

6.3 Integration of bagging with other vineyard management practices

Bagging is most effective when integrated with other vineyard practices that improve cluster-zone microclimate and reduce disease pressure. Reviews of grapevine pest management argue that cultural and physical methods should complement other control tools rather than be treated in isolation, especially as reliance on synthetic pesticides becomes less sustainable (Pavan et al., 2026). This logic fits grape bagging well, because bagging provides direct fruit protection while pruning, irrigation, and canopy management regulate the surrounding environment that still shapes temperature, humidity, and pathogen risk.

Field evidence supports combining bagging with practices such as defoliation, bunch-density reduction, and irrigation control to strengthen disease suppression and quality preservation. In vineyards, defoliation, reduced bunch density, and irrigation cut-off significantly reduced *Aspergillus* occurrence on berries and altered the carposphere microbiome in ways associated with lower disease pressure (Testempasis et al., 2023). At a broader systems level, extensive vineyard management with vegetation cover and low pesticide use increased biodiversity and ecosystem services, including pest control, suggesting that bagging should be positioned within low-input, ecology-based production systems rather than as a stand-alone intervention (Winter et al., 2025).

7 Case Studies: Application of Fruit Bagging in Commercial Grape Production

7.1 Effects of different bag colors on red grape anthocyanin accumulation

Commercial experience with red grapes shows that bag color strongly regulates anthocyanin accumulation by modifying cluster light environment rather than by providing a uniform bagging effect. In three red table grape cultivars, anthocyanin responses differed among seven bag types: mesh bags produced the highest anthocyanin content in RDZH, yellow bags were best in RDHY, and transparent or mesh bags outperformed paper bags in RDHM, showing that the optimal color or material is cultivar-dependent (Wang et al., 2022). A separate production-oriented study in 'Kyoho' likewise found that bagging effects on skin anthocyanins were inconsistent and depended on bag color, bag material, and whether an umbrella was added, confirming that commercial color management must be tailored rather than generalized (Zhou et al., 2020).

The practical lesson from red-grape systems is that some bag colors suppress total anthocyanin accumulation even when they improve uniformity or alter anthocyanin composition. In 'Kyoho', white, green, and yellow bags significantly reduced soluble solids and both total and individual anthocyanin concentrations, with green and yellow bags causing the strongest inhibition (Figure 2) (Zhou et al., 2020). By contrast, in teinturier grape 'Yan 73', red and blue photosensitive bags increased redness and brightness and raised anthocyanin, total phenol, and antioxidant activity, indicating that spectral selectivity rather than simple shading is the key design principle for premium color enhancement (Zhang et al., 2025).

A second case-study pattern is that bagging timing determines whether color suppression is temporary or persistent. In 'Shenhua' and 'Shenfeng', bagging imposed low-light stress, lowered soluble sugars, and delayed pigment development, but fruit color and soluble solids recovered rapidly after bag removal near maturity. Cabernet Sauvignon showed the same stage dependence at higher physiological resolution: bagging during véraison or late ripening inhibited anthocyanin accumulation, whereas early shading followed by sunlight re-exposure could preserve or even enhance final phenolic outcomes.

From a commercial perspective, the best red-grape strategy is therefore not simply “bag or do not bag,” but to choose spectrally appropriate materials and define a removal window that restores light before final coloration. Transparent and white polypropylene micro-perforation bags promoted phenolics and monoterpenes more consistently than pink or blue bags in Muscat-flavored table grapes, while yellow bags specifically increased anthocyanins in RDHY but inhibited certain traits in other cultivars (Wang et al., 2022). More generally, Mediterranean field data indicate that bagging can either promote or inhibit fruit color depending on bag type, bagging date, bag removal date, and climate, which is why color-targeted protocols must be cultivar- and region-specific (Pisciotta et al., 2020).