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22-Table grape production and quality as related to the use of agrotextile fabrics as new climate control cover and reflective groundcover

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Background and Aims

Controlling vineyard microclimate and light environment are main goals to produce high quality grapes, since budbreak (3, 7), shoot growth (5, 6), bud fruitfulness (10) and berry composition (9) are influenced. In vineyards with dense foliage, overhead training systems and plastic coverings, the quantity/quality of available solar radiation is crucial for thermal balance, photosynthetic rate, berry set, yield, juice composition and skin color (1, 2, 4, 11). Growing table grapes under cover is useful to increase air temperature for advancing budbreak and ripening, as well as to protect leaves and bunches from rain, wind and light hail for improving grape health and prolonging the harvest period. Nevertheless, the effects of covers on grape quality and yield should be properly evaluated (8). The present trial aimed to investigate the effects of two recently developed agrotextile plastic fabrics adopted, respectively, to control vineyard microclimate for early ripening and to improve light environment increasing the sunlight reflection.

Experimental Procedure and Main Results

The trial was run in South Italy (Laporta farm, BAT province, Apulia region). In the 2015 and 2016 winters, two 1-hectar plots (Experimental plot= E plot; Reference plot= R plot) of cv Victoria/1103 P (spaced at 2.4 x 2.4 m), trained to *tendone* trellis pruned at 2-3 canes per vine, were entirely covered with plastic sheets.
The E plot top was covered with *Coverlys®,* a PE fabric having also a PE layer at the inner side (165 g/m^2, 200 μm thick); the R plot top was covered with a PE based film (170 g/m^2, 200 μm thick). Both these sheets are transparent to solar radiation and, among other additives, equipped with UV stabilizers. The vineyard sides of both plots were covered using a cheap opaque woven fabric adopted by the farm. The optical properties of the top covers were analyzed according to Vox and coll. (2014).
A white reflective woven groundcover (G; 100 g/m^2), *Lumilys®,* was laid out on the soil. In 2015 it was installed on 10 E plot inter-rows, before budbreak; in 2016, it was installed on one half of both plots, at veraison; these zones were labeled as EG and RG. Other viticultural practices were applied uniformly, including sub-irrigation (~2000 m^3/year, starting ~15 dd. after flowering). After berry-set the lateral covers were removed to improve air circulation and reduce overheating. Microclimate was monitored outdoor and indoor on each trial units (R, E, RG, EG): over canopy photosynthetically active radiation (PAR), air (at 2 m height) and soil (at 40 cm depth) temperature and humidity were recorded at 15' freq. (Decagon's ECH2O sensors/dataloggers). Groundcover light reflection was measured as PAR, using a solar bar. On 5 vines per unit, phenology and shoot growth were monitored at all nodes of 2 canes. Vine water status (stem water potential between midmorning and midday) was monitored from early June; at farm harvest grape carpological features, berry juice composition, skin color (CIE L*a*b*) and phenol accumulation were assessed according to de Palma and coll. (2012). Grape yield was also evaluated.
Main results. *Coverlys®* showed higher retention of long IR rays (+30%), higher transmittance to UV rays (+37%) and greater diffusivity to all tested wavelengths; PE film showed higher transmittance to PAR (+11%) and to short IR rays (+8%). The daily average air temperatures were similar for both coverings, in facts, in the covering-budbreak period, the sum of internal average daily temperature exceeded the outdoor one: E= +71 °C, R= +68 °C in 2105; E= +96 °C, R= +97 °C in 2016. Average air RH was also similar, but for some days when it increased/decreased up to 3% in E plot *vs.* R plot: in 2016 this occurrence was less frequent.
Lumilys® reflected 60-76% of PAR during 10:00 to 12:00 hrs. (clear days), while soil reflected ~20%; in the covering-budbreak period 2015, light reflection increased max. air temperature up to +2-3 °C.
Phenology of Victoria vines was generally similar in all trial units; nonetheless, in 2015 a slight advance was observed in EG vines *vs*. R vines: -5 dd. at budbreak, -2 dd. at harvest. Victoria vines grown at some nearby

open-air vineyards had budbreak and harvest delayed by 10 dd. and 12 dd. respect to EG vines which benefited of a warmer microclimate. Final shoot length did not differ among trial units.
Within each covering, white groundcover increased soil humidity up to 3.6% wvc (+18% relative increase) and lowered soil temperature by 1.5 °C (-6% relative decrease). Stem water potential ranged from -0.60 to -0.80 MPa (medium level); in July 2016, RG and EG vines showed a better water status.
In 2015, grape harvest started on July 15, with TSS ~13 °Brix and TSS/TA 20-21. E and EG grapes had 10-11% higher berry weight than R grapes (9.35 g); EG bunch was 15% heavier than the R one (694 g), thus EG unit was more productive at same extent. EG berry skin color was 6% less green and 6% more yellow than R berry (a*=5.75; b*=10.44). An improved light environment may account for these results.
In 2016, TSS ~13 °Brix was reached on July 21, but farm harvest was delayed to July 30 looking for a better skin color respect to the previous year. At harvest, TSS was quite high: ~16.7 °Brix for R and RG grapes, 15.9-5.2 °Brix for E and EG grapes. Berry water content, assessed in 2016, did not differ. Bunches of units with white groundcover had a greater percentage of big berries (+14%) and were ~18% heavier (RG 1054 g; EG 1073 g) than the others; the normalized grape yield of both units increased equally (32-33 t/ha). The grapes were visually divided by the farm into premium (bunches with bigger, more elongated and golden berries) and 2nd choice; premium grape yield increased by 11% with *Lumilys®* and was 81% of the total production. Premium berries reached 11.8 g in RG and EG units (+1 or 2% *vs*. E and R berry). The yellow skin color reached max. intensity in EG (b*=14.49), decreased slightly in RG and E (-6%; -7%) and, at a greater extent, in R berry (-15%). EG and E berry increased total skin polyphenol content by 20%; EG berry increased total flavonoids content by 90% compared to berry of the reference plot. As it is well known, richness in phenol compounds, due to its relationship with antioxidant activity, is recognized as a main factor that makes grapes beneficial for human health.

Significance of the Study and Conclusions

The study showed that both a film cover and a high quality woven cover may exert similar influence on thermal regime; in the present trial, this was supported by compensatory effects of cover radiometric properties on air warming. Moreover, the study pointed out the relevant effects of the light environment on both quality and quantity of grapes produced by vineyards trained to overhead canopy systems.
The agrotextile transparent fabric *Coverlys*® was found to provide a very high retention of long IR radiations that accounted for its thermal efficiency. Moreover, it was found to have great light diffussivity that is known to reduce the intra-canopy shade that lowers leaf photosynthetic efficiency, and to decrease the impact of solar energy on top foliage that makes possible sunburns. Finally, *Coverlys*® showed very high UV transmittance resulting in more skin phenols. These are the main features of this new developed product.
The agrotextile white reflective groundcover *Lumilys*® showed a great potential for recovering ground reflecting light. In combination with *Coverlys*®, it gave a definitive contribution to the light environment under canopy. This improved grape yield, mainly by enhancing the large berries percentage and hence the bunch weigh, skin color and total flavonoid accumulation. The soil protection with *Lumilys*® proved to lower soil temperature and water evaporation, allowing to keep the soil more moisturized.

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