Investigations on the photosynthetic productivity of some newly selected grapevine varieties

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Summary: Investigations were carried out on the photosynthetic productivity of 5 wine varieties which had been selected at the Institute of Viticulture and Enology: Storgoziya, Nikopolski mavrud, Pomoritski biser, Dunavska gamza and Dunavski lazur. The first of them was grafted on Chasselas x Berlandier 41 B rootstock, each of the others was on three rootstocks: Chasselas x Berlandier 41 B, Berlandier x Riparia SO 4, and (Berlandier x Riparia Kober 5 BB) x (Rupestris Martin) III-102 D.

For all varieties, the leaf dry matter per unit leaf area was greatest when they were grafted on III-102 rootstock. During the vegetation period, the specific leaf weight increased, but the rate of dry matter accumulation in leaves was not constant and gradually decreased with time. The content of pigments and the leaf area per vine were greatest on SO 4 rootstock. On this rootstock, the highest yield was obtained for all cultivars mainly at the expense of the grape cluster weight. The thickness of the trunk under the graft-union, though, was smallest and an irregular increase of the diameters of the two components, rootstock and scion, occurred.

Key words: rootstock, scion, variety of vine, grafting, photosynthesis, chlorophyll, yield, production, phenology, statistics, Bulgaria.

Introduction

In our previous investigations (SLAVCHEVA 1981, 1988; STOEV and SLAVCHEVA 1982) the effect of the most important ecological factors – light, temperature, carbon dioxide, soil humidity – and of some agricultural factors – training systems, planting density – on the photosynthetic rate of grapevine was shown. Our efforts have recently been directed to investigating physiological and biochemical peculiarities of grapevine plant in relation to variety and also choice of rootstock. This is aimed at facilitating selection of perspective grapevine varieties with optimum parameters of leaf photosynthesis and with valuable agrobiological characteristics, as well as at utilizing the obtained knowledge for the progress of grapevine breeding. Some results in this field are presented in this paper.

Materials and methods

The experimental work was carried out at the Institute of Viticulture and Enology, Pleven. Five wine varieties bred at the institute were investigated: Storgoziya, Nikopolski mavrud, Pomoritski biser, Dunavska gamza and Dunavski lazur. The first of these was grafted on Chasselas x Berlandier 41 B rootstock, each of the other cultivars on three rootstocks: Chasselas x Berlandier 41 B, Berlandier x Riparia SO 4 and (Berlandier x Riparia Kober 5 BB) x (Rupestris Martin) III-102 D\textsuperscript{1}, the latter having been developed at the Institute of Viticulture and Enology (DIMITROV 1977, author's certificate no. 23562). During the vegetation period, dry matter accumulation in leaves, pigment content, leaf area, grape yield, as well as other additional characteristics were determined.

Dry matter accumulated in leaves during the day was determined after the method of SACHS (PoPov et al. 1957), leaf samples were taken for this purpose at 8 a.m., 12 p.m. and 4 p.m. three times during the vegetation period in phenophases of flowering, onset of grape maturation

\textsuperscript{1} For brevity: 41 B, SO 4, III-102.
Genetic improvement of grapevine form or function

Specific leaf (dry) weight was measured as mg/dm$^2$. Pigment content (chlorophyll a, chlorophyll b and carotenoids) was determined spectrophotometrically (Pochinok 1976) during the same phases as mg% (mg per 100 g dry weight). Leaf area per vine was calculated as m$^2$ (Carbonneau 1976; Slavcheva 1983, 1987). Grape yield was measured as kg per grapevine.

The data were statistically processed (Mudra 1958; Barov and Naidenova 1969).

