FIRST RESULTS ON SOIL MANAGEMENT OF ORGANIC SUGRATHIRTEEN® TABLE GRAPES COVERED WITH PLASTIC FILM IN APULIA REGION

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In the world there is an increasing consumer demand for residue-free, organically grown seedless table grapes. Organic table grapes cultivation is very complex and in organic viticulture cover crops are considered a highly sustainability choice for the soil management strategies.
BACKGROUND AND AIMS

There are many choices for cover crops in viticulture, ranging from perennial and annual grasses, to legumes considering that each species have strengths and weaknesses, as well as associated seed and management costs.
The use of inter-row cover crops (permanent or temporary) in viticulture have many advantages, such as the reduction of water runoff and soil erosion, restriction of evaporation from the soil surface, improvement soil water holding capacity and soil organic content, the reduction of temperature fluctuations in the soil, as well as the regulation of the vine growth and vigor, with influence on grape quality and quantity (de Palma et al., 2007; Fourie, 2010).
Sugrathirteen ® (Midnight beauty® brand) is a new early-season black seedless table grape variety obtained by David W. Cain in Wasco, (California) and developed and produced under license throughout the world by Sun World Int., (Coachella, California, USA). It’s characterized by high productivity and has firm, low acid, early ripening (ripens along with Superior Seedless) naturally large, elongated black berries, which does not require exogenous applications of gibberellic acid to obtain commercially acceptable berry size (U.S.P.P. N° 10.434; Gentilescio et al., 2011).
### Average characteristics* of Sugrathirteen® tablegrape

(Gentilesco et al., 2011)

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bunch weight (g)</td>
<td>560÷780</td>
</tr>
<tr>
<td>Berry weight (g)</td>
<td>4.20÷5.60</td>
</tr>
<tr>
<td>Rachis weight (g)</td>
<td>4.58÷5.71</td>
</tr>
<tr>
<td>Berries/cluster (n)</td>
<td>100÷175</td>
</tr>
<tr>
<td>Compactness index (berries/cm)</td>
<td>5.26÷8.19</td>
</tr>
<tr>
<td>Soluble solids (° Brix)</td>
<td>13.50÷17.40</td>
</tr>
<tr>
<td>Titratable acidity (g L(^{-1}))</td>
<td>4.58÷5.71</td>
</tr>
<tr>
<td>pH</td>
<td>3.37÷3.64</td>
</tr>
</tbody>
</table>

* without Plant Growth regulators applications
Average characteristics* of Sugrathirteen® tablegrape
(Gentileesco et al., 2011)

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyphenols ( (mg \text{ kg}^{-1} \text{ grapes}) )</td>
<td>372÷513</td>
</tr>
<tr>
<td>Anthocyanins ( (mg \text{ kg}^{-1} \text{ grapes}) )</td>
<td>356÷596</td>
</tr>
<tr>
<td>Flavonoids ( (mg \text{ kg}^{-1} \text{ grapes}) )</td>
<td>800÷1347</td>
</tr>
</tbody>
</table>

* without Plant Growth regulators application
Skin anthocyanins in Sugrathirteen® grapevines (Gentilesco et al., 2011)
BACKGROUND AND AIMS

IN THIS RESEARCH THREE SOIL INTER-ROW MANAGEMENT TECHNIQUES WERE COMPARED TO TEST THEIR EFFECTS ON VINE GROWTH, VINE WATER STATUS, LEAF GAS EXCHANGE, PRODUCTION AND JUICE COMPOSITION OF ORGANIC SUGRATHIRTEEN® VINES.
# MATERIALS AND METHODS

