THE EXPOSED LEAF AREA/YIELD RATIO, A NEW CRITERION OF EVALUATION FOR THE QUALITATIVE POTENTIAL OF THE TRAINING SYSTEMS USED IN VITICULTURE

RAPORTUL SUFRAFAȚĂ FOLIARĂ EXPUSĂ/MĂRIMEA PRODUCȚIEI, UN NOU CRITERIU DE EVALUARE A POTENȚIALULUI CALITATIV AL SISTEMELOR DE CONDUCERE ÎN VITICULTURĂ

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Abstract. *The determinations carried out in 2007 in Husi, Iasi and Cotnari vineyards, point out the possibility to use the ratio between the exposed leaf area (SFE) and the level of the yield (Yield) as an indicator of the qualitative potential of the training systems used in viticulture. In the case of Feteasca alba variety, the accumulation of 180 g/l sugar in must, is correlated with a SFE/Yield ratio of 1.60 in Husi vineyard, 1.76 in Iasi vineyard and 1. 86 in Cotnari vineyard. These values show the necessity to assure a bigger exposed leaf area for the vines grown in the vineyards with a reduced amount of heliotermic resources. For the red wines varieties, a positive correlation was highlighted between the SFE/Yield ratio and the must content in anthocyans, as well as a negative one between SFE/Yield and the total acidity of the must.*

Rezumat. *Determinările efectuate în anul 2007 în podgoriile Huşi, Iaşi şi Cotnari, relevă posibilitatea utilizării raportului dintre suprafața foliară expusă (SFE) şi mărimea producției (Prod.) ca indicator al potențialului calitativ al sistemelor de conducere folosite în cultura viței de vie. La soiul Fetească albă, conținutul de 180 g zaharuri/l must corespunde unei valori a raportului SFE/Prod. de 1.60 în podgoria Huşi, 1.76 în podgoria Iaşi şi 1.86 în podgoria Cotnari. Aceste valori indică necesitatea asigurării unei suprafețe foliare expuse mai mari la vița de vie în podgoriile cu resurse heliotermice reduse. La soiurile pentru vinuri roşii a fost pusă în evidență o corelație pozitivă între valoarea raportului SFE/Prod. şi conținutul mustului în antociani, precum şi o corelație negativă între SFE/Prod. şi aciditatea totală a mustului.*

The consumers exigencies concerning the quality of wines as well as the intention to increase the economical efficiency in vine exploitations, determine the viticulture research to focus its attention on the improvement of the vine training systems, the main factor that determine the grapes quality. The vine plantation is studied as a whole, outranking the level of the technological measures improvement. Thus, it is possible to reveal some relations between the grapes quality and the training system parametres. One of these is the ratio between the exposed leaf area and the yield quantity (*SFE/Yield*). The recent research made in the French vineyards has shown that for the Grolleau variety, a 0.5 *SFE/Yield* ratio assures a sugar accumulation of 170 g/l must, while a 1.4 –

1.5 *SFE/Yield* ratio assures 204 g sugar/l must. For the Merlot variety, a 1.0 *SFE/Yield* ratio determines 204 g/l sugar accumulation, while for a 2.0 *SFE/Yield* ratio, the sugar content is 221.0 g/l (*Dufourcq T., Bonnisseau M., 2005)*.

The study of the vines canopy and its correlation with the quality and quantity of the grapes, shows that *SFE/Yield* ratio can be used as an indicator for the qualitative potential of the vine training systems.

MATERIAL AND METHOD

The varieties experimented were *Feteasca albă* in Huşi, Iaşi and Cotnari wine-growing centres and *Feteasca neagră* in Huşi and Iaşi wine-growing centres. Two different training systems were studied in each wine-growing centre.

For ***Feteasca albă*** variety:

Huşi wine-growing centre:

- plantation with 2.0 m distance between the rows and 1.2 m between the vines on the row, bilateral cordon trellising form and the height of the trunks of 0.75 m;
- plantation with 2.2 x 1.2 m distances, bilateral cordon trellising form and the height of the trunks of 1.0 m high.

