986		0.999	-0.98		0.98	-0.98		0.98			0.997
Developed eyes along fruit cane – 5 eye	-0.957			-0.98		-0.771	-0.98		-0.771	0.637	0.965	
Developed eyes along fruit cane– 6 eye	-0.751	-0.66		-0.969		-0.893	-0.969		-0.893		-1.000	
Developed eyes along fruit cane – 7 eye	-0.97		-0.999	-0.998		0.98	-0.998		0.98		-0.746	0.666
Developed eyes along fruit cane – 8 eye	-0.999			-0.558	0.83	-0.98	-0.558	0.83	-0.98		-0.746	0.666
Fertility ratio – 1 eye	-0.999				-0.972			-0.972		0.982	0.764	0.645
Fertility ratio – 2 eye		-0.978	0.578	0.955			0.955			-0.883		-0.901
Fertility ratio – 3 eye	0.919		0.976	0.778	0.629	-0.573	0.778	0.629	-0.573	0.82	-1.000	
Fertility ratio – 4 eye	0.539	0.842	-0.947	-0.915		0.98	-0.915		0.98		0.705	0.71
Fertility ratio – 5 eye	0.782	0.623	0.878		-0.896	0.836		-0.896	0.836	0.549		0.933
Fertility ratio – 6 eye	-0.506	0.863	0.86	0.998		0.98	0.998		0.98		0.963	
Fertility ratio – 7 eye		0.947		0.992		0.945	0.992		0.945			0.998
Fertility ratio – 8 eye	0.974				-0.991	0.98		-0.991	0.98		0.956	
Average number of clusters –spurs	1.000		1.000	0.813	0.582	-0.646	0.813	0.582	-0.646	-0.763		0.967
Average number of clusters – fruit cane	0.981		0.972	0.915		0.62	0.915		0.62	-0.785	0.898	
Average number of clusters– fruit shoot	0.992		0.989	0.994			0.994			-1.000	0.854	0.52
Shoots developed from dormant buds (sprouts), %	0.952		0.88	0.986		0.857	0.986		0.857	-0.515	0.998	
Fertility ratio from sprouts	0.956				0.952	0.994		0.952	0.994		0.991	
Developed corner eyes, %	-0.981		-0.628		0.938	-0.801		0.938	-0.801	-0.599	0.523	0.853
Fruit shoots from corner eyes, %	0.997		-0.538	-0.975		-0.89	-0.975		-0.89			0.983
Fertility ratio of shoots developed from corner eyes	0.986		0.722		0.96			0.96		-0.997	0.513	0.858
Factor impact	**74%**	**26%**	**53%**	**66%**	**34%**	**55%**	**66%**	**34%**	**55%**	**45%**	**51%**	**49%**

cally proved. The plural coefficients of correlation are high – from 0.951 (32/12) to 0.997 (9/5) and show strong correlation meaning that the change of the coefficient of winter eyes potential fertility is due mainly to the factors F_1 and F_2.

Two factors (F_1 и F_2) influence over the formation of the general indicator – shoot fertility coefficient for the population and for all clones (Table 7). Not in all the variants of the study F_1 takes part with bigger share in its formation – 74% (population), 66% (32/12), 55% (34/24), 51% (52/8). For the rest variants F_2 exceeds it by value – 66% (9/5) and 55% (32/1) (Table 8). For the most of the clones the biggest direct influence, according to the standardized coefficients of regression, has the first factor (F_1) – 0.789 (9/5), 0.983 (32/1), 0.955 (32/12) and 0.979 (34/24). There also are differences for 52/8, where F_2 (0,710) exceeds F_1 (0,705), as well as for the population characterized with negative direct influence of F_1 (-0.947). The values for F_2 are negative only for 32/12 (-0.296) and 34/24 (-0.206). The coefficients of the regression model for all the variants are statistically significant. The plural coefficients are high for both the population and clones – from 0.938 (52/8) to 0.997 and reflect strong correlation between the factors and the dependent variable. The determination coefficients are also very high – from 0.880 (52/8) to 0.994 (population), which confirms that the changes in the shoot actual fertility coefficient are due mainly to the indicators of the two factors.

