MATERIALS AND METHODS OF THE STUDY OF INFLUENCE OF AGROTECHNICAL METHODS ON SENSORY CHARACTERISTICS OF TECHNICAL SORTS OF GRAPE

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Abstract

The topicality of using the sensory analysis of berries in enological practice at planning of agrotechnical complex at vineyard to receive the certain style and quality of production was grounded. For study of the influence of agrotechnical methods on sensory characteristics of technical sorts of grape Zagrey and Fragrant, selected by NSC "IVaW named after V. E. Tairov" (Ukraine), there was elaborated the algorithm of research, including field experiment and laboratory sensory analysis. The method of organoleptic analysis of berries, consisted of 20 parameters for assessment of visual, tactile and gustatory properties of pulp, peel and seeds, was approbated. Mathematical processing of experimental data was carried out by the methods of one- and two-factor analysis of variance and analysis of main components in the environment of package of applied programs MS Excell 2010, Statistica Statsoft ver. 7.0 (Tulsa, USA).

The sensory descriptors, characterizing the quality of studied sorts of grape, were determined. It was established, that agrotechnical methods of planting grape bushes influenced the sensory characteristics of berries of studied sorts.

Keywords: sensory analysis of berries, agrotechnical methods of planting, Zagrey, Fragrant.

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1. Introduction

The method of sensory assessment of grape is actively used in production practice in addition to the standard methods of chemical analysis, realized at monitoring of harvest ripening. The sensory analysis of grape gives to enologists the effective instrument for making decisions about harvesting and further direction of the use of raw material, allows adapt vinification procedure taking into account the quality of received production [1, 2].

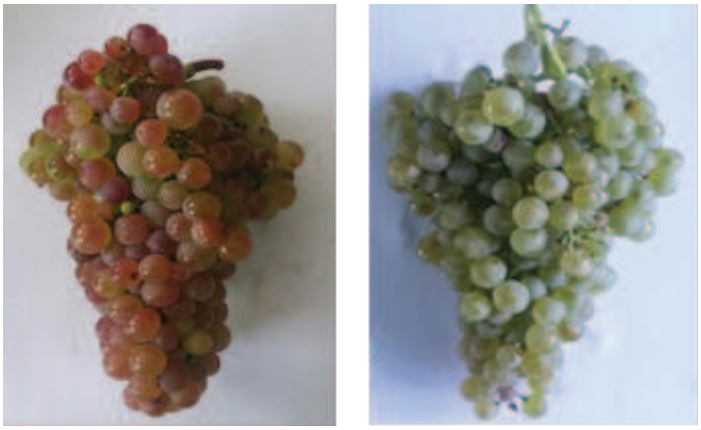
Scientific works in the field of sensory analysis of grape are mainly aimed at establishment of correlations between organoleptic properties of berries and correspondent characteristics of wine [2–6]. In this aspect the topical direction of research is the study of influence of viticultural practices on sensory properties of grape for producing wine of certain style and quality.

The recent elaborations of the scientists of NSC "IVaW, named after V. E. Tairov" (Ukraine) in selection of technical sorts of grape allowed add the Ukrainian assortment with new sorts with original organoleptic properties. But the existent standard approach to agrotechnique of grape planting and assessment of raw material quality doesn't allow fully realize its technological potential [7].

The authors of this article offer to use sensory analysis of berries for target planting of grape of new sorts with high quality parameters under agroecological conditions of Ukraine.

2. Materials and Methods

The object of the study is grape of white technical sorts: Fragrant (**Fig. 1, *a***) and Zagrey (**Fig. 1, *b***) (selected by NSC "IVaW named after V. E. Tairov"), harvest of 2016, planted in agroecological conditions of Odessa region, Ukraine.



a *b*

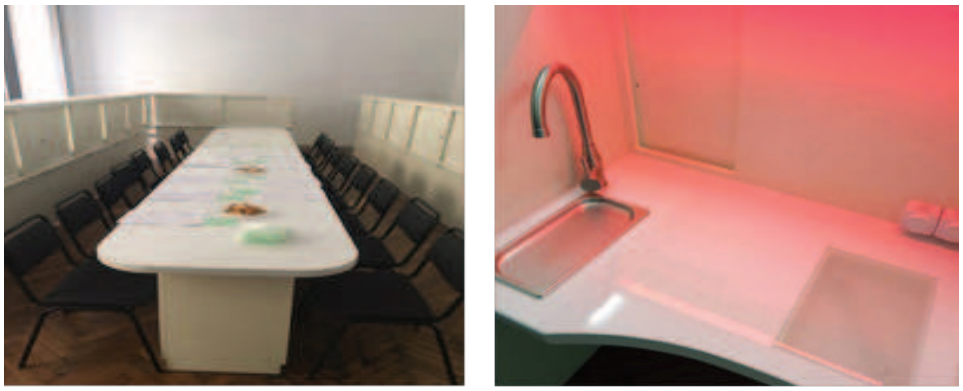
Fig. 1. *Grape of studied sorts: a* – Fragrant; *b* – Zagrey

