THE EXPOSABLE LEAF AREA AND THE LEAF INDEX, WHICH CHARACTERIZE THE GRAPEVINE TRAINING SYSTEMS IN THE AVEREŞTI WINE-GROWING CENTRE, HUŞI VINEYARD

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Abstract. *Investigations carried out in the Avereşti wine- growing centre, in the Huşi vineyard, pointed out that the training forms on high-trunk and on semi-high trunk defined two different training systems. These were different from each other by the exposable leaf area, the leaf index and the exposure degree of the canopy to the direct solar radiation. The values of these indicators showed that the training system on semi-high trunk had a qualitative potential superior to the training system on high-trunk, ensuring a more rational distribution of the young shoot within the grapevine canopy, and a better exposure of the leaf area to direct solar radiation. Due to these characteristics the training system on semi-high trunk allowed to accumulate higher quantities of sugar in grapes and to obtain must with balanced acidity.*

Key words: grapevine training systems, leaf area index, grapevine canopy

REZUMAT – Suprafaţa frunzei potenţial expusă şi indicele frunzei ce caracterizează sistemele de conducere la vita de vie din centrul viticol Avereşti, podgoria Huşi. *Cercetările efectuate în centrul viticol Avereşti-podgoria Huşi evidenţiază faptul că formele de conducere a viţei de vie pe tulpină înaltă şi pe tulpină semiînaltă definesc două sisteme de conducere diferite. Acestea se deosebesc între ele prin suprafaţa foliară potential expusă, indicele foliar şi gradul de expunere a frunzişului la radiaţie solară directă. Valorile acestor indicatori arată că sistemul de conducere pe tulpină semiînaltă prezintă un potenţial calitativ superior sistemului de conducere pe tulpină înaltă, asigurând distribuţia raţională a lăstarilor în interiorul covorului vegetal şi expunerea mai bună a frunzelor la radiaţie solară directă. Datorită acestor caracteristici, sistemul de conducere pe tulpină semiînaltă determină acumularea unor cantităţi mai mari de zaharuri în boabe şi obţinerea unor musturi cu aciditate echilibrată.*

Cuvinte cheie: sistem de conducere, indice foliar, covor vegetal

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INTRODUCTION

The training system represents the totality of factors allowing man to correlate the biological characteristics of the vine variety to growing characteristics: geometry of the plantation, orientation of rows, trunk height, pruning type, bud load, way of vine shoot nailing up (Carbonneau, 1995).

The qualitative potential of training systems is assessed according to exposable leaf area (ELA, m^2 /ha), leaf index (LI) and degree of exposure of leaf apparatus to direct solar radiation (DSR, %). These indicators express the favourableness of microclimate conditions determined by training system at the canopy of vine stocks.

Investigations conducted in the latest years show that the training system allows the expression of qualitative biological potential in vine varieties with similar vigour, under determined ecological conditions. In case of increasing the bud load, for maintaining the yield quality, some parameters of the training system must be modified, so that the entire leaf apparatus should be exposed to direct solar radiation. Varieties with high growth vigour need adequate training systems, ensuring the rational spreading of shoots inside the canopy and the optimum exposure of leaf apparatus to direct solar radiation.

One of the main objectives of the investigations carried out during 2000-2002 at the Avereşti wine-growing centre from the Huşi vineyard was to establish the influence of training systems on the quality of grape yield.

MATERIALS AND METHODS

The biological material was represented by Fetească albă variety grafted on Kober 5BB rootstock. The tested training systems are the training systems on high trunk with vertical monoplane nailing up (THT) and training system on semi-high trunk with vertical monoplane nailing up (TShT). The planting distances are of 2.2/1.2 m, the density of plantation is of 3409 stocks/ha, the training form is bilateral training cordon on trunk with the height of 1.0 m at THT and 0.75 m at TShT, the width of canopy is of 0.85 m at THT and 1.10 m at TShT.

