

Review

Susceptibility to Arthropod Pests of Mildew-Resistant Grape Varieties: What Do We Know and Where Are We Going?

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Abstract

Grapevine breeding has successfully developed mildew-resistant varieties, yet their susceptibility to arthropod pests remains largely unexplored. This review synthesizes current knowledge of arthropod pest interactions with mildew-resistant grapevines and compares them with those of conventional and parental varieties. Only a few studies have reported detailed information on arthropod pest susceptibility, covering 23 resistant varieties tested against seven species/groups, including *Daktulosphaira vitifoliae*, *Lobesia botrana*, *Drosophila suzukii* and eriophyid mites. About half of the available studies focused on berry pests—particularly the invasive *D. suzukii*—while leaf and root pests received little attention. In several cases, resistant varieties exhibited susceptibility levels comparable to those of their parental varieties, although the limited number of studies makes it difficult to draw clear conclusions. Overall, major knowledge gaps remain, highlighting the need for breeding programs that integrate mildew resistance with improved assessment of arthropod pest susceptibility, without compromising agronomic performance and wine quality.

Keywords: grapevine; *Vitis*; resistance; tolerance; susceptibility; insects; mites; downy mildew; powdery mildew

1. Grapevine and Biotic Stresses

Biotic stresses in plants are caused by living organisms—vertebrates and invertebrates, weeds, and pathogens—and can reduce crop fitness, causing yield and quality losses [1–4]. These impacts extend beyond the field, affecting the social, economic and ecological sustainability of crop production [5–8]. Plant domestication has often reduced resilience, unintentionally increasing susceptibility to pests and pathogens. In grapevine, as in other perennial crops, the selection for traits such as yield, cluster compactness and berry quality during domestication has often been accompanied by a loss of natural defenses, including structural barriers and secondary metabolites that deter herbivores. Modern varieties of *Vitis vinifera* L. are particularly susceptible to both fungal pathogens and arthropod pests because this plant species evolved in environments where major biotic stressors—such as the grape phylloxera *Daktulosphaira vitifoliae* (Fitch) (Hemiptera: Phylloxeridae), the downy mildew *Plasmopara viticola* (Berk. & M.A. Curtis) Berl. & De Toni (Oomycetes: Peronosporaceae) and powdery mildew *Erysiphe necator* (Schwein.) Burrill (Leotiomyces: Erysiphaceae)—were absent, and therefore it did not coevolve effective



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resistance to them [9]. Experimental evidence further shows that *V. vinifera* lacks effective defense responses against the root-feeding stages of *D. vitifoliae*, which can exploit infected tissues as nutrient reservoirs without triggering hypersensitive or structural reaction [10]. Consequently, the recovery and integration of traits associated with host plant resistance (HPR) is a desirable goal within Integrated Pest Management (IPM) strategies [11–13].

Grapevine is one of the world's most important crops for wine and table grape production (about 7.3 million ha yielding >70 million tonnes of grapes, ~40% in Europe [14–16]). Grapevine production frequently depends on intensive insecticide and fungicide use; in table grapes, insecticide applications may reach 10 treatments per year [17]. Major pathogens causing economic losses in vineyards include downy mildew *P. viticola*, powdery mildew *E. necator* and gray mold *Botrytis cinerea* Pers. (Leotiomyces: Sclerotiniaceae). Developing varieties resistant to downy and/or powdery mildews is a promising approach to reduce crop losses and pesticide use [17–19]. In addition to the loss of structural defenses, biochemical and signaling-based mechanisms also play a crucial role in shaping grapevine responses to biotic stress. However, the resistance mechanisms conferring protection against fungal pathogens, mainly mediated by salicylic-acid signaling and hypersensitive response genes (e.g., *Rpv* and *Ren* loci), may interact antagonistically with jasmonic-acid- and ethylene-dependent pathways that govern resistance to chewing or sucking arthropods. While this hormonal crosstalk is well-documented in model plants, recent transcriptomic and molecular studies in *V. vinifera* and *Vitis* hybrids confirm that this antagonism operates via a highly specific transcriptional reprogramming web. Specifically, when a vine perceives a biotrophic fungal pathogen, the activation of *Rpv* or *Ren* loci triggers a massive salicylic-acid-dependent signaling cascade, upregulating key regulatory genes in susceptible varieties, such as *VvNPR1*, specific *VvWRKY* transcription factors, and downstream pathogenesis-related proteins like *VvPR1* [20,21]. This intense salicylic-acid-mediated transcriptional shift actively suppresses the lipoxygenase biosynthetic pathway—mirroring mechanisms observed in other plants [22–24]—and downregulates *VvMYC* transcription factors, which simultaneously impairs jasmonic acid-dependent defense responses including abiotic adaptations like cold tolerance [25]. Furthermore, this regulatory network intimately intersects with auxin signaling, a crucial driver of biotic stress homeostasis that regulates physical defense adaptations, including leaf trichome development [26,27]. This multi-hormonal cross-talk can potentially generate metabolic trade-offs by pleiotropically altering structural defenses or secondary metabolite profiles—such as flavonoids and protective phenolics—leading to unpredictable susceptibility patterns in newly bred resistant varieties [28–31]. Because modern PIWI varieties possess highly diverse genetic backgrounds depending on their unique wild parentage, these introgressed genomic fragments introduce highly variable baseline hormonal cross-talk and metabolic resource cross-allocation. This complex genomic friction may explain why final pest susceptibility patterns remain highly variable and unpredictable in newly registered resistant varieties [32]. Consequently, these hypotheses must be rigorously tested ad hoc within the pest–grapevine system.

Beyond pathogens, grapevine is attacked by numerous arthropod pests, including grape berry moths (Lepidoptera: Tortricidae), leafhoppers (Hemiptera: Cicadellidae), mealybugs (Hemiptera: Pseudococcidae) and mites (Acari: Eriophyidae, Tetranychidae) [17]. Arthropod pest and disease pressure forced growers to rely heavily on pesticides [33,34], which raise concerns for human health and the environment [17,35]. Intensive pesticide use also promotes resistance development and pest resurgence, e.g., [36–41]. The reduction or elimination of fungicide sprays in mildew-resistant vineyards can also influence arthropod communities, potentially favoring the non-target pests while enhancing populations of predators and parasitoids. Consequently, evaluating arthropod pest sus-

ceptibility in resistant varieties cannot be dissociated from the broader ecological context in which these grapevines are cultivated [42–45]. Despite significant progress in breeding mildew-resistant grapevine varieties, their interactions with arthropod pests remain poorly understood. Information on arthropod pest susceptibility is fragmented and often limited to a few species or varieties, leaving major gaps in our understanding of their broader resistance profile. This review summarizes current knowledge on the susceptibility of mildew-resistant grapevine varieties to invertebrate pests, comparing available data with those of conventional varieties and, where possible, their parental lines.

2. Methodology

Literature Research

The literature research was performed by searching in Google Scholar, Web of Science and Scopus, using a combination of the following terms:

“[variety name]” AND “resistan*” or “susceptib*” or “toleran*” AND “beetle*”
or “leafhopper*” or “mite*” or “moth*” or “nematode*” or “pest*” or
“phylloxera*” or “scale*”

all the terms were used in multiple logical combinations. The research was also conducted in Italian, German and French, and included articles in languages other than those listed above. As concerns mildew-resistant varieties, the list was retrieved from Pertot et al. [17] and *Vitis* International Variety Catalogue (VIVC; [46]); the varieties derived from the VIVC we have chosen are listed as resistant to *P. viticola* and/or *E. necator*.

For resistant varieties with at least one pest-susceptibility study, we also examined susceptibility traits of one or both parental varieties using VIVC data [46]. Because available information on arthropod pest interactions with mildew-resistant varieties is limited, we present results descriptively and discuss them in the context of existing knowledge gaps.

3. Where Do We Come from? Grape Varieties Resistant to Mildews

Grapevine breeding aims to modify key growing-season traits, including phenological timing, enhance tolerance to cold and drought stress, and improve resistance to diseases [47,48]. Historically, early hybrids between American *Vitis* species and *V. vinifera* often had agronomic drawbacks and off-flavors [17,49], reducing consumer acceptance [9]. Market and regulatory barriers further slowed adoption [17,18,50], as did the need for farmers to adapt agronomic and enological practices.

More recent HPR varieties—FRG (Fungus-Resistant Grapes) and PIWI (from the German “Pilzwiderstandsfähige”, meaning disease-resistant)—exhibit improved agronomic and enological traits without major wine-quality penalties [17,18,50]. Advantages include reduced fungicide and fuel use for their applications (up to 60–100%), reduced soil copper accumulation, improved biodiversity, lower costs and disease risk, reduced worker exposure, and smoother labor distribution [17,50]. In addition, reduced fungicide inputs may indirectly promote higher abundance and activity of natural enemies [38,42,51,52].

Modern breeding often uses marker-assisted pyramiding to introgress multiple resistance loci while preserving wine quality [9,17,47,53]. However, most varieties have not yet been systematically screened for arthropod pest susceptibility [54]. Marker validation across germplasm is required before varieties can be widely released for wine production [47,55,56]. In this context, recent breeding techniques (e.g., genome editing) may face social and regulatory challenges even when they do not introduce foreign DNA, thus having social acceptance and policy as crucial components of deployment.

4. What Are We? Grape Varieties and Interaction with Pests

Mildew-resistant grape varieties may exhibit varying susceptibility to arthropod pests, depending on environmental context and management practices [18]. Although most available evidence derives from *V. vinifera* varieties or interspecific hybrids not specifically bred for disease resistance, these examples illustrate the diversity of plant traits influencing arthropod pest interactions and are relevant when assessing newly developed resistant varieties. Resistance mechanisms are commonly linked to phenology, morphology and biochemical traits that affect pest preference, survival, development and fecundity. Smith & Clement [57] classify plant resistance as: (1) phenological resistance (timing mismatch between pest and vulnerable plant stages), (2) antixenosis (non-preference due to lack of stimuli), (3) antibiosis (adverse effects on pest fitness), and (4) tolerance (ability to withstand damage). However, these mechanisms are often poorly characterized in grapevines.

The host plant resistance—defined as genetically inherited traits that render one variety less damaged by a pest than a susceptible counterpart—offers economic and environmental benefits by reducing the number of insecticide applications and consequently their residues [58,59]. The economic injury level (EIL) provides a functional, threshold-based measure of plant resistance by representing the pest density at which the cost of control equals the value of crop yield saved. Because the EIL directly integrates management costs and market values, it can function as a confounding factor; shifts in labor, machinery, or pesticide pricing can alter this threshold independently of plant genetics. From a strictly biological perspective, however, host genotypes express distinct defense strategies. Resistant plants typically do not experience economic damage, whereas partially resistant plants sustain damage only at high pest densities. In contrast, tolerant plants are able to maintain higher yield and quality under comparable herbivore pressure, effectively elevating their economic injury level, while susceptible plants reach the economic injury level at lower pest population levels [11,60]. All these aspects are generally linked to plant defenses against herbivores that can involve various mechanisms including the structural barriers (e.g., tissue toughness, trichomes) and allelochemicals acting as antifeedants or toxins [57,59,61]. Indirect defenses such as volatile organic compounds that attract natural enemies also modulate herbivore impacts and may interact with pathogen-induced signaling pathways [57,62], and show that plant defense mechanisms can be both constitutive or induced by pest attack [63–66].

Rootstocks illustrate how genotype influences pest interactions. Rootstocks confer resistance to soil pathogens and improve abiotic stress tolerance [67]. The case of the grape phylloxera *D. vitifoliae* demonstrates the value of resistant American *Vitis* rootstocks for controlling this devastating pest introduced into Europe in the 1860s [59,68]. In addition, susceptibility to phylloxera is influenced by host–pest genotype interactions, which affect important biological traits of the pest such as feeding success, gall formation and development [69–79]. Similarly, rootstocks influence nematode susceptibility [80,81] and may reduce *Colomerus vitis* (Pagenstecher) (Acari: Eriophyidae) leaf infestation via altered enzyme activity or resveratrol levels [82].