Table 1: Specific leaf weight during the day (mg dry wt/dm$^2$)

<table>
<thead>
<tr>
<th>Rootstocks</th>
<th>Cultivars</th>
<th>Nikopolski mavrud</th>
<th>Pomoriski biser</th>
<th>Dunavska gamza</th>
<th>Dunavski lazur</th>
<th>Storgoziya</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
<tr>
<td>Flowering</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>41 B</td>
<td>I$^1)$</td>
<td>454.4</td>
<td>492.4</td>
<td>495.4</td>
<td>459.1</td>
<td>469.4</td>
</tr>
<tr>
<td></td>
<td>II$^1)$</td>
<td>488.8</td>
<td>524.7</td>
<td>522.1</td>
<td>497.8</td>
<td>498.1</td>
</tr>
<tr>
<td></td>
<td>III$^1)$</td>
<td>500.3</td>
<td>555.5</td>
<td>559.6</td>
<td>521.5</td>
<td>524.9</td>
</tr>
<tr>
<td>SO4</td>
<td>I</td>
<td>451.8</td>
<td>493.0</td>
<td>502.3</td>
<td>467.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>488.2</td>
<td>526.5</td>
<td>543.3</td>
<td>492.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>503.1</td>
<td>549.2</td>
<td>566.6</td>
<td>520.6</td>
<td></td>
</tr>
<tr>
<td>III-102</td>
<td>I</td>
<td>469.3</td>
<td>504.2</td>
<td>527.6</td>
<td>469.1</td>
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<td></td>
<td>II</td>
<td>493.1</td>
<td>537.0</td>
<td>553.0</td>
<td>509.2</td>
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<tr>
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<td>III</td>
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<td>573.4</td>
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<tr>
<td>Onset of maturation</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>41 B</td>
<td>I</td>
<td>675.9</td>
<td>727.4</td>
<td>717.1</td>
<td>684.5</td>
<td>627.9</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>708.7</td>
<td>775.4</td>
<td>766.3</td>
<td>721.2</td>
<td>660.6</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>722.4</td>
<td>767.6</td>
<td>781.4</td>
<td>733.0</td>
<td>665.8</td>
</tr>
<tr>
<td>SO4</td>
<td>I</td>
<td>670.3</td>
<td>718.2</td>
<td>737.6</td>
<td>684.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>712.8</td>
<td>762.3</td>
<td>781.5</td>
<td>716.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>728.6</td>
<td>795.2</td>
<td>795.0</td>
<td>724.5</td>
<td></td>
</tr>
<tr>
<td>III-102</td>
<td>I</td>
<td>697.5</td>
<td>757.4</td>
<td>747.8</td>
<td>687.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>743.2</td>
<td>791.1</td>
<td>790.5</td>
<td>728.2</td>
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</tr>
<tr>
<td></td>
<td>III</td>
<td>746.2</td>
<td>806.0</td>
<td>812.5</td>
<td>738.6</td>
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<tr>
<td>Maturation</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>41 B</td>
<td>I</td>
<td>675.4</td>
<td>796.0</td>
<td>763.3</td>
<td>700.2</td>
<td>656.8</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>698.0</td>
<td>825.6</td>
<td>784.5</td>
<td>712.5</td>
<td>694.8</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>711.4</td>
<td>830.9</td>
<td>801.5</td>
<td>712.9</td>
<td>694.6</td>
</tr>
<tr>
<td>SO4</td>
<td>I</td>
<td>680.5</td>
<td>791.5</td>
<td>798.1</td>
<td>697.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>712.4</td>
<td>841.5</td>
<td>811.5</td>
<td>708.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>724.8</td>
<td>820.4</td>
<td>816.5</td>
<td>709.3</td>
<td></td>
</tr>
<tr>
<td>III-102</td>
<td>I</td>
<td>726.6</td>
<td>841.5</td>
<td>811.6</td>
<td>740.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>766.1</td>
<td>901.5</td>
<td>833.5</td>
<td>768.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>757.1</td>
<td>868.1</td>
<td>828.2</td>
<td>748.3</td>
<td></td>
</tr>
</tbody>
</table>

$^1$) First (8 a.m.), second (12 p.m.), third (4 p.m.) samples in the day-time.
Results and discussion

In Table 1 data are shown on specific leaf weight at 8 a.m., 12 p.m. and 4 p.m. during flowering, onset of maturation and maturation. The specific weight of leaves increased during the day as a result of their photosynthetic activity irrespective of variety and rootstock. This allowed to use summarized equations for characterization of the general regularities. The dry matter increment of leaves during the day can be described by linear regressions as follows:

<table>
<thead>
<tr>
<th>Rootstock</th>
<th>Flowering</th>
<th>Onset of maturation</th>
<th>Maturation</th>
</tr>
</thead>
<tbody>
<tr>
<td>41 B</td>
<td>y = 408.6 + 8.06x</td>
<td>y = 629.6 + 8.30x</td>
<td>y = 695.7 + 4.46x</td>
</tr>
<tr>
<td>SO 4</td>
<td>y = 415.1 + 7.74x</td>
<td>y = 634.6 + 8.21x</td>
<td>y = 717.3 + 3.39x</td>
</tr>
<tr>
<td>III-102</td>
<td>y = 435.3 + 6.95x</td>
<td>y = 657.6 + 7.83x</td>
<td>y = 763.7 + 2.88x</td>
</tr>
</tbody>
</table>

In the equations y is the specific leaf weight, i.e. the leaf dry weight per unit leaf area (mg/dm²), and x the time of day (h between 8 a.m. and 4 p.m.). During flowering the t-test for the three rootstocks was $t_{\text{exp.}} > t_{\text{tab.}}$, during onset of maturation this was relevant to 41 B and SO 4 rootstocks, during grape maturation $t_{\text{exp.}} < t_{\text{tab.}}$. The rate of dry matter accumulation in leaves during the day, i.e. the change in leaf dry weight per unit leaf area per unit time, was highest on 41 B rootstock, and lowest on III-102. The specific leaf weight, in contrast, was greatest on III-102 and lowest on 41 B (significant differences). Furthermore, the dry matter accumulation rate in leaves during the day depended also on the phase; it was highest during onset of maturation and lowest during maturation.

Changes in specific leaf weight during the day can be described by a non-linear regression, polynomial of second degree:

<table>
<thead>
<tr>
<th>Rootstock</th>
<th>Flowering</th>
<th>Onset of maturation</th>
<th>Maturation</th>
</tr>
</thead>
<tbody>
<tr>
<td>41 B</td>
<td>y = 324.6 + 22.75x - 0.60x²</td>
<td>y = 464.9 + 37.77x - 1.24x²</td>
<td>y = 612.2 + 18.53x - 0.56x²</td>
</tr>
<tr>
<td>SO 4</td>
<td>y = 307.1 + 26.62x - 0.78x²</td>
<td>y = 500.2 + 31.43x - 0.95x²</td>
<td>y = 624.2 + 19.10x - 0.63x²</td>
</tr>
<tr>
<td>III-102</td>
<td>y = 311.2 + 28.64x - 0.89x²</td>
<td>y = 456.6 + 42.54x - 1.42x²</td>
<td>y = 435.8 + 58.28x - 2.22x²</td>
</tr>
</tbody>
</table>

The meaning of y and x is the same as above.

After differentiating the above-mentioned equations the following was obtained:

<table>
<thead>
<tr>
<th>Rootstock</th>
<th>Flowering</th>
<th>Onset of maturation</th>
<th>Maturation</th>
</tr>
</thead>
<tbody>
<tr>
<td>41 B</td>
<td>$\frac{dy}{dx} = 22.75 - 1.20x$</td>
<td>$\frac{dy}{dx} = 37.77 - 2.48x$</td>
<td>$\frac{dy}{dx} = 18.53 - 1.12x$</td>
</tr>
<tr>
<td>SO 4</td>
<td>$\frac{dy}{dx} = 26.62 - 1.56x$</td>
<td>$\frac{dy}{dx} = 31.43 - 1.90x$</td>
<td>$\frac{dy}{dx} = 19.10 - 1.26x$</td>
</tr>
<tr>
<td>III-102</td>
<td>$\frac{dy}{dx} = 28.64 - 1.78x$</td>
<td>$\frac{dy}{dx} = 42.54 - 2.84x$</td>
<td>$\frac{dy}{dx} = 58.28 - 4.44x$</td>
</tr>
</tbody>
</table>

In the equations $\frac{dy}{dx}$ is the rate of dry matter accumulation in leaves during the day (mg/dm² · h) and x as formerly the time of day between 8 a.m. and 4 p.m. (h). This dry matter accumulation rate depended on the rate of net assimilates production and the rate of their translocation to the other organs. It decreased linearly with time from the morning hours (8 a.m.) towards the afternoon hours (4 p.m.), which was probably due to overcharging the photosynthetic apparatus with assimilates, causing a depression of photosynthesis. The coefficient before x is a measure of the reduction of dry matter accumulation rate in leaves per unit time.
Statistic data processing was complicated by the use of a non-linear regression to describe the
change in specific leaf weight during the day. Verification by an F-test did not give better results, so
we could satisfy ourselves with a linear regression. Experimental data, however, are better
described by a non-linear regression and, provided a sufficiently large number of replicates is
available, it is preferable.