<table>
<thead>
<tr>
<th><strong>PERIOD</strong></th>
<th>2012-2013</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LOCATION</strong></td>
<td>Gioia del Colle (Bari), Apulia Region (latitude 40°47'48” N and longitude 16°55'24” E)</td>
</tr>
<tr>
<td><strong>VEGETAL MATERIAL</strong></td>
<td><em>Vitis vinifera</em> cv Sugrathirteen (Midnight Beauty® brand), grafted onto <em>Vitis berlandieri</em> x <em>Vitis rupestris</em> 140 Ruggeri rootstock</td>
</tr>
<tr>
<td><strong>TRAINING SYSTEM</strong></td>
<td>Y trellis system covered with plastic film</td>
</tr>
<tr>
<td><strong>VINE SPACING</strong></td>
<td>3.5 x 2.0 m (1.428 vines ha⁻¹)</td>
</tr>
<tr>
<td><strong>PRUNING SYSTEM</strong></td>
<td>Cane pruned (72 buds per vine)</td>
</tr>
<tr>
<td><strong>SOIL CHARACTERISTICS</strong></td>
<td>Medium chemical fertility soil texture: clay-loam</td>
</tr>
</tbody>
</table>
| TREATMENTS | **MC**: in rows and inter-rows soil mechanical cultivation or no cover crop  
**RV**: inter-rows cover crop by permanent resident vegetation while in rows mechanical cultivation  
**TR**: inter-rows space were sown in 2010, two years before the measurements with *Trifolium subterraneum* L. ssp. *brachycalicinum* cv Antas |
| --- | --- |
| IRRIGATION | Drip system with a single irrigation line per row and pressure compensated emitters  
(discharge rate of 10 l h\(^{-1}\) per vine) |
| EXPERIMENTAL DESIGN AND STATISTICS | Completely randomized block Systat 11 package (SYSTAT Software Inc., Richmond, California, USA). |
EXPERIMENTAL VINEYARD
Mechanical cultivation

Subterranean clover
Resident vegetation
cover crop
PARAMETERS MEASURED

Midday stem water potential, stomatal conductance, leaf gas exchange, yield components, vegetative parameters, berry skin color parameter \((L^*, a^*, b^*, \text{CIRG})\).

CIRG (color index of red grapes) was calculated by this formula:

\[
\text{CIRG} = (180 - H) (L^* + C)
\]

\(H\) = Hue angle
\(C\) = Chroma
\(L^*\) = Lightness
AIR TEMPERATURE AT EXPERIMENTAL SITE IN 2012
RAINFALL AT EXPERIMENTAL SITE IN 2012.
Radiometric coefficients of the plastic film
(thickness 130 μm)

<table>
<thead>
<tr>
<th>Plastic Film</th>
<th>Transmissivity (%)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>LDPE film</td>
<td>Solar total</td>
<td>Solar diffuse</td>
</tr>
<tr>
<td>N</td>
<td>83.7</td>
<td>29.9</td>
</tr>
</tbody>
</table>

*Solar radiation: 300-2500 nm*
*Solar NIR: 700-2500 nm*
*PAR total: 400-700 nm*
*UVA: 320-380 nm*
*LWIR: 7500-12500 nm*
HIGHEST PAR IN OPEN AIR: 2246 μmol m$^2$ s$^{-1}$
HIGHEST PAR UNDER COVERING: 1781 μmol m$^2$ s$^{-1}$ (-21%)
HIGHEST HUMIDITY IN OPEN AIR: 98.4%
HIGHEST HUMIDITY UNDER COVERING: 100%
LOWEST HUMIDITY IN OPEN AIR: 19%
LOWEST HUMIDITY UNDER COVERING: 29.6% (+56%)
HIGHEST T IN OPEN AIR: 39.7 °C
HIGHEST T UNDER COVERING: 42.9 °C (+8%)
LOWEST T IN OPEN AIR: 9.5 °C
LOWEST T UNDER COVERING: 8.5 °C
## VEGETATIVE AND PRODUCTIVE CHARACTERISTICS
(before cluster thinning)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Shoots per vine (n)</th>
<th>Clusters per vine (n)</th>
<th>Node fertility</th>
<th>Fruitfulness</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC</td>
<td>52.67 a</td>
<td>59.00 b</td>
<td>0.82 b</td>
<td>1.12 a</td>
</tr>
<tr>
<td>TR</td>
<td>57.70 a</td>
<td>74.33 a</td>
<td>1.03 a</td>
<td>1.29 a</td>
</tr>
<tr>
<td>RV</td>
<td>56.73 a</td>
<td>68.67 ab</td>
<td>0.95 ab</td>
<td>1.21 a</td>
</tr>
</tbody>
</table>