Variability in disease incidence and recovery for phytoplasmas and xylem bacteria has also been observed among varieties [83–88]. Molecular and biochemical responses of grapevine to pests have been documented: vine mealybug *Planococcus ficus* (Signoret) (Hemiptera: Pseudococcidae) feeding elicits defense-related protein expression [89]. Single dominant alleles confer resistance to root-knot nematodes ('MJR1') or phylloxera ('RDV2'), often involving hypersensitive responses and secondary metabolite production [90–94]. Mite feeding can trigger upregulation of genes related to cell-wall proteins and defensive enzymes [95,96].

Morphological traits such as cluster architecture influence pest pressure. For instance, highly compact bunches increase *Lobesia botrana* (Denis & Schiffermüller) (Lepidoptera: Tortricidae) infestation and facilitate the spread of secondary rots [97–101]. Berry traits (trichomes, epicuticular wax, skin thickness, pulp firmness) affect oviposition and larval success. In this context, the scarcity of pubescence on inflorescences positively affects the 1st-generation infestation levels of *L. botrana* and *Eupoecilia ambiguella* (Hübner) (Lepidoptera: Tortricidae) larvae, as does the earliness of inflorescence emergence [102]. The spotted wing drosophila *Drosophila suzukii* Matsumura (Diptera: Drosophilidae) preferentially oviposits in berries with thin skin and low pulp penetration force [103–107], although some variability among studies has been reported [108]. High berry wax reduces oviposition by *L. botrana* and *E. ambiguella* [109], while leaf waxiness and trichome density influence eriophyid mite settling and affect the efficacy of natural enemies, such as phytoseiid mites, e.g., [95,110,111].

Chemical traits, including volatiles and secondary metabolites, influence pest behavior and performance. Variation in infestation and oviposition across varieties has been reported for the brown marmorated stink bug *Halyomorpha halys* (Stål) (Hemiptera: Pentatomidae), the Japanese beetle *Popillia japonica* Newman (Coleoptera: Scarabaeidae), the leafhoppers *Hebata vitis* (Göthe) and *Erythroneura* spp. (Hemiptera: Cicadellidae) and the grape berry moth *L. botrana* [112–117]. Volatiles can attract or repel pests and influence berry moth oviposition via antennal and ovipositor responses, acting together with the physical features of the oviposition site [118–124]. For instance, on plants treated with resistance inducers, the planthopper *Hyalesthes obsoletus* Signoret (Hemiptera: Cixiidae)—the primary vector of ‘*Candidatus* Phytoplasma solani’ in grapevines—displayed variable responses to the volatiles emitted by the vines, showing either attraction or repellence [124]. Berry sugar content and larval host experience influence *L. botrana* oviposition preference [125,126], and leaf nitrogen can enhance larval performance in *Epiphyas postvittana* (Walker) (Lepidoptera: Tortricidae) [127]. Soluble solids and chemical cues mediate *D. suzukii* oviposition and probably similarly influence tephritid fruit flies (Diptera: Tephritidae) [105,108,128,129]. Furthermore, allelochemicals in grapevines alter immune responses in *L. botrana* and *E. ambiguella* larvae [130,131] and act as oviposition or feeding deterrents [132]. Unlike other berry parts, Cabernet Sauvignon seeds reduced *L. botrana* fitness in laboratory tests [133]. Phenolics and carbohydrates can reduce eriophyid mite density by inhibiting feeding [95], and mite abundance correlates with indole-3-acetic acid and inversely with salicylic and jasmonic acids [95,134]. Crucially, these downstream chemical defenses are initiated by early-stage reactive oxygen and nitrogen species (ROS/RNS) signaling. These molecules act as primary redox alarms that help the plant recognize attackers and activate defense genes, possibly making them essential to the long-term resilience of new breeding lines [26], though further evaluation on PIWI varieties is required.

Grapevine phenological resistance offers an effective strategy to reduce pest damage by using varieties that ripen before or after peak pest activity. For example, early- or late-ripening varieties significantly reduced attacks by the green June beetle *Cotinis nitida* (L.) (Coleoptera: Scarabaeidae) in the United States [135]. Similarly, infestations by *L. botrana* are strongly influenced by grapevine phenology [102,131,136–138], as are infestations by the invasive *D. suzukii* [107,139,140]. The European grapevine moth also tends to avoid ovipositing during the third or fourth generation on varieties that are close to harvest [101,141,142]. In addition, mite damage has been reported to decrease in varieties with fast-growing shoots [143], and *D. vitifoliae* root infestations differ between “fast-growing” rootstocks (1103P, *Vitis berlandieri* Planch. × *Vitis rupestris* Scheele) and “slow-growing” ones (101–14 Mgt, *Vitis riparia* Michx. × *V. rupestris*), with the former exhibiting

lower survivorship of infested roots [144]. Grapevine vigor can also enhance tolerance mechanisms, as observed for Margarodidae (Hemiptera) infestations [145].

While plant-derived resistance and tolerance traits hold promise for pest management, strong selection for mildew resistance in cultivated grapes may exert evolutionary pressure on phytophagous insects, leading to shifts in feeding behavior [146]. A striking example is the emergence of *D. vitifoliae* populations capable of feeding on the leaves of previously resistant grape scions, possibly driven by combined local and global anthropogenic pressures [147,148].

5. Where Are We Going? Arthropod Pest Susceptibility of Mildew-Resistant Grape Varieties

Current knowledge on how mildew-resistant grape varieties interact with arthropod pests remains scarce and fragmented. While the foundational studies reviewed in the previous section demonstrate that grapevine defenses rely on a complex matrix of phenological, morphological, and chemical traits, it remains unclear how these defensive systems operate within modern, mildew-resistant varieties. Because breeding lines are primarily selected for localized pathogen resistance, the downstream effects on insect dynamics are often treated as secondary factors. New grape varieties are primarily evaluated for desirable agronomic and enological traits, as well as resistance to diseases [50], but their susceptibility to insect and mite pests has seldom been considered during the selection or registration processes. Research on arthropod pest susceptibility in mildew-resistant grape varieties has only recently gained attention. For instance, recent studies indicate that resistance to diseases does not automatically translate into resistance to specific phytoplasmas, with notable variability in susceptibility across different PIWI varieties [149,150]. To systematically assess how these breeding priorities alter pest dynamics in practice, a comprehensive compilation and analysis of the existing empirical literature was performed. Overall, we identified 23 mildew-resistant varieties across 11 studies [69,108,109,113,147,151–156] that evaluated susceptibility to seven pest taxa affecting leaves, fruits, or roots (Figure 1 and Table A1). More than half the studies (53.3%) targeted pests attacking berries, primarily Drosophilidae (33.3%), followed by *L. botrana* (13.3%) and *E. ambiguella* (6.7%). Leaf-feeding arthropod pest studies accounted for 40.0%, with *D. vitifoliae* representing 20.0%; single studies examined Eriophyidae, *H. vitis*, and *P. japonica* (6.7% each), with *D. vitifoliae* also represented for roots in a study (Figure 2; Table A1). Measured parameters included infestation incidence, severity, oviposition preference (e.g., for *D. suzukii*, *E. ambiguella*, and *L. botrana*), and phylloxera mortality across genetic lineages (Table A1). Certain varieties, such as Regent and Seyval, were slightly more frequently represented in scientific publications (Figure 3).

Only a few records document pest susceptibility of the parental varieties, leaving it uncertain whether arthropod susceptibility is reliably heritable from parental lines or whether the introgression of resistance loci disrupts existing pest-defense mechanisms in unpredictable ways [157]. Cabernet Sauvignon—parent of Cabernet Cortis and Souvignier Gris (Table 1)—shows relatively high susceptibility to eriophyid mites [158], moderate to pronounced susceptibility to leaf and root phylloxera and *H. vitis* [70,71,73–76,116,159–162], and also susceptibility to *D. suzukii* [106,163]. These patterns partially align with the high susceptibility observed in Cabernet Cortis and Souvignier Gris (Table A1), although one study on *H. vitis* suggested that Cabernet Cortis may be less susceptible than other tested varieties [155], these results warrant further validation. Moreover, the PIWI variety Noah exhibited intermediate susceptibility to *L. botrana* infestation in the field (Table A1), while Taylor—one of its two parental lines (Table 1)—is reported among the varieties susceptible to this pest [159]. These observations suggest that susceptibility patterns in newly bred varieties often reflect the inherited genetic background of their parental lines due to additive

gene action or stable metabolic resource allocation. However, physical introgression and downstream hormonal cross-talk can also introduce unpredictable phenotypic variations or disrupt structural defense mechanisms—a challenge further exacerbated by the complex phenotypic expressions typically encountered when evaluating *Vitis* hybrids under field conditions [164,165]. The present inconsistencies and severely limited data highlight a critical need for systematic, ad hoc evaluation of both parental and resistant lines within the pest–grapevine system.

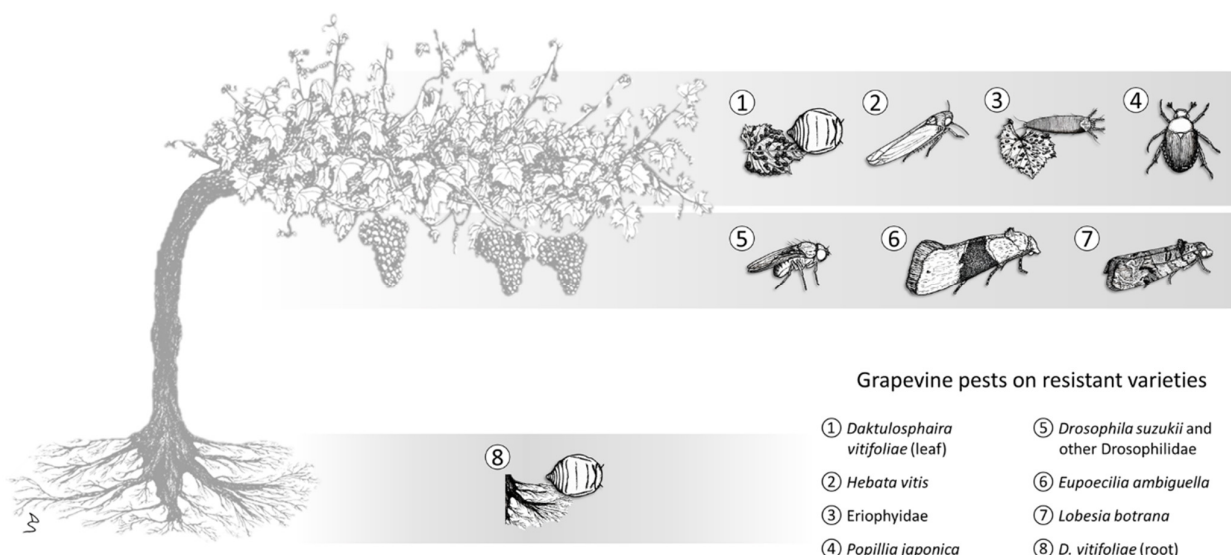


Figure 1. Schematic representation of arthropod pests studied on mildew-resistant grape varieties, by leaf, fruit and root systems (gray bands—from top to bottom, respectively). Credits: D. Scaccini.