Iaşi wine-growing centre:

- plantation with 2.2 m between the rows and 1.2 m between the vines on the row, bilateral cordon trellising form and the height of the trunk of 0.75 m;
- plantation with 3.0 x 1.0 m distances, bilateral cordon as trellising form and the height of the trunks of 1.0 m.

Cotnari wine-growing centre:

- plantation with 2.0 x 1.0 m distances and low trellising form;
- plantation with 3.0 x 1.2 m distances, double cordons trellising and the height of the trunk of 1.0 m.

For ***Feteasca neagră*** variety:

- in Huşi, a plantation of 2.2 x 1.2 m distances, bilateral cordon trellising form and the height of the trunk of 1.0 m;
- in Iaşi a plantation of 2.2 x 1.2 m and 0.75 m height of the trunk.

The determinations: *exposed leaf area (m^2/ha), total leaf area (m^2/ha), foliar index (IF), yield (kg/ha), sugars (g/l), total acidity (g/l H_2SO_4), anthocyans (mg/kg grapes) for the Fetească neagră variety*.

RESULTS AND DISCUSSIONS

Exposed leaf area (SFE, m^2/ha). This factor quantifies the external area of the foliar apparatus, that is 100% photosynthetic active. Its value is stable for each training system used in vine plantations. The calculation manner is based on the canopy parametres, presented in the **fig. 1** (Murisier F., 1996):

$$\mathbf{SFE,\ m^2/ha = (2 \times H + L / E) \times 10000}$$

Where:

H = height of the canopy (m)
L = thickness of the canopy (m)
E = distance between the rows (m)

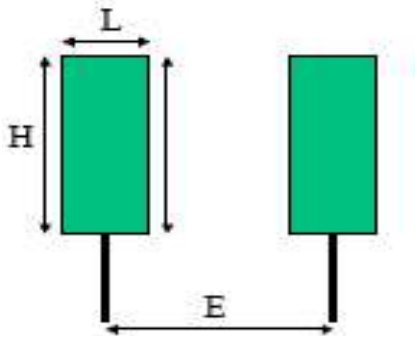

Fig. no. 1 The parametres for SFE measurement

The data show that the exposed leaf area increases at the same time with the height of the canopy and with the plantation thickness ***(tab. 1)***. The maximum value of SFE (14500 m^2/ha) is registered in plantations with 2.0 m distance between the rows and low trellising form, while the lowest is met in plantations with 3.0 m distance between the rows and vines trellised on high trunk, where the exposed leaf area is 7666 - 10000 m^2/ha.

Table 1

The canopy parametres in Huşi, Iaşi and Cotnari wine-growing centres

Wine-growing centre	Variety	Trellising form	H (m)	L (m)	E (m)	SFE (m^2/ha)
Huşi	Fetească albă	semi-high	1.10	0.50	2.0	13500
		high	0.90	0.50	2.2	10454
	Fetească neagră	high	0.90	0.50	2.2	10454
Iaşi	Fetească albă	semi-high	0.90	0.50	2.2	10454
		high	0.90	0.50	3.0	7666
	Fetească neagră	semi-high	1.10	0.50	2.2	12272
Cotnari	Fetească albă	low	1.20	0.50	2.0	14500
		low	1.20	0.60	3.0	10000

Total leaf area and the compactness of the canopy. The intense vegetative growth, typical for Fetească albă and Fetească neagră varieties, determines the development of a large total foliage, of a compact canopy, excessive shaded, with a reduced photosynthetic productivity.