The factor distribution of the economically very important indicators influencing over the vine yield is represented by two factors (F_1 and F_2) for population, 32/1 and 32/12 and only by F_1 for 9/5, 34/24 and 52/8 (Table 9). In the first group of variants there are differences between the population and the clones 32/1 and 32/12 in the number and the type of the indicators included in F_1 and F_2. The first factor takes part in the formation of the general indicator with 78% (population), 61% (32/1) and 60% (32/12), and the second - with 22 %, 39% and 40%, respectively. For the clones with one factor these values are 92% (9/5, 34/24) and 91% (52/8), which means that the expression of the dependent variable

Table 8

Regression model coefficients of actual fertility indicators for the population and the clones of Misket vrachanski variety

Variety	Factors	Regression coefficient B	Standard error	Standartized coefficient of regression Beta	Student's test (t)	Significance level (Sig)
Misket vrachanski population	Constant	1.097	0.02	-0.947	123.5	0.012
	F_1	-0.011	0.021	0.321	44.13	0.000
	F_2	0.004	0.021		1.84	0.001
	R = 0.997	R^2 = 0.994				
Clone 9/5	Constant	1.39	0.011		66.7	0.034
	F_1	0.084	0.045	0.789	49.63	0.000
	F_2	0.065	0.065	0.614	5.44	0.041
	R = 0.988	R^2 = 0.976				
Clone 32/1	Constant	1.263	0.011		57.17	0.029
	F_1	0.045	0.045	0.983	33.61	0.022
	F_2	0.009	0.077	0.185	5.14	0.023
	R = 0.990	R^2 = 0.981				
Clone 32/12	Constant	1.28	0.123		14.55	0.000
	F_1	0.082	0.459	0.955	6.25	0.014
	F_2	-0.025	0.077	-0.296	14.89	0.025
	R = 0.992	R^2 = 0.985				
Clone 34/24	Constant	1.223	0.000		59.81	0.032
	F_1	0.025	0.000	0.979	31.32	0.023
	F_2	-0.005	0.000	-0.206	20.53	0.015
	R = 0.989	R^2 = 0.978				
Clone 52/8	Constant	1.27	0.234		56.08	0.04
	F_1	0.037	0.12	0.705	1.93	0.02
	F_2	0.037	0.24	0.71	8.36	0.035
	R = 0.938	R^2 = 0.880				

Table 9

Factor distribution of yield indicators in the population and the clones of Misket vrachanski variety

Indicators	Misket vrachanski variety		Clone 9/5	Clone 32/1		Clone 32/12		Clone 34/24	Clone 52/8
	F_1	F_2	F_1	F_1	F_2	F_1	F_2	F_1	F_1
Clusters from spurs, number		-0.887	-0.998		0.93		0.905	-1.000	-0.98
Clusters from fruit cane, number	-0.995		-0.994		0.981	-0.6	0.8	-1.000	-0.934
Clusters from vine, number	-0.995		-0.996		0.958	-0.535	0.845	-1.000	-0.987
Clusters from sprouts, number	-0.75	0.662	-1.000	-0.863	0.505		0.974	-0.98	-0.97
Average weight per cluster from spurs, g	0.998		0.94	0.952		0.995		0.945	0.895
Average weight per cluster – fruit cane, g	0.884		0.971	0.896		0.886		0.949	0.899
Average weight per cluster from vine, g	0.961		0.954	0.934		0.975		0.947	0.899
Average weight per cluster – sprouts, g	0.987		0.836	0.967		1.000		0.987	0.998
Yield from spurs per vine, kg		0.965	0.97	0.99		0.97		0.976	0.934
Yield from fruit cane per vine, kg	0.958		0.934	0.846	-0.532	0.822	-0.57	0.949	0.921
Yield from sprouts per vine, kg	1.000		0.983		-0.868		0.945	0.805	0.812
Yield per vine, kg	0.984		0.952	0.936		0.947		0.966	0.978
Factor impact	78%	22%	92%	61%	39%	60%	40%	92%	91%

Table 10

Regression model coefficients of yield indicators for the population and the clones of Misket vrachanski variety