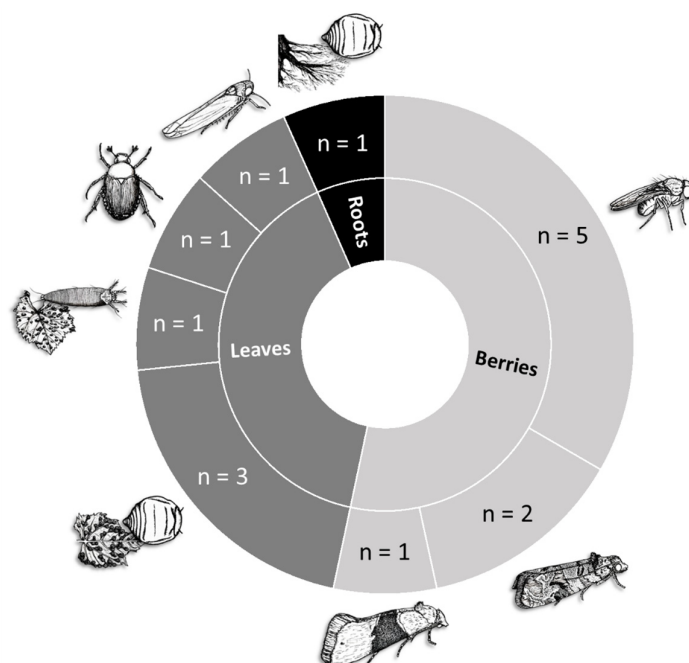


Figure 2. Pie-chart showing the relative presence of studies on the susceptibility to arthropod pests of mildew-resistant grapevine varieties based on the literature research, by plant part and pest taxon (for details on the latter, see Figure 1). ‘n’ refers to the number of studies referring to the specific pest. Credits: D. Scaccini.

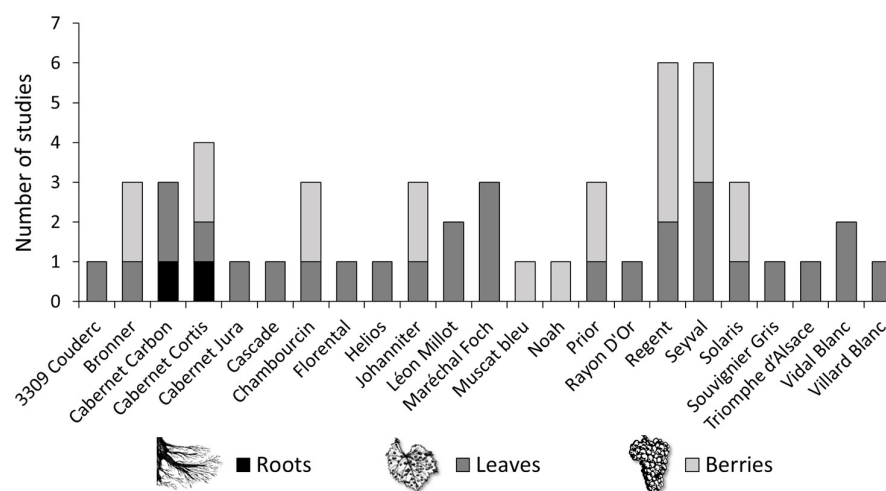


Figure 3. Number of studies for each mildew-resistant grape variety (listed alphabetically) evaluated for arthropod pest susceptibility, by roots, leaves and berries. Credits: D. Scaccini.

Table 1. Resistant grapevine varieties for which studies on arthropod pests were conducted, and parental details as reported in the *Vitis* International Variety Catalogue [46].

Resistant Variety	Color of Berry Skin	Pedigree as Given by Breeder/Bibliography	Pedigree Confirmed by Markers
3309 Couderc	Noir	<i>Vitis riparia</i> (Riparia Tomenteux) × <i>Vitis rupestris</i> (Rupestris Martin)	
Bronner	Blanc	Merzling × Geisenheim 64934	
Cabernet Carbon	Noir	Cabernet Sauvignon × Bronner	
Cabernet Cortis	Noir	Cabernet Sauvignon × Solaris	
Cabernet Jura	Noir	Medina × Kaberne Severnyi	Medina × Kaberne Severnyi
Cascade	Noir	Seibel 7042 × Seibel 5409	[Parent 1 and parent 2 were not confirmed]
Chambourcin	Noir	Seyve Villard 12-417 [=Joannes Seyve 11369] × Seibel 7053	Joannes Seyve 11369 × Plantet
Florental	Noir	Seibel 8365 × Gamay N	
Helios	Blanc	Merzling × Freiburg 986-60	
Johanniter	Blanc	Riesling Weiss [=Renano] × Freiburg 589-54	
Léon Millot	Noir	Millardet et Grasset 101 O.P. × ?	Millardet et Grasset 101 O.P. × Goldriesling
Maréchal Foch	Noir	Millardet et Grasset 101 O.P. × ?	Millardet et Grasset 101 O.P. × Goldriesling
Muscat bleu	Noir	Garnier 15-6 × Seyve Villard 20-347	
Noah	Blanc	Taylor O.P.	Taylor × ?
Prior	Noir	Freiburg 4-61 × Freiburg 236-75	
Rayon D'Or	Blanc	Seibel 405 × Seibel 2007 [=Aramon du Gard]	Seibel 405 × Seibel 867
Regent	Noir	Diana × Chambourcin	
Seyval	Blanc	Seibel 5656 × Seibel 4986	Seibel 5656 × Rayon D'Or [=Seibel 4986]

Table 1. Cont.

Resistant Variety	Color of Berry Skin	Pedigree as Given by Breeder/Bibliography	Pedigree Confirmed by Markers
“	Noir	Seibel 5656 × Seibel 4986	Seibel 5656 × Seibel 4986
Solaris	Blanc	Merzling × Geisenheim 6493	
Souvignier Gris	Rose	Cabernet Sauvignon × Bronner	Seyval × Zaehring
Triomphe d’Alsace	Noir	Millardet et Grasset 101 O.P. × Knipperle	Millardet et Grasset 101 O.P. × Knipperle
Vidal Blanc	Blanc	St. Emilion [=Ugni Blanc] × Seibel 4986	Ugni Blanc × Rayon D’Or
Villard Blanc	Blanc	Seibel 6468 × Seibel 6905	

6. Mildew-Resistant Grape Varieties and Susceptibility to Arthropod Pests—Where Should We Go?

Our review highlights a major knowledge gap, i.e., the susceptibility of mildew-resistant varieties to arthropod pests is poorly documented and insufficiently integrated into breeding pipelines. To bridge this gap, coordinated efforts are needed between breeders, entomologists and viticulturists to design multi-year, multi-site evaluations that explicitly include pest assessments during variety testing.

Arthropod pest and disease management strongly influence both the economic and environmental sustainability of viticulture. Mildew-resistant grapevine varieties have the potential to significantly reduce pesticide inputs, but their adoption depends on factors such as agronomic performance, wine quality, regulatory approval and consumer acceptance. Increasing societal concern regarding environmental and public health impacts associated with pesticide use may further accelerate the adoption of resistant varieties [19,166].

Nevertheless, the ecological consequences associated with reduced pesticide use require further investigation. In particular, greater attention should be devoted to the multitrophic interactions occurring within vineyard ecosystems, also in relation to resistant varieties, as these may influence not only phytophagous arthropods but also their natural enemies. For example, some grapevine varieties may deter key parasitoids of pest species, potentially affecting their diversity and abundance [167–169]. Reducing pesticide use may also reshape arthropod communities and encourage the emergence of new balances between pests and their natural enemies. Specifically, the reduction in traditional fungicide regimes (e.g., inorganic copper and sulfur, or synthetic systemic and contact fungicides) removes significant negative effects on non-target beneficials, allowing key natural enemies like predatory mites (Phytoseiidae) and parasitoids to recover and fortify top-down suppression, e.g., [42,170–172]. However, reducing fungicide applications can eliminate their concomitant suppression of secondary pests, potentially triggering resurgences of previously minor herbivore guilds once free from this unintended chemical control, e.g., [170,173–179]. This dual dynamic highlights the need for systematic monitoring of pest dynamics to ensure the long-term resilience of viticultural systems. Moreover, current knowledge regarding several important groups of phytophagous arthropods—such as thrips (Thysanoptera), mealybugs, spider mites (Acari: Tetranychidae), and leaf miners (Lepidoptera)—remains limited in evaluations of mildew-resistant grapevine varieties, thus warranting targeted investigations on these interactions.

Breeding strategies must balance crop quality, local breeding goals, germplasm exploration and biodiversity conservation [180]. New breeding techniques should meet scientific, social and cultural requirements. Given current knowledge gaps, research agen-

das should prioritize a sequential framework structured by immediate operational urgency and long-term ecological impact:

1. Systematic pest screening of HPR varieties across phenological stages and at different field scales (laboratory and multi-site field trials). This baseline screening represents the most immediate, highest-impact prerequisite needed to map current vulnerabilities;
2. Evaluation of parental lines and rootstocks to assess heritability and root-based vs. scion-based arthropod pest susceptibility through morphological, phenological and biochemical traits. This represents a crucial mechanistic parallel to baseline screening, establishing whether observed field traits are predictably heritable;
3. Monitoring for pest adaptation to new mildew-resistant varieties, including potential shifts in host range or feeding/oviposition behavior. Importantly, this long-term tracking depends directly on the baselines established in items 1 and 2, shifting the focus from immediate mapping to future ecosystem resilience;
4. Socioeconomic and regulatory analyses to foster adoption while maintaining wine quality and consumer confidence. While less biological, this final step represents the ultimate practical bottleneck governing whether these multi-resistant varieties can achieve widespread commercial deployment.

Integrating arthropod pest resistance into breeding programs will support sustainable viticulture. Future programs should aim to combine mildew resistance with reduced susceptibility to arthropod pests, thus producing varieties that reduce chemical inputs while maintaining product quality and ecosystem services.

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Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Table A1. List of grape varieties with reference to arthropod pests including mildew-resistant ones, by published paper/report. The list of mildew-resistant-varieties (in bold) is retrieved from Pertot et al. [17] and *Vitis* International Variety Catalogue [46]. The varieties derived from the VIVC are listed as resistant to *Plasmopara viticola* and/or *Erysiphe necator*.

Plant Part	Pest	Varieties	Susceptibility *	Parameter	Notes	Reference(s)
Berries	<i>Drosophila suzukii</i>	IRAC 1999	A	Oviposition holes in berries	Laboratory	[151,152]
		Bronner	AB			
		Cabernet Cortis	AB			
		Seyval blanc	AB			
		VB 91 26 04	ABC			
		VB 32-7	ABCD			
		Johanniter	BCD			
		Solaris	BCD			
		Blauburgunder	CDE			
		Prior	DE			
		Chambourcin	E			
	<i>Drosophila suzukii</i>	Acolon	Very high	Infestation severity of berries	Field	[108]
		Regent	High to very high			
		Pinot Noir	High			
		Müller-Thurgau	Very low			
		Pinot Blanc	Very low			
	<i>Drosophila suzukii</i>	(other 34 varieties with no statistical analysis)	(variable)	Adult location preference	Laboratory, dual-choice assays	[108]
		Acolon	High			
		Regent	High			
		Pinot Noir	Low to high			
		Müller-Thurgau	Low			
		Pinot Blanc	Low			

Table A1. Cont.

Plant Part	Pest	Varieties	Susceptibility *	Parameter	Notes	Reference(s)
	<i>Drosophila suzukii</i>	Regent	High	Oviposition preference	Laboratory, dual-choice assays	[108]
		Acolon	Low to high			
		Pinot Blanc	Low to high			
		Müller-Thurgau	Low			
		Pinot Noir	Low			
	<i>Drosophila suzukii</i>	Acolon	A	Insect infestation	Field (samples studied in laboratory)	[152]
		Cabernet Dorsa	A			
		Cornalin	A			
		Divico	A			
		Dornfelder	A			
		Dunkelfelder	A			
		Galotta	A			
		Garanoir	A			
		Humagne rouge	A			
		Mara	A			
		Regent	A			
		Syrah	A			
		Chasselas	B			
		Cornalin	B			
		Dakapo	B			
		Diolinoir	B			
		Gamaret	B			
		Gamay	B			
		Merlot	B			
		Müller-Thurgau	B			
		Muscat bleu	B			
		Pinot Noir	B			

Table A1. Cont.