Means followed by different letters were significantly different at $p \leq 0.05$ using SNK test.
# GRAPEVINE WATER STATUS

<table>
<thead>
<tr>
<th>STAGE</th>
<th>Midday stem water potential ((\Psi_{mds}, MPa))</th>
<th>Stomatal conductance ((\text{mmol m}^2 \text{s}^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fruit-set</td>
<td>Pea-size</td>
</tr>
<tr>
<td>MC</td>
<td>-0.87 b</td>
<td>-0.89 a</td>
</tr>
<tr>
<td>TR</td>
<td>-1.04 a</td>
<td>-0.92 a</td>
</tr>
<tr>
<td>RV</td>
<td>-1.01 a</td>
<td>-0.87 a</td>
</tr>
</tbody>
</table>

Means followed by different letters were significantly different at \(p \leq 0.05\) using SNK test.
TEMPORAL VARIATION OF SOIL WATER CONTENT IN DIFFERENT ROOT ZONE (inter row and in-row)
## LEAF GAS EXCHANGE

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Leaf T (°C)</th>
<th>Stomatal conductance (mol m(^{-2}) s(^{-1}))</th>
<th>Net photosynthesis (µmol m(^{-2}) s(^{-1}))</th>
<th>Transpiration (mol m(^{-2}) s(^{-1}))</th>
<th>WUE (µmol:mmol)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC</td>
<td>33.60 b</td>
<td>0.295 a</td>
<td>13.08 a</td>
<td>4.72 b</td>
<td>2.77 a</td>
</tr>
<tr>
<td>TR</td>
<td>35.42 a</td>
<td>0.352 a</td>
<td>12.77 a</td>
<td>6.35 a</td>
<td>2.20 b</td>
</tr>
<tr>
<td>RV</td>
<td>35.22 a</td>
<td>0.342 a</td>
<td>13.10 a</td>
<td>5.88 ab</td>
<td>1.99 b</td>
</tr>
</tbody>
</table>

Means followed by different letters were significantly different at p ≤ 0.05 using SNK test.
## MAIN QUANTITATIVE AND QUALITATIVE YIELD PARAMETERS AT HARVEST

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Bunch weight (g)</th>
<th>Rachis weight (g)</th>
<th>Berries per cluster (n)</th>
<th>Berry weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC</td>
<td>563.51 a</td>
<td>13 a</td>
<td>131 a</td>
<td>4.30 b</td>
</tr>
<tr>
<td>TR</td>
<td>554.86 a</td>
<td>11 ab</td>
<td>116 ab</td>
<td>4.80 a</td>
</tr>
<tr>
<td>RV</td>
<td>518.18 a</td>
<td>10 b</td>
<td>108 b</td>
<td>4.70 a</td>
</tr>
</tbody>
</table>

*Means followed by different letters were significantly different at p ≤ 0.05 using SNK test.*
## MAIN QUANTITATIVE AND QUALITATIVE YIELD PARAMETERS AT HARVEST

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Polar diameter $(mm)$</th>
<th>Equatorial diameter $(mm)$</th>
<th>Cluster compactness index $(berry/cm rachis)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC</td>
<td>24.39 a</td>
<td>19.61 a</td>
<td>5.69 a</td>
</tr>
<tr>
<td>TR</td>
<td>23.99 a</td>
<td>19.41 a</td>
<td>5.27 a</td>
</tr>
<tr>
<td>RV</td>
<td>22.79 b</td>
<td>18.77 b</td>
<td>5.14 a</td>
</tr>
</tbody>
</table>

Means followed by different letters were significantly different at $p \leq 0.05$ using SNK test.
# MAIN QUANTITATIVE AND QUALITATIVE YIELD PARAMETERS AT HARVEST