Variety	Factors	Regression coefficient B	Standard error	Standartized coefficient of regression Beta	Student's test (t)	Significance level (Sig)
Misket vrachanski population	Constant	5.131	0.000		56.08	0.04
	F_1	0.338	0.000	0.987	1.93	0.02
	F_2	-0.055	0.000	-0.162	8.36	0.035
	R = 0.999	R^2 = 0,999				
Clone 9/5	Constant	6.993	0.273		25.647	0.025
	F_1	1.041	0.334	0.952	3.117	0.019
	R = 0.952	R^2 = 0,907				
Clone 32/1	Constant	6.136	0.000		465.91	0.000
	F_1	0.553	0.000	0.919	3.245	0.007
	F_2	-0.237	0.000	-0.394	0.268	0.033
	R = 0.997	R^2 = 0,995				
Clone 32/12	Constant	6.777	0.000		15.167	0.015
	F_1	0.626	0.000	0.984	6.1223	0.039
	F_2	-0.115	0.000	-0.18	8.231	0.000
	R = 0.994	R^2 = 0,989				
Clone 34/24	Constant	6.185	0.17		36.439	0.017
	F_1	0.723	0.208	0.961	3.478	0.178
	R = 0.961	R^2 = 0,924				
Clone 52/8	Constant	6.185	0.17		36.439	0.017
	F_1	0.723	0.208	0.961	3.478	0.178
	R = 0.961	R^2 = 0.924				

Table 11

Factor distribution of cluster and berry mechanical analysis indicators for the population and the clones of Misket vrachanski variety

Indicators	Misket vrachanski			Clone 9/5		Clone 32/1			Clone 32/12			Clone 34/24		Clone 52/8		
	F_1	F_2	F_3	F_1	F_2	F_1	F_2	F_3	F_1	F_2	F_3	F_1	F_2	F_1	F_2	F_3
Skins, %	-0.94			0.9		0.95			0.67	0.65		0.98		-0.8	0.55	
Flesh, %	0.91			-0.64		-0.66				-0.87		-0.86		0.88		
Berries, %	-0.89			0.83		0.98				0.68		0.99		-0.93		
Rachis, %	0.89			-0.83	-0.51	-0.98				-0.68		-0.99		0.93		
Sugars, %	0.82			-0.71	0.64	-0.57	0.75				0.94	-0.61	0.77	0.93		
Seeds, %	0.74			-0.96		-0.98			-0.93			-0.91			-0.89	
Average weight of 100 berries - fruit cane, g	-0.68			0.92		0.96			0.61			0.93		-0.94		
Seeds in 100 berries, number		0.89			0.83			0.93		0.85		0.74				0.65
Average weight of seeds in 100 berries, g		0.87			0.81			0.74			0.89	0.9				0.86
Acids, g/dm³			0.86		0.96		0.89		0.7				0.98		0.96	
Average weight of 100 berries - spurs, g			0.82	0.86		0.64	0.63		0.71				0.81		0.88	
Factor impact	**58%**	**17%**	**10%**	**53%**	**35%**	**56%**	**21%**	**14%**	**33%**	**30%**	**22%**	**66%**	**24%**	**50%**	**29%**	**11%**

almost thoroughly directly is defined by the indicators included in the study. There is a specific in the influence of the different indicators over the vine yield for the various clones and between them and the population, which confirms the efficiency of the choice. The coefficients of the regression analysis show that the greatest direct influence has F_1 with values from 0.987 (population) to 0.919 (32/1) (Table 10). The factor F_2 shows negative direct influence over the vine yield for the population (-0.162), 32/12 (-0.180) and 32/1 (-0.394). The indicators from F_2 influence more weakly but positively over this process (0.439 – 0.664). All the coefficients of the regression model are statistically significant. The plural coefficients have high values – from 0.999 (population) to 0.952 (9/5), which means strong correlation. The determinant coefficients also have very high values – from 0.999 (population) to 0.907 (9/5) and define that from 99.9% to 90.7% of the vine yield change is due to the indicators of the factors F_1 and F_2.