Table 2

The exposure of the foliage to direct solar radiation depending on the training system, in Huşi, Iaşi and Cotnari wine-growing centres

Wine-growing centre	Variety	Trellising form	SFT (m^2/ha)	SFE (m^2/ha)	GECV (%)	IF
Huşi	Fetească albă	semi-high	26420	13500	47.5	0.47
		high	27600	10454	37.8	0.37
	Fetească neagră	high	28800	10454	36.2	0.36
Iaşi	Fetească albă	semi-high	24200	10454	43.1	0.43
		high	28900	7666	26.5	0.26
	Fetească neagră	semi-high	29300	12272	41.8	0.41
Cotnari	Fetească albă	low	25250	14500	57.4	0.57
		high	27200	10000	36.7	0.36

In 2007, a droughty year, the total foliage surface of the vines was 24 -32 % smaller than the one in the preceding years, varying between 24200 - 28900 m^2/ha for Fetească albă variety and 28800 – 29300 m^2/ha for Fetească neagră variety (***tab. 2***). Even in these conditions, the canopy of the vines presented a pronounced compactness, the values of the foliar index being of 0.26 – 0.37 for the high trellising form and of 0.43 - 0.57 for the semi-high and low forms. The exposure of the foliage to the sun radiation was of 57.4 % for low trellising form, of 41.8 – 43.1 for semi-high trellising form and of 26.5 - 36.7 % for high trellising form.

The quality and the size of the yield. For the Fetească albă variety, the yield was under the biologic potential of the variety, because of the drought in the vegetative season. But, there were some differences between the trellising forms that is, for the low and semi-high forms the yield was 9.75 - 16.6 % superior to the high one (***tab. 3***). The sugar content in the must was 158.8 - 208.0 g/l, bigger in the case of the low and semi-high trellising forms compared to the high trellising form. The biggest sugar content was registered for the low trellising form and was of 208 g/l, while the lowest content for the high trellising form was of 158.8 g/l.

Table 3

Quantity and quality of the yield for Fetească albă and Fetească neagră varieties, in Huşi, Iaşi and Cotnari wine-growing centres

Wine growing centre	Variety	Trellising form	Yield (kg/ha)	Sugar (g/l)	Acidity (g/l ac. tartric)
Huşi	Fetească albă	semi-high	7850	191.20	3.76
		high	6970	168.6	3.84
	Fetească neagră	high	5820	178.0	4.80
Iaşi	Fetească albă	semi-high	5680	189.18	3.58
		high	4732	167.68	4.20
	Fetească neagră	semi-high	6640	190.2	4.54
Cotnari	Fetească albă	low	6839	208.0	3.45
		high	6172	158.6	4.2

The total acidity of the must was generally reduced, with values between 3.45 and 4.20 g/l tartric acid. This parametre of the quality presents different values for the trellising forms, the lowest values being registered for the low and semi-high trellising forms (3.45 – 3.76 g/l tartric acid) and the highest for the high trellising form (3.84 – 4.2 g/l tartric acid).

The exposed leaf area/yield ratio (SFE/Yield). The data presented in ***table 4*** show that the SFE/Yield ratio presents bigger values for low and semi-high trellising forms (1.71 - 2.12), compared to the high trellising form (1.42 - 1.62). These differences appear because of the large exposed leaf area of the low and semi-high trellising forms.

Table 4

The exposed leaf area/yield ratio values for Feteasca albă and Feteasca neagră varieties, in Huşi, Iaşi and Cotnari wine-growing centres

Wine-growing centre	Variety	SFE (m^2/ha)	Yield (kg/ha)	SFE/Yield	
Huşi	Fetească albă	13500	7850	1.71	1.61
		10454	6970	1.49	
	Fetească neagră	10454	5820	1.79	-
Iaşi	Fetească albă	10454	5680	1.84	1.76
		7666	4732	1.62	
	Fetească neagră	10454	6640	1.84	-
Cotnari	Fetească albă	14500	6839	2.12	1.86
		10000	6172	1.62	

The *SFE/Yield* ratio values are positively correlated with the sugar content values (r = 0.8964). The minimum value of the *SFE/Yield* ratio (1.49) corresponds to a sugar content of 166.6 g/l, and the maximum value of the ratio (2.12) to the maximum sugar content (208.0 g/l) (***fig. 2***). This positive correlation, evidenced by the experimental data, attests the possibility to use the *SFE/Yield* ratio as an indicator for the qualitative potential of the vine training systems.