Determinations refer to exposable leaf area (ELA, m^2/ha), leaf index (LI) and leaf exposure degree at direct solar radiation (LED, %).

Exposable leaf area (ELA, m^2/ha) expresses the size of leaf area, which may be exposed to direct solar radiation, in one ha of vine plantation. The indicator has a constant value for each training system, and by its reporting to the necessary of 1.0 – 1.2 m^2 ELA for ripeness under normal conditions of 1 kg of grapes (Murisier 1996; Intrieri Filippetti, 2000), one may calculate the quantitative limits for obtaining quality yields. Exposable leaf area is calculated by using the following relation (Carbonneau A., 1980):

$$\mathbf{ELA\ (m^2 / ha) = 10000 / E \times (1 - t/D)\ EA}$$

Where,

10000/E = total length of vine rows/ha of plantation;
(1 – t/D) = lack of canopy on the length of rows;
EA = external area of the canopy (m^2/m of row);

Leaf index (LI) expresses the denseness of the canopy and is given by the ratio between its exterior area (EA) and total leaf area (TLA), which develops on 1 m of row.

LI values are 0.75-1.0 in case of the canopy with rational shoot distribution and optimum leaf exposure to direct solar radiation. Values lower than 0.75 are found in the canopy with high compactness and values higher than 1.0 characterize the canopy, which does not revaluate the space given to stocks by the training system.

For the calculation of the leaf index we use the relation (Schneider C., 1986):

$$\mathbf{LI = (1 - t/D)\ EA / TLA}$$

Where,

(1 – t/D) = gaps in the canopy (m^2/m of row);
EA = exterior area of the canopy (m^2/m of row);
TLA = total leaf area at 1 m of row

The degree of canopy exposure (DCE, %). This indicator expresses as percentage the leaf area exposed to direct solar radiation.

RESULTS

1. Exposable Leaf Area (ELA, m^2/ha). The main calculation element is the exterior area of the canopy (EA). It differs from one training system to another, according to stock training form and trellis type. At the training system on high trunk with vertical monoplane nailing up, EA is of 2.15 m^2/m of row, and at the training system on semi-trunk with vertical monoplane nailing up, it is of 2.65 m^2/ m of row (*Figure 1*).

Because the plantation had a percentage of 10% of gaps, the calculation of EA real value was necessary. We eliminated the canopy gaps, which represented 10 cm/ m of row.

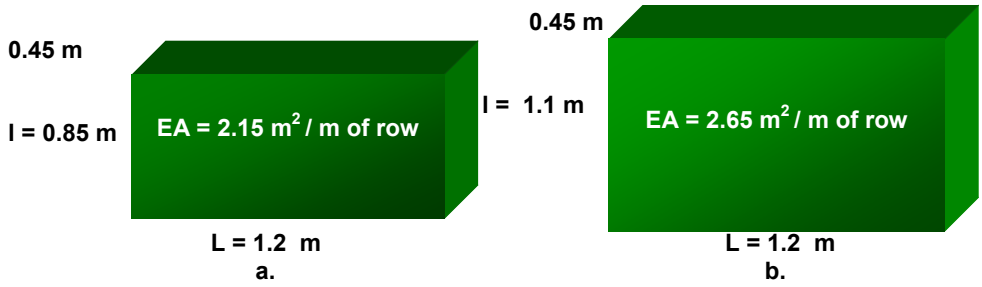

Figure 1 – Canopy form and exterior area : a. training system on high trunk with vertical monoplane nailing up (THT); b. training system on semi-high trunk with vertical monoplane nailing up (TShT)

The exposable leaf area (m^2/ha) is given by the product between the total length of rows (10000/E), the correction coefficients of gaps (1-t/D) and canopy exterior area (EA):

- *At the training system on high trunk* (THT):

ELA (m^2/ha) = 10000/Ex(1–t) S = 10000/2.2x(1 – 0.10)x2.15 = **8794.5 m^2/ha**

- *At the training system on semi-high trunk* (TShT):