Plant Part	Pest	Varieties	Susceptibility *	Parameter	Notes	Reference(s)
	<i>Drosophila suzukii</i> and other Drosophilidae	Concord	A	Infestations of berries (adult emergence)	Field (samples studied in laboratory)	[153]
		Pinot gris	A			
		Chardonnay	AB			
		Marquette	AB			
		Marquis	AB			
		Niagara	AB			
		Pinot Noir	AB			
		Seyval blanc	AB			
		Vanessa	AB			
		Zweigelt	AB			
		Cabernet Franc	B			
		Mars	B			
		Merlot	B			
		Noiret	B			
		Regent	B			
		Traminette	B			
	<i>Eupoecilia ambiguella</i>	Regent	A	Oviposition preference	Laboratory, dual-choice experiment; influence of wax layer on berry	[109]
		Pinot Noir	A			
		Müller-Thurgau	AB			
		Riesling	B			
	<i>Lobesia botrana</i>	Regent	A	Oviposition preference	Laboratory, dual-choice experiment; influence of wax layer on berry	[109]
		Pinot Noir	A			
		Müller-Thurgau	AB			
		Riesling	B			
	<i>Lobesia botrana</i>	Chardonnay	A	Infestation (number of pupae per cluster)	Field	[154]
		Merlot	A			
		Noah	AB			
		Pinot	AB			

Table A1. Cont.

Plant Part	Pest	Varieties	Susceptibility *	Parameter	Notes	Reference(s)
		Chasselas	B			
		Riesling	B			
Leaves	<i>Daktulosphaira vitifoliae</i>	Léon Millot	High (11 out of 11)			
		Maréchal Foch	High (15 out of 19)			
		Baco Noir	Medium to high (2 out of 3)			
		Charmont	Medium to high (1 out of 1)			
		Clinton	Medium to high (1 out of 1)			
		Divico	Medium to high (1 out of 1)			[147]
		York Madeira	Medium to high (1 out of 1)			
		Cabernet Jura	Medium to high (1 out of 1)	Infestation, leaf galls (and no. of sub-plots with leaf galls)	Field	
		Chasselas	Medium to high (1 out of 2)			
		Chardonnay Blanc	Medium to high (2 out of 2)			
		Seyval	Medium to high (2 out of 2)			
		Triomphe d'Alsace	Medium to high (2 out of 2)			
		VB 32-7	Medium to high (2 out of 2)			
		Pinot Noir	No galls (0 out of 1)			
		Cabernet Carbon	No galls (0 out of 1)			
		xxx	xxx			

Table A1. Cont.

Plant Part	Pest	Varieties	Susceptibility *	Parameter	Notes	Reference(s)
	<i>Daktulosphaira vitifoliae</i>	Seyval	High (80.0%; 162)	Infestation (and % of leaves infested; no. of galls per leaf)	Field. Fluctuations in years	[69]
		Aurora	High (75.2%; 182)			
		Rayon D’Or	High (43.2%; 155)			
		Cascade	High (78.8%; 82)			
		Villard Blanc	High (77.2%; 64)			
		Chancellor	High (40.4%; 209)			
		Delaware	Medium (27.2%; 140)			
		Vignoles	Medium (28.4%; 98)			
		Léon Millot	Medium (26.4%; 106)			
		Vidal 256 [=Vidal Blanc]	Medium (34.8%; 68)			
		Baco Noir	Medium (16.4%; 102)			
		Chelois	Medium (27.6%; 82)			
		Dutchess	Medium (13.2%; 94)			
		Niagara	Medium (4.0%; 72)			
		J. Riesling	Medium (9.2%; 34)			
		Florental	Medium (8.0%; 20)			
		Catawba	Medium (2.0%; 31)			
		Maréchal Foch	Medium (8.8%; 16)			
		Cabernet Sauvignon	Medium (9.2%; 11)			
		Chardonnay	Medium (9.2%; 3)			
		Steuben	Medium (1.2%; 2)			
		DeChaunac	No galls (0%; 0)			
		Gamay	No galls (0%; 0)			

Table A1. Cont.

Plant Part	Pest	Varieties	Susceptibility *	Parameter	Notes	Reference(s)
	<i>Daktulosphaira vitifoliae</i>	Cabernet Cortis	High	'Resistance' [other details not specified] (score 1 to 10)	Field	[155]
		Bronner	High			
		Johanniter	High			
		Helios	Low to medium			
		Cabernet Carbon	Low			
		Prior	Low			
		Regent	Low			
		Solaris	Low			
		Southern Gris	Low			
	Eriophyidae	Cabernet Cortis	High	'Resistance' (leaf galls; score 1 to 10)	Field	[155]
		Southern Gris	High			
		Cabernet Carbon	Medium			
		Regent	Medium			
		Bronner	Medium			
		Prior	Low			
		Solaris	Low			
		Helios	Low			
		Johanniter	Low			
	<i>Hebata vitis</i>	Regent	High	'Resistance' (score 1 to 10)	Field	[155]
		Prior	Medium			
		Bronner	Low			
		Cabernet Carbon	Low			
		Cabernet Cortis	Low			
		Southern Gris	Low			
		Solaris	Low			
		Helios	Low			
		Johanniter	Low			

Table A1. Cont.

Plant Part	Pest	Varieties	Susceptibility *	Parameter	Notes	Reference(s)
	<i>Popillia japonica</i>	Vidal Blanc	A	Incidence (% of damaged leaves)	Semi-field (cage experiment)	[113]
		Seyval	AB			
		Rougeon	ABC			
		St. Croix	ABC			
		St. Vincent	ABC			
		Vignoles	ABC			
		Lemberger	ABC			
		Chambourcin	ABC			
		Glenora	ABC			
		DeChaunac	ABC			
		Maréchal Foch (Marshal Foch)	ABC			
		Himrod	ABC			
		Chardonnay	ABC			
		Delaware (Pr)	ABC			
		Cayuga White	ABC			
		Chardonnay (Pr)	ABC			
		Chancellor	ABC			
		Frantenac	ABC			
		Lacrosse	ABC			
		Cabernet Sauvignon (Pr)	BC			
		Cabernet Franc	BC			
		Vanessa	BC			
		Jupiter	BC			
		Reliance	BCD			
		Catawba (At)	BCD			
		Concord Seedless	BCD			

Table A1. Cont.

Plant Part	Pest	Varieties	Susceptibility *	Parameter	Notes	Reference(s)
		Concord	BCD			
		Edelweiss	BCD			
		3309 Couderc	BCD			
		Einset	BCD			
		Marquis	CD			
		Mars	D			
Roots	<i>Daktulosphaira vitifoliae</i>	Cabernet Cortis	High (mean mortality 17%)	Mortality rate	Laboratory, material from different field origin. Different phylloxera lineages and populations were used	[156]
		Cabernet Carbon	High (mean mortality 17%)			
		Cabernet Dorse We750	High (mean mortality 17%)			
		Cabernet Mitos We650	High (mean mortality 17%)			
		125AA—Gm1	Medium (mean mortality 15%)			
		125AA—Gm3	Medium (mean mortality 15%)			
		125AA—Gm5	Medium (mean mortality 15%)			

* Where available, different letters indicate statistically significant differences as reported in the cited studies, standardized to an A–Z order, with A denoting higher susceptibility for the trait under investigation. In studies without statistical groupings, susceptibility was evaluated according to the reported qualitative categories (very low to very high) from the published results.

References

- Peterson, R.K.D.; Higley, L.G. *Biotic Stress and Yield Loss*; CRC Press LLC: Boca Raton, FL, USA, 2001; 276p.
- Flynn, P. Biotic vs. Abiotic—Distinguishing Disease Problems. Available online: <https://yardandgarden.extension.iastate.edu/how-to/biotic-vs-abiotic-distinguishing-disease-problems> (accessed on 15 December 2025).
- Oerke, E.-C. Crop losses to pests. *J. Agric. Sci.* **2005**, *144*, 31–43. [\[CrossRef\]](#)
- Oerke, E.-C.; Dehne, H.W. Safeguarding production—Losses in major crops and the role of crop protection. *Crop Prot.* **2004**, *23*, 275–285. [\[CrossRef\]](#)
- Metcalfe, R.L.; Luckmann, W.H. *Introduction to Insect Pest Management*, 3rd ed.; Wiley-Interscience: John Wiley and Sons, Inc.: New York, NY, USA, 1994; 672p.
- Dent, D. *Insect Pest Management*, 2nd ed.; CABI: Wallingford, UK, 2000; 410p.
- Bony, S.; Gillet, C.; Bouchez, A.; Margoum, C.; Devaux, A. Genotoxic pressure of vineyard pesticides in fish: Field and mesocosm surveys. *Aquat. Toxicol.* **2008**, *89*, 197–203. [\[CrossRef\]](#) [\[PubMed\]](#)
- Fantke, P.; Friedrich, R.; Jolliet, O. Health impact and damage cost assessment of pesticides in Europe. *Environ. Int.* **2012**, *49*, 9–17. [\[CrossRef\]](#) [\[PubMed\]](#)
- Töpfer, R.; Hausmann, L.; Harst, M.; Maul, E.; Zyprian, E.; Eibach, R. New horizons for grapevine breeding. In *Methods in Temperate Fruit Breeding*; Flachowsky, H., Hanke, M.V., Eds.; Global Science Books; Springer: Dordrecht, The Netherlands, 2011; pp. 79–100. [\[CrossRef\]](#)
- Kellow, A.V.; Sedgley, M.; Van Heeswijck, R. Interaction between *Vitis vinifera* and grape phylloxera: Changes in root tissue during nodosity formation. *Ann. Bot.* **2004**, *93*, 581–590. [\[CrossRef\]](#) [\[PubMed\]](#)
- Berlinger, M.J. Plant resistance to insects. In *Encyclopedia of Entomology*, 2nd ed.; Capinera, J.L., Ed.; Springer: Dordrecht, The Netherlands, 2008; pp. 2930–2935.
- Lamichhane, J.R.; Dachbrodt-Saaydeh, S.; Kudsk, P.; Messéan, A. Toward a reduced reliance on conventional pesticides in European agriculture. *Plant Dis.* **2015**, *100*, 10–24. [\[CrossRef\]](#) [\[PubMed\]](#)
- Stenberg, J.A. A conceptual framework for Integrated Pest Management. *Trends Plant Sci.* **2017**, *22*, 759–769. [\[CrossRef\]](#) [\[PubMed\]](#)
- Reisch, B.I.; Owens, C.L.; Cousins, P.S. Grape. In *Fruit Breeding*; Badenes, M.L., Byrne, D.H., Eds.; Springer Science & Business Media: Dordrecht, The Netherlands, 2012; Volume 8, pp. 225–262.
- OIV (International Organization of Vine and Wine). OIV Statistical Report on World Vitiviniculture—2018 World Vitiviniculture Situation. Available online: <http://www.oiv.int/public/medias/6371/oiv-statistical-report-on-world-vitiviniculture-2018.pdf> (accessed on 11 January 2025).
- OIV (International Organization of Vine and Wine). State of the World Wine and Wine Sector in 2022. Available online: https://www.oiv.int/sites/default/files/documents/OIV_State_of_the_world_Vine_and_Wine_sector_in_2022_2.pdf (accessed on 11 January 2025).
- Pertot, I.; Caffi, T.; Rossi, V.; Mugnai, L.; Hoffmann, C.; Grando, M.S.; Gary, C.; Lafond, D.; Duso, C.; Thiery, D. A critical review of plant protection tools for reducing pesticide use on grapevine and new perspectives for the implementation of IPM in viticulture. *Crop Prot.* **2017**, *97*, 70–84. [\[CrossRef\]](#)
- Pedneault, K.; Provost, C. Fungus resistant grape varieties as a suitable alternative for organic wine production: Benefits, limits, and challenges. *Sci. Hortic.* **2016**, *208*, 57–77. [\[CrossRef\]](#)
- Trapp, O.; Avia, K.; Borrelli, C.; Eibach, R.; Merdinoglu, D.; Töpfer, R. More sustainability in Europe’s vineyards—Using resistant grapevine varieties to reduce the input of pesticides. *Plants People Planet* **2025**, *7*, 1621–1628. [\[CrossRef\]](#)
- Erb, M.; Reymond, P. Molecular interactions between plants and insect herbivores. *Annu. Rev. Plant Biol.* **2019**, *70*, 527–557. [\[CrossRef\]](#) [\[PubMed\]](#)
- Rahman, F.U.; Khan, I.A.; Aslam, A.; Liu, R.; Sun, L.; Wu, Y.; Aslam, M.M.; Khan, A.U.; Li, P.; Jiang, J.; et al. Transcriptome analysis reveals pathogenesis-related gene 1 pathway against salicylic acid treatment in grapevine (*Vitis vinifera* L). *Front. Genet.* **2022**, *13*, 1033288. [\[CrossRef\]](#) [\[PubMed\]](#)
- Feussner, I.; Wasternack, C. The lipoxygenase pathway. *Annu. Rev. Plant Biol.* **2002**, *53*, 275–297. [\[CrossRef\]](#) [\[PubMed\]](#)
- Yan, L.; Zhai, Q.; Wei, J.; Li, S.; Wang, B.; Huang, T.; Du, M.; Sun, J.; Kang, L.; Li, C.-B.; et al. Role of tomato lipoxygenase D in wound-induced jasmonate biosynthesis and plant immunity to insect herbivores. *PLoS Genet.* **2013**, *9*, e1003964. [\[CrossRef\]](#) [\[PubMed\]](#)
- Singh, P.; Arif, Y.; Miszczuk, E.; Bajguz, A.; Hayat, S. Specific roles of lipoxygenases in development and responses to stress in plants. *Plants* **2022**, *11*, 979. [\[CrossRef\]](#) [\[PubMed\]](#)
- Li, B.; Chen, D.; Fan, Z.; Lu, G.; Li, P.; Sun, L.; Li, G. Genome-wide identification and analysis of the jasmonic acid biosynthetic and signaling gene families in grapevine and the functional verification of *VvLOX9* in resistance to cold. *Plant Physiol. Biochem.* **2026**, *234*, 111350. [\[CrossRef\]](#) [\[PubMed\]](#)
- Ali, M.; Shi, L.; Khan, M.A.; Ali, A.; Hu, S.; Shen, J. Auxin biodynamics and its integral role in enhancing plant resilience to environmental cues. *Physiol. Plant.* **2025**, *177*, e70165. [\[CrossRef\]](#) [\[PubMed\]](#)