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Skin firmness ((N))</th>
<th>Berry removal force ((N))</th>
<th>Firmness ((N))</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC</td>
<td>1.37 a</td>
<td>2.65 a</td>
<td>12.95 a</td>
</tr>
<tr>
<td>TR</td>
<td>1.18 a</td>
<td>2.55 a</td>
<td>13.34 a</td>
</tr>
<tr>
<td>RV</td>
<td>1.24 a</td>
<td>22.65 a</td>
<td>13.92 a</td>
</tr>
</tbody>
</table>

Means followed by different letters were significantly different at \(p \leq 0.05\) using SNK test.
# BERRY JUICE COMPOSITION

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Total soluble solids ((^\circ\text{Brix}))</th>
<th>Titratable acidity ((g L^{-1}))</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC</td>
<td>15.20 b</td>
<td>5.32 b</td>
<td>3.29 b</td>
</tr>
<tr>
<td>TR</td>
<td>16.70 a</td>
<td>5.74 a</td>
<td>3.26 c</td>
</tr>
<tr>
<td>RV</td>
<td>16.90 a</td>
<td>5.32 b</td>
<td>3.39 a</td>
</tr>
</tbody>
</table>

Means followed by different letters were significantly different at \(p \leq 0.05\) using SNK test.
### BERRY SKIN COLOR PARAMETERS

<table>
<thead>
<tr>
<th>Treatment</th>
<th>L* (brightness)</th>
<th>a* (greenness)</th>
<th>b* (yellowness)</th>
<th>CIRG</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC</td>
<td>31.41 a</td>
<td>2.49 b</td>
<td>-7.14a</td>
<td>4.65 b</td>
</tr>
<tr>
<td>TR</td>
<td>29.69 b</td>
<td>2.89 a</td>
<td>-7.49 b</td>
<td>4.80 a</td>
</tr>
<tr>
<td>RV</td>
<td>31.65 a</td>
<td>2.86 a</td>
<td>-7.88 c</td>
<td>4.53 b</td>
</tr>
</tbody>
</table>

*Means followed by different letters were significantly different at p ≤ 0.05 using SNK test.*
## YIELD COMPONENTS AND MAIN VEGETATIVE PARAMETERS

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Yield (kg vine(^{-1}))</th>
<th>Total leaf area per vine (m(^2) vine(^{-1}))</th>
<th>Leaf area/yield (m(^2) kg(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC</td>
<td>16.90 a</td>
<td>13.70 b</td>
<td>0.81 b</td>
</tr>
<tr>
<td>TR</td>
<td>16.64 a</td>
<td>17.13 a</td>
<td>1.03 a</td>
</tr>
<tr>
<td>RV</td>
<td>15.54 a</td>
<td>14.93 b</td>
<td>0.96 a</td>
</tr>
</tbody>
</table>

Means followed by different letters were significantly different at \( p \leq 0.05 \) using SNK test.
### PRUNING WEIGHT

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Pruning weight (g)</th>
<th>Average cane weight (g)</th>
<th>Ravaz Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC</td>
<td>2767 a</td>
<td>61.30 a</td>
<td>6.76 a</td>
</tr>
<tr>
<td>TR</td>
<td>2989 a</td>
<td>89.53 a</td>
<td>5.87 a</td>
</tr>
<tr>
<td>RV</td>
<td>2369 a</td>
<td>59.80 a</td>
<td>6.94 a</td>
</tr>
</tbody>
</table>

*Means followed by different letters were significantly different at p ≤ 0.05 using SNK test.*
CONCLUSIONS

Cover crops had positive effects:
- on berry sugar content and berry weight of organic Sugrathirteen® vines.
- the benefit of temporary subterranean clover cover crop, which was at beginning of veraison (July) in its summer standstill, and has exerted mulching effect and less water competition to the vines, was evaluated.
- A temporary cover crop with sub clover or resident vegetation had no negative effect on vine growth and productivity;
- Cover crops have induced clear benefits in relation to soil compaction, soil water storage, organic content and soil microbial biomass (ongoing analysis).
THANK YOU FOR YOUR ATTENTION