ELA (m^2/ha) = 10000/Ex(1–t) S=10000/2.2x(1 – 0.10)x2.65 = **10839 m^2/ha**

The quantitative limits for obtaining quality yields have been established according to the ratio between **ELA** (m^2/ha) and necessary of 1.0-1.2 m^2 **ELA** for the maturation under best conditions of 1 kg of grapes. It resulted that the training system on high trunk allowed getting quality yields within the limits 7300 - 8200 kg grapes/ha, and the training system on semi-high trunk, 9000-10800 kg grapes/ha.

2. Leaf index (LI) was calculated according to the ratio between canopy exterior area (EA) and total leaf area (TLA).

At THT, the exterior leaf area is of 2.15 m^2/ m of row, and at TsHT, of 2.65 m^2/m of row. With a bud load of 45 buds/ stock, a total leaf area of 4.13 m^2/m of row developed at THT and of 4.41 m^2/m of row at TShT. The leaf index was calculated as follows:

- *At training system on high trunk:*

LI = (1 – 0.1) x 2.15 / 4.13 = 0.46

- *At training system on semi-high trunk:*

LI = (1–0.1) x 2.65 / 4.41 = 0.54

LI values pointed out the canopy high compactness in both training systems. At the same bud load, the training system on semi-heigh trunk presented a higher leaf index than the training system on high trunk.

With the load of 55 buds /stock, LI had the following values:

- *At the training system on high trunk:*

LI = (1 – 0.1) x 2.15 / 5.18 = 0.37

- *At the training system on semi-high trunk:*

LI = (1– 0.1) x 2.65 / 5.31 = 0.44

It was found a decrease in the values of the leaf index, respectively, an increase in the canopy compactness, because of the increase in total leaf area of vine stocks.

Table 1

External leaf area, total leaf area and leaf index, according to training system and bud load / stock at pruning (Avereşti wine-growing centre)

Bud load	45 buds/stock		55 buds/stock	
Training system	**THT**	**TShT**	**THT**	**TShT**
Canopy external area (m^2/m row)	2.15	2.65	2.15	2.65
Total leaf area (m^2/m row)	4.13	4.41	5.18	5.31
Leaf index (LI)	0.46	0.54	0.37	0.44

3. Degree of canopy exposure (DCE, %). At loads of 45-55 buds / stock the training system on high trunk allowed the exposure at direct solar radiation of 41.5-52.0% of the total leaf area, and the training system on semi-trunk, 49.9-60.8% (Table 2). From the analysis of DCE values, it resulted that the increase of bud load has determined, indifferently of the training system, a diminution in the weight of the leaf area exposable to direct solar radiation.

Table 2

Values of total leaf area and exposable leaf area, according to buds load / stock at pruning

Training system	TST		TSSt	
Bud load (bud/stock)	45	55	45	55
Total leaf area (m^2/ha)	16839	21188	18039	21720
Exposable leaf area (m^2/ha)	8794.5		10839	
Canopy exposure degree (%)	52.0	41.5	60.8	49.9

CONCLUSIONS

The training system on high trunk ensures an exposable leaf area of 8794.5 m^2/ha, and the training system on semi-trunk, of 10839 m^2/ha.

At the training system on high trunk, quality yields may be obtained within 7300-8200 kg/ha, and at the training system on semi-high trunk, within 9000-10800 kg/ha.

At the tested training systems, the loads of 45 and 55 buds / stock determine the increase in canopy denseness, pointed out by small values of leaf index: LI = 0.37 – 0.46 at the training system on high trunk and LI = 0.44 – 0.54 at the training system on semi-high trunk.

The training system on semi-trunk ensures a better exposure of the leaf apparatus to direct solar radiation than the training system on high trunk: 49.9–60.8% of the leaf apparatus developed on vine stocks is exposed at direct solar radiation, in case of THT, and only 41-52%, in case of TShT.

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