27. Tonga, A.; Ali, J. Jasmonate-mediated plant responses to sap-sucking herbivores: A comprehensive review with emerging implications. In *Insect-Plant Interactions*; Ali, J., Tonga, A., Shakeel, A., Chen, R., Eds.; Apple Academic Press: New York, NY, USA, 2026; pp. 59–104.
28. Pieterse, C.M.J.; Van der Does, D.; Zamioudis, C.; Leon-Reyes, A.; Van Wees, S.C.M. Hormonal modulation of plant immunity. *Annu. Rev. Cell Dev. Biol.* **2012**, *28*, 489–521. [[CrossRef](#)] [[PubMed](#)]
29. Thaler, J.S.; Humphrey, P.T.; Whiteman, N.K. Evolution of jasmonate and salicylate signal crosstalk. *Trends Plant Sci.* **2012**, *17*, 260–270. [[CrossRef](#)] [[PubMed](#)]
30. Erb, M.; Meldau, S.; Howe, G.A. Role of phytohormones in insect-specific plant reactions. *New Phytol.* **2012**, *194*, 703–716. [[CrossRef](#)] [[PubMed](#)]
31. Robert-Seilaniantz, A.; Grant, M.; Jones, J.D.G. Hormone crosstalk in plant disease and defense: More than just jasmonate–salicylate antagonism. *Annu. Rev. Phytopathol.* **2011**, *49*, 317–343. [[CrossRef](#)] [[PubMed](#)]
32. Salotti, I.; Bove, F.; Ji, T.; Rossi, V. Information on disease resistance patterns of grape varieties may improve disease management. *Front. Plant Sci.* **2022**, *13*, 1017658. [[CrossRef](#)] [[PubMed](#)]
33. Miller, G.T.; Spoolmen, S. *Sustaining the Earth*, 11th ed.; Cengage Learning: Stamford, CT, USA, 2014; 384p.
34. Lund, K. Western United States grapevine breeding. In *Grapevine Breeding Programs for the Wine Industry*; Reynolds, A., Ed.; Elsevier Ltd.: Cambridge, UK, 2015; pp. 359–378.
35. Zhang, X.; Starner, K.; Spurlock, F. Analysis of chlorpyrifos agricultural use in regions of frequent surface water detections in California, USA. *Bull. Environ. Contam. Toxicol.* **2012**, *89*, 978–984. [[CrossRef](#)] [[PubMed](#)]
36. McMurtry, J.A.; Huffaker, C.B.; van de Vrie, M.I. Tetranychid enemies: Their biological characters and the impact of spray practices. *Hilgardia* **1970**, *40*, 331–390. [[CrossRef](#)]
37. Granett, J.; Walker, M.A.; Kocsis, L.; Omer, A.D. Biology and management of grape phylloxera. *Annu. Rev. Entomol.* **2001**, *46*, 387–412. [[CrossRef](#)] [[PubMed](#)]
38. Duso, C.; Pozzebon, A.; Kreiter, S.; Tixier, M.S.; Candolfi, M.P. Management of phytophagous mites in European vineyards. In *Arthropod Management in Vineyards: Pests, Approaches, and Future Directions*; Bostanian, N.J., Vincent, C., Isaacs, R., Eds.; Springer: Dordrecht, The Netherlands, 2012; pp. 191–217. [[CrossRef](#)]
39. Civolani, S.; Boselli, M.; Butturini, A.; Chicca, M.; Fano, E.A.; Cassanelli, S. Assessment of insecticide resistance of *Lobesia botrana* (Lepidoptera: Tortricidae) in Emilia-Romagna region. *J. Econ. Entomol.* **2014**, *107*, 1245–1249. [[CrossRef](#)] [[PubMed](#)]
40. Andreason, S.A.; Prabhaker, N.; Castle, S.J.; Ganjisaffar, F.; Haviland, D.R.; Stone-Smith, B.; Perring, T.M. Reduced susceptibility of *Homalodisca vitripennis* (Hemiptera: Cicadellidae) to commonly applied insecticides. *J. Econ. Entomol.* **2018**, *111*, 2340–2348. [[CrossRef](#)] [[PubMed](#)]
41. Pasquini, S.; Haxaire-Lutun, M.O.; Rison, J.-L.; Flier, W.G.; Teixeira, L.A. Susceptibility of *Lobesia botrana* (Lepidoptera: Tortricidae) to chlorantraniliprole in the Emilia Romagna region of Northeast Italy. *J. Econ. Entomol.* **2018**, *111*, 369–374. [[CrossRef](#)] [[PubMed](#)]
42. Pennington, T.; Reiff, J.M.; Theiss, K.; Entling, M.H.; Hoffmann, C. Reduced fungicide applications improve insect pest control in grapevine. *BioControl* **2018**, *63*, 687–695. [[CrossRef](#)]
43. Reiff, J.M.; Sudarsan, K.; Hoffmann, C.; Entling, M.H. Arthropods on grapes benefit more from fungicide reduction than from organic farming. *Pest Manag. Sci.* **2023**, *79*, 3271–3279. [[CrossRef](#)] [[PubMed](#)]
44. Blaise, C.; Mazzia, C.; Bischoff, A.; Dutoit, T. Vegetation increases abundances of ground and canopy arthropods in Mediterranean vineyards. *Sci. Rep.* **2022**, *12*, 3680. [[CrossRef](#)] [[PubMed](#)]
45. Pavan, F.; Cargnus, E.; Zandigiacomo, P. Vineyard design, cultural practices and physical methods for controlling grapevine pests and disease vectors in Europe: A review. *Insects* **2026**, *17*, 113. [[CrossRef](#)] [[PubMed](#)]
46. Röckel, F. *Vitis International Variety Catalogue*. Available online: www.vivc.de (accessed on 15 December 2025).
47. Reynolds, A. *Grapevine Breeding Programs for the Wine Industry*; Elsevier Ltd.: Cambridge, UK, 2015; 439p.
48. Herzog, K.; Kicherer, A.; Malagol, N.; Trapp, O.; Töpfer, R. High-throughput phenotyping in grapevine breeding research: Technologies and applications. *OENO One* **2025**, *59*, 8458. [[CrossRef](#)]
49. Pacifico, D.; Gaiotti, F.; Giusti, M.; Tomasi, D. Performance of interspecific grapevine varieties in north-east Italy. *Agric. Sci.* **2013**, *4*, 91–101. [[CrossRef](#)]
50. Stokstad, E. Vive la resistant vines! *Science* **2018**, *362*, 146. [[CrossRef](#)] [[PubMed](#)]
51. Testolin, R.; Peterlunger, E.; Collovini, S.; Castellarin, S. *Technical Booklets VCR, The Disease-Resistant Varieties*, 3rd ed.; Vivai Cooperativi Rauscedo: Rauscedo, Italy, 2018; 32p. Available online: <https://www.infowine.com/wp-content/uploads/2000/01/17582-VCR-Quaderno-tecnico-18-III-Ed-It-Uk-Affiancate.pdf> (accessed on 15 December 2025).
52. Pozzebon, A.; Tirello, P.; Moret, R.; Pederiva, M.; Duso, C. A fundamental step in IPM on grapevine: Evaluating the side effects of pesticides on predatory mites. *Insects* **2015**, *6*, 847–857. [[CrossRef](#)] [[PubMed](#)]
53. Di Gaspero, G.; Foria, S. Molecular grapevine breeding techniques. In *Grapevine Breeding Programs for the Wine Industry*; Reynolds, A., Ed.; Elsevier Ltd.: Cambridge, UK, 2015; pp. 23–37.