The sort of grape Fragrant is of middle-early ripening term. Bunch of grapes has cylinder-conic form and hard structure. Berries are of the middle size, rounded with thin pink peel and juicy pulp. The sort is characterized with brightly expressed tones of strawberry, pineapple and caramel in smell of ready wine. Mean mass concentration of sugars – 190 g/dm^3, titrated acids – 6,3 g/dm^3.

The sort of grape Zagrey is of middle-late ripening term. Bunch of grapes has cylinder-conic form and structure of middle hardness. Berries are of the middle size, rounded with thick white peel and juicy pulp. The sort is characterized with brightly expressed flower tones in the smell of ready wine. Mean mass concentration of sugars– 173 g/dm^3, titrated acids – 9,1 g/dm^3.

Gustatory assessment of studied sorts of grape was carried out in the specialized laboratory of sensory analysis of food products that functions in Odessa national academy of food technologies (Odessa, Ukraine) (**Fig. 2, *a***).

The distinctive feature of work organization in the laboratory is individual working places (**Fig. 2, *b***), that excludes an influence of external subjective factors on the final result of the study.



a *b*

Fig. 2. Laboratory of sensory analysis of food products:
a – general appearance; *b* – individual working place of taster

The influence of agrotechnical methods of grape planting on sensory characteristics of berries was modeled within the field experiment. The experiment was found in 2016 at experimental plots of NSC "IVaW named after V. E. Tairov" (Odessa region, Ukraine) according to the standard methods, accepted for agrotechnical studies in viticulture (**Fig. 3**) [8].

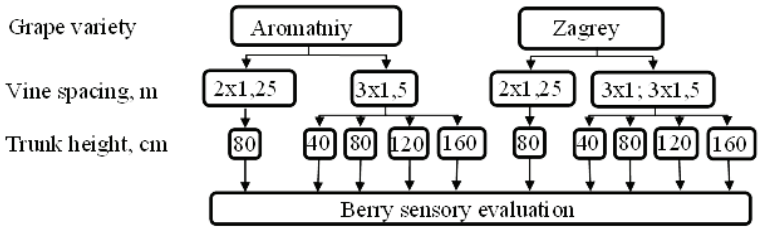


Fig. 3. Scheme of experiment

5 bushes were selected thrice at the plot for each variant of experiment. The grape bushes of studied sorts are of 2013 planting, grafted upon the stock Riparia x Ruoertis 101–14. Soil types of the plots – Southern rich black soil without irrigation.

The experimental bushes were formed as double-arm horizontal cordon on the stem. Sprouts direction is vertical in one-plane trellis. Experimental variants, planted on the stem with height 120 and 160 cm, formed with free sprouts direction. The load of bushes with oculi, sprouts and bunches were established in proportion to the plants growth.

The terms of harvesting were determined, based on the dynamics of accumulation of sugars, titrated acids, pH change. The grapes from experimental bushes were harvested separately in variants for physical-chemical analysis and vinification; the mean sample with weight 1 kg was selected for tasting of grape [9].

2. 1. Experimental procedures

The sensory assessment of berries was realized by the board, consisted of 12 qualified testers, skilled in analysis of wine production.

The assessment was carried out according to methodology, elaborated by Institut Cooperatif du Vin (Montpelier, France) according to the requirements of international standard ISO 11035 [2]. The expert group preliminary studied this method within three training sessions.

The preparation to tasting of the samples of newly harvested grape was in separation of fruit stems with berries from the crest. The sampling consisted of three berries, tasted synchronously.

The sensory analysis was realized in order, presented in the **Table 1**.

20 descriptors were assessed during the analysis, and each of them was structured by rating scale from 0 to 4 points. The experts individually estimated the intensity of descriptor and registered the result in the protocol [2].

The results of tasting were processed separately for each descriptor. The calculation of standard deviation (1) for singular parameter was realized by the formula:

$$S_{\bar{x}} = \sqrt{\frac{\sum_{i=1}^{n} x_i \left(x_i - \bar{x}\right)^2}{n(n-1)}}, \quad (1)$$

where $S_{\bar{x}}$ – mean quadratic deviation of the mean point of each descriptor; x – mean point; n – number of experts; x_i – assessment of each expert.