Data examination for each variety showed that the already mentioned tendencies remain with
little exceptions, so that the use of generalized data proved to be adequate. (Under the aspect of
varieties the data will be examined in more detail in another paper.) Highest values of specific leaf
weight were obtained for cvs Pomoriški biser and Dunavska gamza, and lower values were
obtained for Dunavski lazur, Nikopolski mavrud and Storgoziya. The differences between the two
groups of cultivars were significant ($F_{\text{exp}} > F_{0.001}$). Specific leaf weight is a typical characteristic of
variety and rootstock.

In Table 1 it is also seen that the specific leaf weight increased during the vegetation period. Its
change could be described by a non-linear regression, as follows:

- **41 B**
  - \( y = 475.1 + 4.870x \cdot 0.0207x^2 \) 
  - \( F_{\text{exp}} = 54.94 > F_{0.001} = 27.00 \)
- **SO4**
  - \( y = 477.9 + 5.047x \cdot 0.0223x^2 \) 
  - \( F_{\text{exp}} = 44.66 > F_{0.001} = 27.00 \)
- **III-102**
  - \( y = 486.3 + 5.012x \cdot 0.0199x^2 \) 
  - \( F_{\text{exp}} = 49.12 > F_{0.001} = 27.00 \)

In the equations \( y \) is the specific leaf weight (mean value from the three measurements during
the day) as mg/dm², and \( x \) the time in days (d) after the earliest date of measuring (in this case
during flowering).

When we differentiated the equations, the first derivative of \( y \) with respect to \( x \) was considered
as rate of dry matter accumulation in leaves during the vegetation period. This looked like this:

- **41 B**
  - \( \frac{dy}{dx} = 4.870 \cdot 0.0414x \)
- **SO4**
  - \( \frac{dy}{dx} = 5.047 \cdot 0.0446x \)
- **III-102**
  - \( \frac{dy}{dx} = 5.012 \cdot 0.0398x \)

In the equations \( \frac{dy}{dx} \) is the gain in leaf dry matter, calculated per unit leaf area per unit time
(mg/dm²•d) and \( x \) the time in days (d) after florescence. The rate of dry matter accumulation
decreased uniformly in the course of time, most slowly on III-102 and most rapidly on SO4
rootstock. Considered for each cultivar, the results are analogous; the value of \( \frac{dy}{dx} \) (average for
the vegetation period) was smallest on SO4 and it was highest on III-102 except for cv. Dunavska
gamza, where in general the differences were small.

This fact could be related to the translocation of assimilates toward clusters and other sinks.
According to VAŞEV (1976), interrupted or retarded assimilate flow causes an increase in leaf dry
weight and reduces water content and plastid pigment amount. Export of photosynthates from
leaves is controlled by the needs of the individual sinks (STOEV and IVANTCHEV 1977; ORTH 1983;
EIBACH and ALLEWEIDT 1985). The cluster becomes the principal sink for photosynthates
produced in the middle third of the shoot after fruit-set during its most intensive growth (BALCAR
and HERNANDEZ 1988) and particularly at onset of maturation (STOEV and IVANTCHEV 1977).

From Table 2 it is seen that for all cultivars on SO4 rootstock a higher yield was obtained
mainly at the expense of cluster weight, i.e. reciprocally to the rate of dry matter accumulation in
leaves. This shows the correctness of such an approach.