54. Oliveira, M.J.R.A.; Roriz, M.; Vasconcelos, M.V.; Bertaccini, A.; Carvalho, S.M.P. Conventional and novel approaches for managing “flavescence dorée” in grapevine: Knowledge gaps and future prospects. *Plant Pathol.* **2019**, *68*, 3–17. [\[CrossRef\]](#)
55. Di Gaspero, G.; Copetti, D.; Coleman, C.; Castellarin, S.D.; Eibach, R.; Kozma, P.; Lacombe, T.; Gambetta, G.; Zvyagin, A.; Cindrić, P.; et al. Selective sweep at the *Rpv3* locus during grapevine breeding for downy mildew resistance. *Theor. Appl. Genet.* **2012**, *124*, 277–286. [\[CrossRef\]](#) [\[PubMed\]](#)
56. Venuti, S.; Copetti, D.; Foria, S.; Falginella, L.; Hoffmann, S.; Bellin, D.; Cindric, P.; Kozma, P.; Scalabrin, S.; Morgante, M.; et al. Historical introgression of the downy mildew resistance gene *Rpv12* from the Asian species *Vitis amurensis* into grapevine varieties. *PLoS ONE* **2013**, *8*, e61228. [\[CrossRef\]](#) [\[PubMed\]](#)
57. Smith, C.M.; Clement, S.L. Molecular bases of plant resistance to arthropods. *Annu. Rev. Entomol.* **2012**, *57*, 309–328. [\[CrossRef\]](#) [\[PubMed\]](#)
58. Sharma, H.C.; Ortiz, R. Host plant resistance to insects: An eco-friendly approach for pest management and environment conservation. *J. Environ. Biol.* **2002**, *23*, 111–135. [\[PubMed\]](#)
59. Smith, C.M. *Plant Resistance to Arthropods—Molecular and Conventional Approaches*; Springer: Dordrecht, The Netherlands, 2005; 423p.
60. Sandhu, S.; Kang, M.S. Advances in breeding for resistance to insects. In *Breeding Insect Resistant Crops for Sustainable Agriculture*; Ramesh, A., Surinder, S., Eds.; Springer Nature: Singapore, 2017; pp. 67–99.
61. Dicke, M.; Sabelis, M.W. How plants obtain predatory mites as bodyguards. *Neth. J. Zool.* **1988**, *38*, 148–165.
62. Aljibory, Z.; Chen, M.-S. Indirect plant defense against insect herbivores: A review. *Insect Sci.* **2018**, *25*, 2–23. [\[CrossRef\]](#) [\[PubMed\]](#)
63. Thaler, J.S.; Stout, M.J.; Karban, R.; Duffey, S.S. Jasmonate-mediated induced plant resistance affects a community of herbivores. *Ecol. Entomol.* **2001**, *26*, 312–324. [\[CrossRef\]](#)
64. Gatehouse, J.A. Plant resistance towards insect herbivores: A dynamic interaction. *New Phytol.* **2002**, *156*, 145–169. [\[CrossRef\]](#) [\[PubMed\]](#)
65. Heil, M. Indirect defence via tritrophic interactions. *New Phytol.* **2008**, *178*, 41–61. [\[CrossRef\]](#) [\[PubMed\]](#)
66. Mithöfer, A.; Boland, W. Plant defense against herbivores: Chemical aspects. *Annu. Rev. Plant Biol.* **2012**, *63*, 431–450. [\[CrossRef\]](#) [\[PubMed\]](#)
67. Ollat, N.; Bordenave, L.; Tandonnet, J.P.; Boursiquot, J.M.; Marguerit, E. Grapevine rootstocks: Origins and perspectives. *Acta Hortic.* **2016**, *1136*, 11–22. [\[CrossRef\]](#)
68. Tello, J.; Mammerler, R.; Čajić, M.; Forneck, A. Major outbreaks in the nineteenth century shaped grape phylloxera contemporary genetic structure in Europe. *Sci. Rep.* **2019**, *9*, 17540. [\[CrossRef\]](#) [\[PubMed\]](#)
69. Jubb, G.L., Jr. Grape phylloxera: Incidence of foliage damage to wine grapes in Pennsylvania. *J. Econ. Entomol.* **1976**, *69*, 763–766. [\[CrossRef\]](#)
70. Granett, J.; Bisabri-Ershadi, B.; Carey, J. Life tables of phylloxera on resistant and susceptible grape rootstocks. *Entomol. Exp. Appl.* **1983**, *34*, 13–19. [\[CrossRef\]](#)
71. Hawthorne, D.J.; Via, S. Variation in performance on two grape cultivars within and among populations of grape phylloxera from wild and cultivated habitats. *Entomol. Exp. Appl.* **1994**, *70*, 63–76. [\[CrossRef\]](#)
72. English-Loeb, G.; Karban, R.; Walker, M.A. Genotypic variation in constitutive and induced resistance in grapes against spider mite (Acari: Tetranychidae) herbivores. *Environ. Entomol.* **1998**, *27*, 297–304. [\[CrossRef\]](#) [\[PubMed\]](#)
73. Omer, A.D.; Granett, J.; Kocsis, L.; Downie, D.A. Preference and performance responses of California grape phylloxera to different *Vitis* rootstocks. *J. Appl. Entomol.* **1999**, *123*, 341–346. [\[CrossRef\]](#)
74. Forneck, A.; Walker, M.A.; Blaich, R. Ecological and genetic aspects of grape phylloxera *Daktulosphaira vitifoliae* (Hemiptera: Phylloxeridae) performance on rootstock hosts. *Bull. Entomol. Res.* **2001**, *91*, 445–451. [\[CrossRef\]](#) [\[PubMed\]](#)
75. Forneck, A.; Walker, M.A.; Blaich, R.; Yvon, M.; Leclant, F. Interaction of phylloxera (*Daktulosphaira vitifoliae* Fitch) with grape (*Vitis* spp.) in simple isolation chamber. *Am. J. Enol. Vitic.* **2001**, *52*, 28–34. [\[CrossRef\]](#)
76. Du, Y.P.; Zhai, H.; Sun, Q.H.; Wang, Z.S. Susceptibility of Chinese grapes to grape phylloxera. *Vitis* **2009**, *48*, 57–58.
77. Vidart, M.V.; Mujica, M.V.; Bao, L.; Duarte, F.; Bentancourt, C.M.; Franco, J.; Scatoni, I.B. Life history and assessment of grapevine phylloxera leaf galling incidence on *Vitis* species in Uruguay. *SpringerPlus* **2013**, *2*, 181. [\[CrossRef\]](#) [\[PubMed\]](#)
78. Powell, K.S.; Korosi, G.A. ‘Taking the strain’—Selecting the right rootstock to protect against endemic phylloxera strains. *Acta Hortic.* **2014**, *1045*, 99–108. [\[CrossRef\]](#)
79. Yin, L.; Clark, M.D.; Burkness, E.C.; Hutchison, W.D. Grape phylloxera (Hemiptera: Phylloxeridae), on cold-hardy hybrid wine grapes (*Vitis* spp.): A review of pest biology, damage, and management practices. *J. Integr. Pest Manag.* **2019**, *10*, 16. [\[CrossRef\]](#)
80. Walker, G.E.; Stirling, G.R. Plant-parasitic nematodes in Australian viticulture: Key pests, current management practices and opportunities for future improvements. *Australas. Plant Pathol.* **2008**, *37*, 268–278. [\[CrossRef\]](#)
81. Ferris, H.; Zheng, L.; Walker, M.A. Resistance of grape rootstocks to plant-parasitic nematodes. *J. Nematol.* **2012**, *44*, 377–386. [\[PubMed\]](#)

82. Shi, W.; He, W.; Zhang, Z.; Sun, J.; Zhu, C.; Liu, Z.; Xu, Y.; Zhao, B. Study on the Resistance of ‘Cabernet Sauvignon’ Grapevine with Different Rootstocks to *Colomerus vitis*. *Sustainability* **2022**, *14*, 15193. [\[CrossRef\]](#)
83. Boudon-Padieu, E. Jaunisses à phytoplasmes de la vigne. *C. R. Acad. Agric. Fr.* **1996**, *82*, 5–20.
84. Rashed, A.; Daugherty, M.P.; Almeida, R.P.P. Grapevine genotype susceptibility to *Xylella fastidiosa* does not predict vector transmission success. *Environ. Entomol.* **2011**, *40*, 1192–1199. [\[CrossRef\]](#) [\[PubMed\]](#)
85. Pavan, F.; Mori, N.; Bressan, S.; Mutton, P. Control strategies for grapevine phytoplasma diseases: Factors influencing the profitability of replacing symptomatic plants. *Phytopathol. Mediterr.* **2012**, *51*, 11–22.
86. Bertazzon, N.; Bagnaresi, P.; Forte, V.; Mazzucotelli, E.; Filippin, L.; Guerra, D.; Zechini, A.; Cattivelli, L.; Angelini, E. Grapevine comparative early transcriptomic profiling suggests that Flavescence dorée phytoplasma represses plant responses induced by vector feeding in susceptible varieties. *BMC Genom.* **2019**, *20*, 526. [\[CrossRef\]](#) [\[PubMed\]](#)
87. Ripamonti, M.; Maron, F.; Cornara, D.; Marzachi, C.; Fereres, A.; Bosco, D. Leafhopper feeding behaviour on three grapevine cultivars with different susceptibilities to Flavescence dorée. *J. Insect Physiol.* **2022**, *137*, 104366. [\[CrossRef\]](#) [\[PubMed\]](#)
88. Bene, A.; Vergine, M.; Pedrelli, A.; De Bellis, L.; Luvisi, A. Flavescence dorée and grapevine susceptibility: From host–pathogen interaction to cultivar categorization. *Pathogens* **2025**, *14*, 939. [\[CrossRef\]](#) [\[PubMed\]](#)
89. Timm, A.E.; Reineke, A. First insights into grapevine transcriptional responses as a result of vine mealybug *Planococcus ficus* feeding. *Arthropod-Plant Interact.* **2014**, *8*, 495–505. [\[CrossRef\]](#)
90. Smith, H.M.; Clarke, C.W.; Smith, B.P.; Carmody, B.M.; Thomas, M.R.; Clingeleffer, P.R.; Powell, K.S. Genetic identification of SNP markers linked to a new grape phylloxera resistant locus in *Vitis cinerea* for marker-assisted selection. *BMC Plant Biol.* **2018**, *18*, 360. [\[CrossRef\]](#) [\[PubMed\]](#)
91. Smith, H.M.; Smith, B.P.; Morales, N.B.; Moskwa, S.; Clingeleffer, P.R.; Thomas, M.R. SNP markers tightly linked to root knot nematode resistance in grapevine (*Vitis cinerea*) identified by a genotyping-by-sequencing approach followed by Sequenom MassARRAY validation. *PLoS ONE* **2018**, *13*, e0193121. [\[CrossRef\]](#) [\[PubMed\]](#)
92. Du, Y.-P.; Jiang, E.-S.; Wang, F.-P.; Zhang, S.-Z.; Zhai, H. Gene expression profiling of rootstock ‘140Ru’ and *Vitis vinifera* L. cv. ‘Crimson Seedless’ grape roots infected with grape phylloxera. *Plant Growth Regul.* **2014**, *73*, 1–8. [\[CrossRef\]](#)
93. Forneck, A.; Lawo, N.C.; Schoedl-Hummel, K.; Liebner, F.; Zweckmayr, T.; Griesser, M. Not just sweet: Phylloxerated roots indicate complex plant response mechanisms. *Acta Hort.* **2016**, *1136*, 239–243. [\[CrossRef\]](#)
94. Wang, F.-P.; Zhao, P.-P.; Zhang, L.; Zhai, H.; Du, Y.-P. Functional characterization of WRKY46 in grape and its putative role in the interaction between grape and phylloxera (*Daktulosphaira vitifoliae*). *Hortic. Res.* **2019**, *6*, 102. [\[CrossRef\]](#) [\[PubMed\]](#)
95. de Lillo, E.; Pozzebon, A.; Valenzano, D.; Duso, C. An intimate relationship between eriophyoid mites and their host plants—A review. *Front. Plant Sci.* **2018**, *9*, 1786. [\[CrossRef\]](#) [\[PubMed\]](#)
96. Javadi Khederi, S.; Khanjani, M.; Gholami, M.; Bruno, G.L. Study of defense-related gene expression in grapevine infested by *Colomerus vitis* (Acari: Eriophyidae). *Exp. Appl. Acarol.* **2018**, *75*, 25–40. [\[CrossRef\]](#) [\[PubMed\]](#)
97. Fermaud, M. Cultivar susceptibility of grape berry clusters to larvae of *Lobesia botrana* (Lepidoptera: Tortricidae). *J. Econ. Entomol.* **1998**, *91*, 974–980. [\[CrossRef\]](#)
98. Baldacchino, F.; Moleas, T. Suscettibilità di alcune cultivar di vite a *Lobesia botrana* (Denis et Shciffmüller) (Lepidoptera: Tortricidae). *Atti Giornate Fitopatol.* **2000**, *1*, 441–444.
99. Snjezana, H. Susceptibility of some grapevine cultivars in area of vineyards of Podgorica on the attack of European grape berry moth—*Lobesia botrana* Den. et Schiff. (Lepidoptera, Tortricidae). *Acta Hort.* **2004**, *652*, 355–358. [\[CrossRef\]](#)
100. Pavan, F.; Sacilotto, G.; Girolami, V. Damage evolution, larval sampling and treatment period for grape moths. In *Proceedings of the Meeting EC Experts’ Group “Integrated Pest Control in Viticulture”, Portoferraio, Italy, 26–28 September 1985*; A.A. Balkema: Rotterdam, The Netherlands, 1987; pp. 39–49.
101. Pavan, F.; Stefanelli, G.; Villani, A.; Cargnus, E. Influence of grapevine cultivar on the second generations of *Lobesia botrana* and *Eupoecilia ambiguella*. *Insects* **2018**, *9*, 8. [\[CrossRef\]](#) [\[PubMed\]](#)
102. Pavan, F.; Stefanelli, G.; Cargnus, E.; Villani, A. Assessing the influence of inflorescence traits on the susceptibility of grape to vine moths. *J. Appl. Entomol.* **2009**, *133*, 394–401. [\[CrossRef\]](#)
103. Linder, C.; Martin, C.; Labois, S.; Chatelain, P.G.; Kehrl, P. Susceptibility of various grape cultivars to *Drosophila suzukii* and other vinegar flies. *IOBC-WPRS Bull.* **2014**, *105*, 219–224.
104. Ioriatti, C.; Walton, V.; Dalton, D.; Anfora, G.; Grassi, A.; Maistri, S.; Mazzoni, V. *Drosophila suzukii* (Diptera: Drosophilidae) and its potential impact to wine grapes during harvest in two cool climate wine grape production regions. *J. Econ. Entomol.* **2015**, *108*, 1148–1155. [\[CrossRef\]](#) [\[PubMed\]](#)
105. Baser, N.; Broutou, O.; Verrastro, V.; Porcelli, F.; Ioriatti, C.; Anfora, G.; Mazzoni, V.; Rossi Stacconi, M.V. Susceptibility of table grape varieties grown in south-eastern Italy to *Drosophila suzukii*. *J. Appl. Entomol.* **2018**, *142*, 465–472. [\[CrossRef\]](#)
106. Entling, W.; Anslinger, S.; Jarausch, B.; Michl, G.; Hoffmann, C. Berry skin resistance explains oviposition preferences of *Drosophila suzukii* at the level of grape cultivars and single berries. *J. Pest Sci.* **2019**, *92*, 477–484. [\[CrossRef\]](#)