If the assessment of each expert (x_i) differed from the mean point (x) by the value $2S_{\bar{x}}$, it was not taken into account. The exclusion of misses increased the exactness of the mean point of each descriptor by 25–30 %.

Thus, the studied samples received maximally objective organoleptic characteristic taking into account the fact that each expert has individual sensitivity [10].

Mathematical processing of the received results was carried out in environment of package of applied programs MS Excell 2010, Statistica Statsoft ver. 7.0 (Tulsa, USA).

Table 1
Procedure of sensory analysis of berries

Assessment stage	Parameter
1. Visual and tactile assessment of berries	– ability to compression; – ability to fall; – tint of peel color
2. Analysis of pulp	– adhesion; – sweetness; – acidity; – dominant smells; – intensity of dominant smells
3. Analysis of peel	– ability to rupture; – tannins intensity; – tannins dryness; – acidity; – acerbity; – dominant smells; – intensity of dominant smells
4. Visual and sensory analysis of seeds	– color; – inclination to destruction; – smells; – intensity of tanning substances; – acerbity

3. Results

The decrease of plants number from 4000 to 2222 on 1 ha favored intensification of fruit smells in the peel of berries of Fragrant sort. The planting of bushes of the studied sort on the stem with height 160 cm allowed receive harvest with most preferable characteristics of sweetness and smell of pulp (**Table 2**).

Table 2
Influence of the height of bush stem on organoleptic characteristics of berries of Fragrant sort of grape

Parameter[A]	Stem height, cm				p[B]
	40 K	80	120	160	
Color of peel in the point of stalk separation	3,90[aC]	3,75[a]	2,75	3,83[a]	0,002
Pulp sweetness	2,57[a]	2,55[a]	2,55[a]	3,40	0,001
Pulp smell	2,63[a]	3,30[b]	2,38[a]	3,82[c]	<0,001

Note: [A] – mean values (n=12); [B] – levels of statistical difference significance according to the results of one-factor analysis of variance; [C] – letters of upper index indicate the presence of statistical differences between variants at multiple pair comparison according to HCP_{05} value

The rare plants of Zagrey grape (3333, 2222 plants for 1 ha) differed from the dense ones (4000 plants for 1 ha) by the harvest with most hardness and elasticity of berries. The inclination to fall and weak adhesion of berry tissues were also typical for the plots, planted according to the schemes 3×1 and 3×1,5 m (**Table 3**).

Table 3

Influence of area of bushes nutrition on organoleptic characteristics of berries of Zagrey grape

Parameter[A]	Planting scheme, m			p[C]
	2×1,25 K[B]	3×1	3×1,5	
Compression of berries	3,16	2,33[aD]	2,33[a]	0,022
Ability to fall	2,33	3,00[a]	3,00[a]	0,009
Adhesion of pulp and peel	2,83[a]	2,33[a]	3,60	0,003
Color of seeds семян	3,67	2,57[a]	3,00[a]	0,003
Acerbity of seeds	2,60	1,71[a]	2,00[a]	0,009

Note: [A] – mean values (n=12); [B] – stem height (80 cm) and system of bushes formation (double-arm horizontal cordon with vertical direction of shoot) are equal in all variants of experiment; [C] – levels of statistical difference significance according to the results of one-factor analysis of variance; [D] – letters of upper index indicate the presence of statistical differences between variants at multiple pair comparison according to HCP_{05} value

At the scheme of bushes planting 3×1 m the most intense smells of pulp are observed at bushes planting on stem with height 40 cm. In the variant of experiment, where the bushes were formed on the high stem, the harvest was characterized with high intensity of peel and seeds tannins, acerbity of seeds **(Table 4)**. For better understanding of differences between the variants of experiment, the data analysis by the method of main components was carried out that provided the distribution of mean values of descriptors assessment by two factors (main components) (**Fig. 4**).

At the scheme of bushes planting 3×1,5 m the grape planting on the stem with height 80 cm was optimal for the parameters of adhesion of pulp and peel, pulp sweetness and intensity of tanning substances of seeds (**Table 4**).

The study of influence of complex of agrotechnical factors on berries sensory profile was carried out by the methods of two-factor analysis of variance on the example of Zagrey grape (**Table 5**).

The value of estimate indicator η^2 allowed establish that the factor of stem height has most expressed influence, determining the final assessments of berries ability to fall, peel ability to rupture, color of peel, sweetness, smell intensity of pulp, color and intensity of seeds tanning substances.