Leaf area correlates to yield ($r = +0.799 > r_{0.01} = 0.684$). For all varieties the leaf area per vine
was greatest on SO4 rootstock, mainly at the expense of the mean area per leaf (Table 3).
### Table 2: Grape yield (kg/vine)

<table>
<thead>
<tr>
<th>Rootstocks</th>
<th>Cultivars</th>
<th>Nikopolski</th>
<th>Pomorilski</th>
<th>Dunavska</th>
<th>Dunavski</th>
<th>Storgoziya</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>mavrud</td>
<td>biser</td>
<td>gamza</td>
<td>lazur</td>
<td></td>
</tr>
<tr>
<td>41 B</td>
<td></td>
<td>4.619</td>
<td>5.600</td>
<td>5.844</td>
<td>5.540</td>
<td>7.530</td>
</tr>
<tr>
<td>SO 4</td>
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<td>6.520</td>
<td>7.304</td>
<td>6.717</td>
<td>6.495</td>
<td></td>
</tr>
<tr>
<td>III-102</td>
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<td>5.403</td>
<td>4.864</td>
<td>4.404</td>
<td>5.056</td>
<td></td>
</tr>
</tbody>
</table>

### Table 3: Leaf area (m²/vine)

<table>
<thead>
<tr>
<th>Rootstocks</th>
<th>Cultivars</th>
<th>Nikopolski</th>
<th>Pomorilski</th>
<th>Dunavska</th>
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<th>Storgoziya</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>mavrud</td>
<td>biser</td>
<td>gamza</td>
<td>lazur</td>
<td></td>
</tr>
<tr>
<td>41 B</td>
<td></td>
<td>9.9</td>
<td>9.6</td>
<td>6.8</td>
<td>8.2</td>
<td>13.1</td>
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<tr>
<td>SO 4</td>
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<td>12.0</td>
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<td>7.0</td>
<td>12.6</td>
<td></td>
</tr>
<tr>
<td>III-102</td>
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<td>10.2</td>
<td>6.3</td>
<td>6.3</td>
<td>5.3</td>
<td></td>
</tr>
</tbody>
</table>

### Table 4: Thickness of the trunk (mm) (A) above and (B) under the graft-union

<table>
<thead>
<tr>
<th>Rootstocks</th>
<th>Cultivars</th>
<th>Nikopolski</th>
<th>Pomorilski</th>
<th>Dunavska</th>
<th>Dunavski</th>
<th>Storgoziya</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>gamza</td>
<td>lazur</td>
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<td></td>
<td></td>
<td>A</td>
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<td></td>
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<tr>
<td>41 B</td>
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<td>32.5¹</td>
<td>32.0</td>
<td>28.5</td>
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<td>32.4</td>
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<tr>
<td>SO 4</td>
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<td>34.3</td>
<td>33.6</td>
<td>29.1</td>
<td>31.0</td>
<td></td>
</tr>
<tr>
<td>III-102</td>
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<td>32.6</td>
<td>33.6</td>
<td>29.1</td>
<td>31.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>B</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>41 B</td>
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<td>32.7</td>
<td>35.6</td>
<td>33.2</td>
<td>33.3</td>
<td>35.9</td>
</tr>
<tr>
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<td>28.4</td>
<td>28.9</td>
<td>25.7</td>
<td>28.2</td>
<td></td>
</tr>
<tr>
<td>III-102</td>
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<td>34.7</td>
<td>35.1</td>
<td>31.1</td>
<td>34.7</td>
<td></td>
</tr>
</tbody>
</table>

¹) The data are mean values from 3 years.

As to thickness of the trunk (which is a consumer as well) under the graft-union, it was smallest when the cultivars were grafted on SO 4, probably owing to rival interrelations, i. e. the assimilates
Table 5: Pigment contents in the leaves (mg/100 g dry wt)

<table>
<thead>
<tr>
<th>Rootstocks</th>
<th>Cultivars</th>
<th>41 B</th>
<th>SO 4</th>
<th>III-102</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nikkiopolski mavrud</td>
<td>415</td>
<td>477</td>
<td>434</td>
</tr>
<tr>
<td></td>
<td>Pomoriński biser</td>
<td>406</td>
<td>439</td>
<td>408</td>
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<td></td>
<td>Dunavska gamza</td>
<td>382</td>
<td>383</td>
<td>369</td>
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<tr>
<td></td>
<td>Dunavska lazur</td>
<td>406</td>
<td>435</td>
<td>391</td>
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<tr>
<td></td>
<td>Storgoziya</td>
<td>497</td>
<td></td>
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<tr>
<td>Chlorophyll a</td>
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<tr>
<td>Chlorophyll b</td>
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<tr>
<td>Carotenoids</td>
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1) The data are mean values from the three measurements in phenophases of flowering, onset of grape maturation, and maturation.

were distributed predominantly in the overground part and besides an irregular thickening of both components, rootstock and scion, occurred (Table 4). In contrast, on III-102 rootstock, probably owing to the presence of a smaller consumer (cluster) a greater portion of dry matter was accumulated in the leaves and subsequently in the perennial parts, which corresponds to some results obtained by Dimitrov (1984, unpublished data).