107. Tonina, L.; Giomi, F.; Sancassani, M.; Ajelli, M.; Mori, N.; Giongo, L. Texture features explain the susceptibility of grapevine cultivars to *Drosophila suzukii* (Diptera: Drosophilidae) infestation in ripening and drying grapes. *Sci. Rep.* **2020**, *10*, 10245. [[CrossRef](#)] [[PubMed](#)]
108. Weißinger, L.; Samuel, N.; Breuer, M.; Müller, C. Effects of variety and grape berry condition of *Vitis vinifera* on preference behavior and performance of *Drosophila suzukii*. *Insects* **2019**, *10*, 432. [[CrossRef](#)] [[PubMed](#)]
109. Rid, M.; Markheiser, A.; Hoffmann, C.; Gross, J. Waxy bloom on grape berry surface is one important factor for oviposition of European grapevine moths. *J. Pest Sci.* **2018**, *91*, 1225–1239. [[CrossRef](#)]
110. Pavan, F.; Picotti, P. Influence of grapevine cultivars on the leafhopper *Empoasca vitis* and its egg parasitoids. *BioControl* **2009**, *54*, 55–63. [[CrossRef](#)]
111. Schmidt, R.A. Leaf structures affect predatory mites (Acari: Phytoseiidae) and biological control: A review. *Exp. Appl. Acarol.* **2014**, *62*, 1–17. [[CrossRef](#)] [[PubMed](#)]
112. Martinson, T.E.; Dennehy, T.J. Varietal preferences of *Erythroneura* leafhoppers (Homoptera: Cicadellidae) feeding on grapes in New York. *Environ. Entomol.* **1995**, *24*, 550–558. [[CrossRef](#)]
113. Gu, S.; Pomper, K.W. Grape cultivar feeding preference of adult Japanese beetles. *HortScience* **2008**, *43*, 196–199. [[CrossRef](#)]
114. Sharon, R.; Zahavi, T.; Soroker, V.; Harari, A.R. The effect of grape vine cultivars on *Lobesia botrana* (Lepidoptera: Tortricidae) population levels. *J. Pest Sci.* **2009**, *82*, 187–193. [[CrossRef](#)]
115. Leskey, T.C.; Hamilton, G.C.; Nielsen, A.L.; Polk, D.F.; Rodriguez-Saona, C.; Bergh, J.C.; Herbert, D.A.; Kuhar, T.P.; Pfeiffer, D.; Dively, G.P.; et al. Pest status of the brown marmorated stink bug, *Halyomorpha halys* in the USA. *Outlooks Pest Manag.* **2012**, *23*, 218–226. [[CrossRef](#)]
116. Fornasiero, D.; Pavan, F.; Pozzebon, A.; Picotti, P.; Duso, C. Relative infestation level and sensitivity of grapevine cultivars to the leafhopper *Empoasca vitis* (Hemiptera: Cicadellidae). *J. Econ. Entomol.* **2015**, *109*, 416–425. [[CrossRef](#)] [[PubMed](#)]
117. Scaccini, D.; Fornasiero, D.; Tirello, P.; Vincenzi, S.; Cecchetto, M.; Allgata, I.; Duso, C.; Pozzebon, A. Seasonal dynamics and damage of *Halyomorpha halys* in Italian vineyards. *Insects* **2024**, *15*, 378. [[CrossRef](#)] [[PubMed](#)]
118. Tasin, M.; Bäckman, A.-C.; Coracini, M.; Casado, D.; Ioriatti, C.; Witzgall, P. Synergism and redundancy in a plant volatile blend attracting grapevine moth females. *Phytochemistry* **2007**, *68*, 203–209. [[CrossRef](#)] [[PubMed](#)]
119. Schmidt-Büsser, D.; von Arx, M.; Connétable, S.; Guerin, P.M. Identification of host-plant chemical stimuli for the European grape berry moth *Eupoecilia ambiguella*. *Physiol. Entomol.* **2011**, *36*, 101–110. [[CrossRef](#)]
120. von Arx, M.; Schmidt-Büsser, D.; Guerin, P.M. Host plant volatiles induce oriented flight behaviour in male European grapevine moths, *Lobesia botrana*. *J. Insect Physiol.* **2011**, *57*, 1323–1331. [[CrossRef](#)] [[PubMed](#)]
121. Markheiser, A.; Rid, M.; Biancu, S.; Gross, J.; Hoffmann, C. Physical factors influencing the oviposition behaviour of European grapevine moths *Lobesia botrana* and *Eupoecilia ambiguella*. *J. Appl. Entomol.* **2018**, *142*, 201–210. [[CrossRef](#)]
122. Markheiser, A.; Rid, M.; Biancu, S.; Gross, J.; Hoffmann, C. Tracking short-range attraction and oviposition of European grapevine moths affected by volatile organic compounds in a four-chamber olfactometer. *Insects* **2020**, *11*, 45. [[CrossRef](#)] [[PubMed](#)]
123. Rid, M.; Markheiser, A.; Stein, S.; Hoffmann, C.; Gross, J. Volatiles of several grapevine cultivars emitted at different phenological stages linked to discriminatory ability of grapevine moths. *J. Plant Dis. Prot.* **2019**, *126*, 115–127. [[CrossRef](#)]
124. Minuz, R.L.; Mancini, V.; Ruschioni, S.; Mozzon, M.; Foligni, R.; Isidoro, N.; Romanazzi, G.; Riolo, P. Volatiles emitted by resistance inducer-treated grapevines affect *Hyalesthes obsoletus* behavioural responses. *Bull. Insectol.* **2020**, *73*, 117–123.
125. Maher, N.; Thiery, D.; Städler, E. Oviposition by *Lobesia botrana* is stimulated by sugars detected by contact chemoreceptors. *Physiol. Entomol.* **2006**, *31*, 14–22. [[CrossRef](#)]
126. Moreau, J.; Rahme, J.; Benrey, B.; Thiery, D. Larval host plant origin modifies the adult oviposition preference of the female European grapevine moth *Lobesia botrana*. *Naturwissenschaften* **2008**, *95*, 317–324. [[CrossRef](#)] [[PubMed](#)]
127. Rizvi, S.Z.M.; Raman, A. Effect of leaf chemistry of *Vitis vinifera* L. on the performance and development of *Epiphyas postvittana* (Lepidoptera: Tortricidae). *Aust. J. Grape Wine Res.* **2017**, *23*, 95–102. [[CrossRef](#)]
128. Rezazadeh, A.; Sampson, B.J.; Stafne, E.T.; Marshall-Shaw, D.; Stringer, S.J.; Hummer, K. Susceptibility of bunch grape and muscadine cultivars to berry splitting and spotted-wing *Drosophila* oviposition. *Am. J. Enol. Vitic.* **2018**, *69*, 258–265. [[CrossRef](#)]
129. Corrêa, S.C.; Wille, C.L.; Hoffer, H.; Carissimi Boff, M.I.; Franco, C.R. Oviposition preference and biology of fruit flies (Diptera: Tephritidae) on grape vine genotypes. *Rev. Caatinga* **2018**, *31*, 850–859. [[CrossRef](#)]
130. Vogelweith, F.; Thiéry, D.; Quaglietti, B.; Moret, Y.; Moreau, J. Host plant variation plastically impacts different traits of the immune system of a phytophagous insect. *Funct. Ecol.* **2011**, *25*, 1241–1247. [[CrossRef](#)]
131. Thiéry, D.; Louâpre, P.; Muneret, L.; Rusch, A.; Sentenac, G.; Vogelweith, F.; Iltis, C.; Moreau, J. Biological protection against grape berry moths. A review. *Agron. Sustain. Dev.* **2018**, *38*, 15. [[CrossRef](#)]
132. Calas, D.; Thiéry, D.; Marion-Poll, F. 20-hydroxyecdysone deters oviposition and larval feeding in the European grapevine moth, *Lobesia botrana*. *J. Chem. Ecol.* **2006**, *32*, 2443–2454. [[CrossRef](#)] [[PubMed](#)]
133. Moreau, J.; Arruego, X.; Benrey, B.; Thiéry, D. Differences in nutritional quality of parts of *Vitis vinifera* berries affect fitness of the European grapevine moth. *Entomol. Exp. Appl.* **2006**, *119*, 93–99. [[CrossRef](#)]