The data analysis shows that the value of 1.0 of the *SFE/Yield* ratio corresponds to a sugar content of 117.7 g/l in Huşi wine-growing centre, 101.36 g/l in Iaşi wine-growing centre and 98.5 g/l in Cotnari wine-growing centre. In Iaşi wine-growing centre, a 167.8 g/l sugar content needs a *SFE/Yield* ratio of 1.62 while in Husi wine-growing centre a similar sugar accumulation of 168.6 g/l needs a *SFE/Yield ratio* of 1.49. These data reflect the necessity to adapt the *SFE/Yield* ratio values to the thermic and solar resources that characterize the vine-growing area.

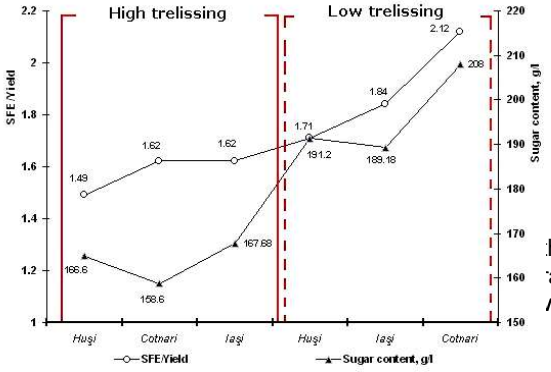

Fig. no. 2 The sugar content in the must according to the *SFE/Yield* ratio and to the trellising form of the vines, for Feteasca albă variety

As far as the total acidity of the must is concerned, the biggest values (3.84 – 4.2 g/l tartric acid) are registered for high trellising form, while the smallest (3.76 – 3.45 g/l tartric acid) for low and semi-high trellising forms. The data analysis showed the negative correlations between *SFE/Yield.* ratio and must acidity (r = 0.7469).

For the Fetească neagră, the highest sugar content (190.2 g/) and anthocyans content (724.8 mg/kg grapes) are registered at the semi-high trellising form (*SFE/Yield.* = 1.84), **(tab. 5)**. At the high trellising form (*SFE/Yield*. = 1.79) the must acidity is higher (4.8 g/l ac. tartric), and the sugar and anthocyans content smaller (178 sugar/l; 642.0 mg anthocyans/kg grapes).

Table 5

The quality characteristics of the must, depending on *SFE/Yield* ratio and the trellising forms, for Feteasca neagră variety

Wine-growing centre	Variety	Trellising form	SFE/Yiel.	Sugar (g/l)	Acidity (g/l ac. tartric)	Anthocyans (mg/kg)
Huşi	Fetească neagră	high	1.79	178.0	4.80	642.0
Iaşi		semi-high	1.84	190.2	4.54	724.8

CONCLUSIONS

1. The exposed leaf area of the canopy is of *14000 m^2/ha for low trellising form*, of *10454 – 13500 m^2/ha for semi-high trellising form* and of *7666 – 10454 m^2/ha for high trellising form*.

2. The average value of the *SFE/Yield ratio is* of 1.61 in Huşi wine/growing centre, of 1.76 in Iaşi wine-growing centre and of 1.86 in Cotnari wine-growing centre.

3. The *SFE/Yield* ratio values are positively correlated with sugar content (r = 0.8964) and negatively with the acidity (r = 0.7469).

4. The value of 1.0 of the *SFE/Yield* ratio assures a *117.7 g sugar/l must* accumulation in Huşi wine-growing centre, *101.36 g sugar/l must* in Iasi wine-growing centre and *98.5 g sugar/l must* in Cotnari wine-growing centre.

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