According to the factor analysis of the cluster and berry mechanical analysis indicators, during the formation of 100 berries mass from clusters and fruit canes, three general factors, each embracing different signs, influence over the most variants of the study. (Table 11). The first factor (F_1) for the population, 32/1 and 52/8 includes predominantly the next signs: percentage of peels, mesocarp, berries, clusters, and for 32/12 – peels, seeds and average mass of 100 berries from fruit canes. For clones 9/5 and 34/24 two factors define the dependent indicator with almost identical distribution of the signs in F_1 and F_2. For all clones and the population the first factor takes part in the formation of the 100 berries mass from clusters and fruit canes with more percentage – 58%, 53%, 56%, 33%, 66% and 50%, followed by the second – 17%, 35%, 21%, 30%, 24%, 29% and 11% and the third – 10%, 14%, 22% and 11%. Depending on the standardized coefficients of regression the biggest direct influence over the population shows F_3 (0.583), for the clones 9/5, 32/1, 32/12 and 34/24 shows F_1 (0.951; 0.895; 0.749 and 0.932), and for 52/8 shows F_2 (0.452) (Table 12). All the clones differ from the population according to the significance of the indicators' mass of 100 berries from clusters and "fruit canes" for the formation of the dependent variable. The coefficients of the regression model are not statistically significant for 32/1 (F_3 – 0.813) and for 52/8 (F_3 – 0.190). The plural coefficients of correlation for the population are lower – 0.793 (significant correlation), compared to these for clones – from 0.917 for 32/12 to 0.960 for 9/5 (strong correlation). The same trend is observed for the determination coefficients.

Table 12

Regression model coefficients of cluster and berry mechanical analysis indicators for the population and the clones of Misket vrachanski variety

Variety	Factors	Regression coefficient B	Standard error	Standartized coefficient of regression Beta	Student's test (t)	Significance level (Sig)
Misket vrachanski population	Constant	276.563	0.889		310.933	0.000
	F_1	-2.827	0.909	-0.424	-3.111	0.006
	F_2	2.206	0.909	0.331	2.428	0.025
	F_3	3.885	0.909	0.583	4.276	0.000
	R = 0.793	R^2 = 0.629				
Clone 9/5	Constant	288.854	0.538		536.760	0.000
	F_1	8.698	0.550	0.951	15.823	0.000
	F_2	1.294	0.550	0.141	2.355	0.028
	R = 0.960	R^2 = 0.922				
Clone 32/1	Constant	279.688	0.540		517.927	0.000
	F_1	7.383	0.552	0.895	13.384	0.000
	F_2	2.737	0.552	0.332	4.963	0.000
	F_3	0.132	0.552	0.016	0.239	0.813
	R = 0.954	R^2=0.911				
Clone 32/12	Constant	287.188	0.578		497.278	0.000
	F_1	4.952	0.590	0.749	8.393	0.000
	F_2	2.404	0.590	0.364	4.076	0.001
	F_3	-2.528	0.590	-0.383	-4.284	0.000
	R = 0.917	R^2 = 0.841				
Clone 34/24	Constant	295.208	0.562		525.098	0.000
	F_1	8.210	0.574	0.932	14.296	0.000
	F_2	1.827	0.574	0.207	3.182	0.004
	R = 0.954	R^2 = 0.911				
Clone 52/8	Constant	276.25	0.58		479.76	0.00
	F_1	-6.59	0.59	-0.82	-11.21	0.00
	F_2	3.62	0.59	0.45	6.15	0.00
	F_3	0.80	0.59	0.10	1.36	0.19
	R = 0.944	R^2 = 0.892				

Conclusions

The use of the factor analysis in comparative ampelographic research between the population and chosen clones of Misket vrachanski variety gives an opportunity to establish the dynamics and the special features of the formation of the economically important for the individual choice signs. The results of the regression analysis are adequate and present in an analytical way the correlations between the most important factor of the particular group, as a dependent variable, and the general independent factors.

The applied model of study is a systematic approach for evaluation and comparison of the economical properties of the clones with the initial population. This experimental approach gives analytical possibilities for reduction of the number of the interpreted indicators, grouping the correlation indicators in between into a general factor and separation of the non-correlation indicators into different factors, which in dependence of the aims of the individual choice can be used for their objective assessment.

There is a statistically significant specific in the number and type of the indicators from the different groups, forming

the general factors in various variants and toward the population, which enables the final choice of elite clones. In almost all groups of indicators there is a strongly expressed plural correlation of the economically most important sign with the general factors. The clones 52/8 and 34/24 differ most strongly from the population according to the factor distribution of phonologic indicators; clones 9/5, 34/24 and 52/8 – according to the yield; clones 9/5 and 34/24 – according to the cluster and berry mechanical analysis and all studied clones – according to the potential and actual fertility.

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