Table 4

Influence of bush stem height on organoleptic characteristics of Zagrey grape

Parameter[A]	Stem height, cm				p[B]
	40 K	80	120	160	
Planting scheme 3×1 m					
Color of peel in the point of stalk separation	3,80	3,00[aC]	3,00[a]	2,5[a]	0,004
Adhesion of pulp and peel	3,00[b]	2,33[a]	2,60[ab]	3,00[b]	0,040
Intensity of pulp smell	2,67[a]	2,33[a]	2,17[ab]	1,67[b]	0,017
Intensity of peel tanning substances	1,50[ab]	1,57[ab]	1,17[a]	2,0[b]	0,048
Intensity of seeds tanning substances	2,33[b]	1,67[a]	2,00[ab]	2,43[b]	0,037
Seeds acerbity	1,43[a]	1,71[a]	1,57[a]	2,33	0,026
Planting scheme 3×1,5 m					
Adhesion of pulp and peel	3,00[ab]	3,60[a]	3,40[a]	2,60[b]	0,036
Pulp sweetness	2,33[a]	2,40[a]	2,40[a]	1,40	0,022
Intensity of seeds tanning substances	3,0[a]	1,67	2,50[a]	3,0[a]	0,001

Note: [A] – mean values (n=12); [B] – levels of statistical difference significance according to the results of one-factor analysis of variances; [C] – letters of upper index indicate the presence of statistical differences between variants at multiple pair comparison according to HCP_{05} value

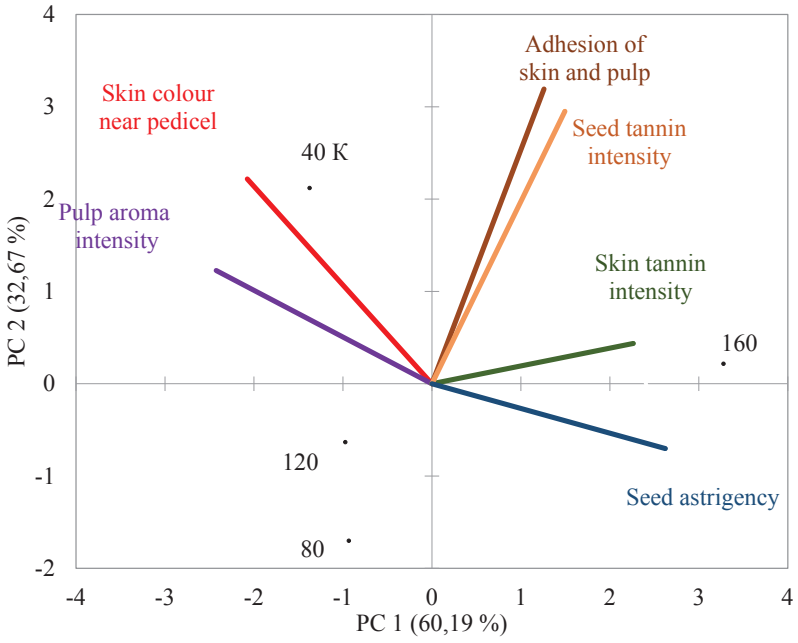


Fig. 4. Graph of calculation of first and second main components

Table 5
Influence of the area of bushes nutrition and stem height on organoleptic characteristics of Zagrey Grape berries

Parameter*	Assessment of factor influence					
	Planting scheme		Stem height		C×B	
	p**	η2, %	P	η2, %	p	η2, %
Ability to fall	in	–	0,002	31	0,009	23
Color of peel in the point of stalk separation	in	–	0,003	38	in***	–
Pulp sweetness	in	–	0,023	19	in	–
Pulp smell	0,005	12	0,006	20	0,006	20
Intensity of pulp smell	in	–	0,009	23	in	–
Color of seeds	in	–	0,003	31	in	–
Intensity of seeds tanning substances	0,005	11	≤0,001	45	in	–

*Note: * – mean values (n=12); ** – levels of statistical analysis significance according to the results of two-factor analysis of variance; *** – in – statistical difference is insignificant according to the results of two-factor analysis of variance*

4. Conclusions

1. The sensory descriptors, characterized the quality of grape of sorts Frangrant and Zagrey, selected by NSC "IVaW named after V. E. Tairov" (Ukraine) were determined according to the method, elaborated by Institut Cooperatif du Vin (Montpelier, France).

2. The correlation between agrotechnical methods of grape bush planting (planting scheme, stem height) and sensory descriptors of berries of studied sorts was established by the methods of one-factor analysis of variance. The complex influence of agrotechnical methods on the result of assessment was studied by two-factor analysis of variance on the example of Zagrey sort of grape.

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