The contents of chlorophyll a, chlorophyll b and carotenoids in leaves are shown in Table 5. The data concerning rootstock III-102 are from 2 years. The highest pigment content was characteristic of cv. Nikkiopolski mavrud, followed by Pomoriński biser, the lowest of cv. Dunavska gamza; on 41 B rootstock, the pigment content was greatest for cv. Storgoziya. Cv. Pomoriński biser was not significantly different ($F_{exp} < F_{0.05}$) from Nikkiopolski mavrud in regards to pigment contents, but the differences were significant for Dunavska lazur and Dunavska gamza ($F_{exp} > F_{0.05}$). For all varieties the total content of pigments was highest on SO 4 rootstock, mainly at the expense of chlorophyll a and the carotenoids.

Pigment contents continuously decreased during the vegetation period. This could be expressed for chlorophyll a by a linear regression, as follows:

41 B: $y = 530 - 1.840x$ ($t_{exp} = 6.523 > t_{0.001} = 5.408$)
SO 4: $y = 515 - 1.158x$ ($t_{exp} = 7.163 > t_{0.001} = 5.408$)
III-102: $y = 571 - 2.302x$ ($t_{exp} = 7.328 > t_{0.01} = 4.604$)

In the equations $y$ is the content of chlorophyll a (mg/100 g dry weight) and $x$ the time (d) after florescence.

Analogous equations were obtained for chlorophyll b:

41 B: $y = 163 - 0.509x$ ($t_{exp} = 5.052 > t_{0.01} = 3.499$)
SO 4: $y = 156 - 0.325x$ ($t_{exp} = 2.287 < t_{0.05} = 2.365$)
III-102: $y = 164 - 0.634x$ ($t_{exp} = 2.309 < t_{0.05} = 2.776$)
where y is the content of chlorophyll b and x as above.

For the carotenoids:

\[
\begin{align*}
41 & B & y = 248 - 0.685x & (t_{\exp} = 3.686 > t_{0.01} = 3.499) \\
SO4 & & y = 251 - 0.491x & (t_{\exp} = 2.775 > t_{0.05} = 2.365) \\
III-102 & & y = 273 - 0.871x & (t_{\exp} = 5.496 > t_{0.01} = 4.604)
\end{align*}
\]

And, finally, jointly for chlorophylls + carotenoids:

\[
\begin{align*}
41 & B & y = 926 - 2.868x & (t_{\exp} = 5.788 > t_{0.001} = 5.408) \\
SO4 & & y = 921 - 1.973x & (t_{\exp} = 6.479 > t_{0.001} = 5.408) \\
III-102 & & y = 1002 - 3.794x & (t_{\exp} = 7.503 > t_{0.01} = 4.604)
\end{align*}
\]

Therefore, with all the three rootstocks pigment contents in leaves decreased during the vegetation period. This change was not observed for chlorophyll b (SO4 and III-102 rootstocks).

It should be noted that during flowering pigment contents in the leaves of the cultivars, grafted on III-102 rootstock, was higher compared to the other two rootstocks, but at the end of the maturation phase it was already lower. Obviously on III-102 rootstock conditions were created for faster shoot maturation, which is one of the premises for its better frost resistance (SLAVCHEVA, unpublished data; POPOV 1988).

A negative correlation \((r > r_{0.001})\) existed between the specific leaf weight and the pigment contents in leaves, both characteristics depended on the time (date), i.e., they changed during the vegetation period.

In conclusion, differences were established in the investigated physiological and other characteristics in relation with variety and rootstock. The obtained knowledge can be utilized in grapevine breeding.

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References