134. Javadi Khederi, S.; Khanjani, M.; Gholami, M.; de Lillo, E. Sources of resistance to the erineum strain of *Colomerus vitis* (Acari: Eriophyidae) in grapevine cultivars. *Syst. Appl. Acarol.* **2018**, *23*, 405–425. [\[CrossRef\]](#)
135. Hammons, D.L.; Kurtural, S.K.; Potter, D.A. Phenological resistance of grapes to the green June beetle, an obligate fruit-eating scarab. *Ann. Appl. Biol.* **2010**, *156*, 271–279. [\[CrossRef\]](#)
136. Gabel, B.; Roehrich, R. Sensitivity of grapevine phenological stages to larvae of European grapevine moth, *Lobesia botrana* Den. et Schiff. (Lep., Tortricidae). *J. Appl. Entomol.* **1995**, *119*, 127–130. [\[CrossRef\]](#)
137. Caffarra, A.; Rinaldi, M.; Eccel, E.; Rossi, V.; Pertot, I. Modelling the impact of climate change on the interaction between grapevine and its pests and pathogens: European grapevine moth and powdery mildew. *Agric. Ecosyst. Environ.* **2012**, *148*, 89–101. [\[CrossRef\]](#)
138. Gennuso, E.; Ragusa, E.; Tsolakis, H. Evaluation of infestation by *Lobesia botrana* (Dennis et Schiffermüller) (Lepidoptera, Tortricidae) and its relation to territorial differences and cultivar susceptibility. *IOBC-WPRS Bull.* **2013**, *85*, 203–210.
139. Gómez, M.; Paranhos, B.A.J.; Silva, J.G.; de Lima, M.A.C.; Silva, M.A.; Macedo, A.T.; Virginio, J.F.; Walder, J.M.M. Oviposition preference of *Ceratitis capitata* (Diptera: Tephritidae) at different times after pruning 'Italia' table grapes grown in Brazil. *J. Insect Sci.* **2019**, *19*, 16. [\[CrossRef\]](#) [\[PubMed\]](#)
140. Jedyi, H.; Naamani, K.; Ait Elkoch, A.; Lemjiber, N. Changes in grapes composition during ripening of five *Vitis vinifera* L varieties as related to Tephritidae and Drosophilidae infestations. *Physiol. Mol. Biol. Plants* **2019**, *25*, 1407–1418. [\[CrossRef\]](#) [\[PubMed\]](#)
141. Marchesini, E.; Dalla Montà, L. Nel Veneto quattro generazioni di tignoletta della vite. *L'Informatore Agrar.* **2004**, *60*, 75–78.
142. Varner, M.; Mattedi, L. Le tignole nella Piana Rotaliana. *L'Informatore Agrar.* **2004**, *60*, 63–69.
143. Bernard, M.B.; Horne, P.A.; Hoffmann, A.A. Eriophyoid mite damage in *Vitis vinifera* (grapevine) in Australia: *Calepitrimerus vitis* and *Colomerus vitis* (Acari: Eriophyidae) as the common cause of the widespread 'Restricted Spring Growth' syndrome. *Exp. Appl. Acarol.* **2005**, *35*, 83–109. [\[CrossRef\]](#) [\[PubMed\]](#)
144. Bauerle, T.L.; Eissenstat, D.M.; Granett, J.; Gardner, D.M.; Smart, D.R. Consequences of insect herbivory on grape fine root systems with different growth rates. *Plant Cell Environ.* **2007**, *30*, 786–795. [\[CrossRef\]](#) [\[PubMed\]](#)
145. Botton, M.; Dalla Colleta, V. Evaluation of the resistance of *Vitis rotundifolia* cultivars to brazilian ground pearl (Hemiptera: Margarodidae) in southern Brazil. *Acta Sci. Agron.* **2010**, *32*, 213–216. [\[CrossRef\]](#)
146. Moreau, J.; Desouhant, E.; Louâpre, P.; Goubault, M.; Rajon, E.; Jarrige, A.; Menu, F.; Thiéry, D. How host plant and fluctuating environment affect insects reproductive strategies? *Adv. Bot. Res.* **2017**, *81*, 259–287. [\[CrossRef\]](#)
147. Fahrentrapp, J.; Müller, L.; Schumacher, P. Is there need for leaf-galling grape phylloxera control? Presence and distribution of *Daktulosphaira vitifoliae* in Swiss vineyards. *Int. J. Pest Manag.* **2015**, *61*, 340–345. [\[CrossRef\]](#)
148. Forneck, A.; Mammerler, R.; Tello, J.; Breuer, M.; Müller, J.; Fahrentrapp, J. First European leaf-feeding grape phylloxera (*Daktulosphaira vitifoliae* Fitch) survey in Swiss and German commercial vineyards. *Eur. J. Plant Pathol.* **2019**, *154*, 1029–1039. [\[CrossRef\]](#)
149. Gelmetti, A.; Bottura, M. Flavescenza dorata—Un preoccupante aumento. *Terra Trent.* **2013**, *58*, 50–52.
150. Portaccio, L.; Paissoni, M.A.; Giacosa, S.; Passera, A.; Barbieri, C.; Maghradze, D.; Rolle, L.; Gerbi, V.; Failla, O.; Bianco, P.A.; et al. Performance of Georgian grapevine varieties in a vineyard infected by Flavescence dorée phytoplasma in Piedmont, northwestern Italy. *Agriculture* **2025**, *15*, 1988. [\[CrossRef\]](#)
151. Cahenzli, F.; Daniel, C. *Susceptibility of Different Grape Varieties to Drosophila suzukii Oviposition*; Report Bericht FiBL; Forschungsinstitut für Biologischen Landbau: Frick, Switzerland, 2016.
152. Kehrli, P.; Cahenzli, F.; Daniel, C.; Linder, C. *Drosophila suzukii*: Importantes différences dans la sensibilité des cépages de vigne. *Rev. Suisse Vitic. Arboric. Hortic.* **2017**, *49*, 234–240.
153. Van Timmeren, S.; Isaacs, R. *Drosophila suzukii* in Michigan vineyards, and the first report of *Zaprionus indianus* from this region. *J. Appl. Entomol.* **2014**, *138*, 519–527. [\[CrossRef\]](#)
154. Thiéry, D.; Monceau, K.; Moreau, J. Different emergence phenology of European grapevine moth (*Lobesia botrana*, Lepidoptera: Tortricidae) on six varieties of grapes. *Bull. Entomol. Res.* **2014**, *104*, 277–287. [\[CrossRef\]](#) [\[PubMed\]](#)
155. Gelmetti, A.; Roman, T.; Bottura, M.; Stefanini, M.; Pedò, S.; Mattè, B.; Mattedi, F.; Nicolini, G. Performance agronomica di viti resistenti: Primi risultati di un progetto poliennale. *Vite Vino* **2019**, *2*, 54–61.
156. Draxler, F.; Fleischhacker, A.; Spangl, C.; Waberer, A.; Griesser, M.; Forneck, A. Host performance of Austrian grape phylloxera (*Daktulosphaira vitifoliae* Fitch) clonal lineages: First results. *Acta Hortic.* **2007**, *816*, 85–90. [\[CrossRef\]](#)
157. Vezzulli, S.; Gramaje, D.; Tello, J.; Gambino, G.; Bettinelli, P.; Pirrello, C.; Schwandner, A.; Barba, P.; Angelini, E.; Anfora, G.; et al. Genomic designing for biotic stress resistant grapevine. In *Genomic Designing for Biotic Stress Resistant Fruit Crops*; Kole, C., Ed.; Springer: Cham, Switzerland, 2022; pp. 87–256. [\[CrossRef\]](#)
158. Jensen, L.B.M.; Lowery, D.T.; DeLury, N.C. Grape leaf rust mite, *Calepitrimerus vitis* (Acari: Eriophyidae), a new pest of grapes in British Columbia. *J. Entomol. Soc. Br. Columbia* **2017**, *114*, 3–14.

159. Galet, P. *Les Maladies et les Parasites de la Vigne*; Imprimerie du «Paysan du Midi»: Montpellier, France, 1982; Volume II, pp. 883–1876.
160. Granett, J.; Timper, P.; Lider, L.A. Grape phylloxera (*Daktulosphaira vitifoliae*) (Homoptera: Phylloxeridae) biotypes in California. *J. Econ. Entomol.* **1985**, *78*, 1463–1467. [[CrossRef](#)]
161. Granett, J.; De Benedictis, J.; Wolpert, J.; Weber, E.; Goheen, A. Deadly insect pest poses increased risk to north coast vineyards. *Calif. Agric.* **1991**, *45*, 30–32. [[CrossRef](#)]
162. Du, Y.P.; Wang, Z.S.; Sun, Q.H.; Zhai, H.; Wang, Z.Y. Evaluation on grape phylloxera resistance in several grape varieties and rootstocks. *Acta Entomol. Sci.* **2008**, *51*, 33–39.
163. Andreazza, F.; Baronio, C.A.; Botton, M.; Valgas, R.A.; Ritschel, P.S.; Maia, J.D.G.; Nava, D.E. Suscetibilidade de bagas de genótipos de videira pela infestação por *Drosophila suzukii* (Diptera: Drosophilidae). *Pesqui. Agropecu. Bras.* **2016**, *51*, 599–606. [[CrossRef](#)]
164. Ruiz-García, L.; Gago, P.; Martínez-Mora, C.; Santiago, J.L.; Fernández-López, D.J.; Martínez, M.d.C.; Boso, S. Evaluation and pre-selection of new grapevine genotypes resistant to downy and powdery mildew, obtained by cross-breeding programs in Spain. *Front. Plant Sci.* **2021**, *12*, 674510. [[CrossRef](#)] [[PubMed](#)]
165. Scariolo, F.; Gabelli, G.; Magon, G.; Palumbo, F.; Pirrello, C.; Farinati, S.; Curioni, A.; Devillars, A.; Lucchin, M.; Barcaccia, G.; et al. The transcriptional landscape of berry skin in red and white PIWI (“Pilzwiderstandsfähig”) grapevines possessing QTLs for partial resistance to downy and powdery mildews. *Plants* **2024**, *13*, 2574. [[CrossRef](#)] [[PubMed](#)]
166. Montaigne, E.; Coelho, A.; Khefifi, L. Economic issues and perspectives on innovation in new resistant grapevine varieties in France. *Wine Econ. Policy* **2016**, *5*, 73–77. [[CrossRef](#)]
167. Moreau, J.; Richard, A.; Benrey, B.; Thiéry, D. Host plant cultivar of the grapevine moth *Lobesia botrana* affects the life history traits of an egg parasitoid. *Biol. Control* **2009**, *50*, 117–122. [[CrossRef](#)]
168. Moreau, J.; Villemant, C.; Benrey, B.; Thiéry, D. Species diversity of larval parasitoids of the European grapevine moth (*Lobesia botrana*, Lepidoptera: Tortricidae): The influence of region and cultivar. *Biol. Control* **2010**, *54*, 300–306. [[CrossRef](#)]
169. Xuéreb, A.; Thiéry, D. Does natural larval parasitism of *Lobesia botrana* (Lepidoptera: Tortricidae) vary between years, generation, density of the host and vine cultivar? *Bull. Entomol. Res.* **2006**, *96*, 105–110. [[CrossRef](#)] [[PubMed](#)]
170. Tacoli, F.; Cargnus, E.; Zandigiacomo, P.; Pavan, F. Side effects of sulfur dust on the European grapevine moth *Lobesia botrana* and the predatory mite *Kampimodromus aberrans* in vineyards. *Insects* **2020**, *11*, 825. [[CrossRef](#)] [[PubMed](#)]
171. Reiff, J.M.; Ehringer, M.; Hoffmann, C.; Entling, M.H. Fungicide reduction favors the control of phytophagous mites under both organic and conventional viticulture. *Agric. Ecosyst. Environ.* **2021**, *305*, 107172. [[CrossRef](#)]
172. Mele, A.; Ceccato, E.; Simoni, F.; Tirello, P.; Scaccini, D.; Duso, C.; Pozzebon, A. Lethal and sub-lethal effects of fungicides and plant strengtheners on *Trissolcus japonicus* and *Trissolcus mitsukurii*, egg parasitoids of *Halyomorpha halys*. *Ecotox. Environ. Safe.* **2025**, *304*, 119088. [[CrossRef](#)] [[PubMed](#)]
173. Daniel, C.; Haeseli, A.; Weibel, F. *The Side Effects of Lime Sulphur on Predaceous Arthropods, i.e., Typhlodromus pyri, and Other Leaf Occupying Arthropods*; FiBL Forschungsinstitut für Biologischen Landbau: Frick, Switzerland, 2001; Volume 11, pp. 1–8.
174. Duso, C.; Castagnoli, M.; Simoni, S.; Angeli, G. The impact of eriophyoids on crops: Recent issues on *Aculus schlechtendali*, *Calepitrimerus vitis* and *Aculops lycopersici*. *Exp. Appl. Acarol.* **2010**, *51*, 151–168. [[CrossRef](#)] [[PubMed](#)]
175. Zappalà, L.; Siscaro, G.; Biondi, A.; Mollá, O.; González-Cabrera, J.; Urbaneja, A. Efficacy of sulphur on *Tuta absoluta* and its side effects on the predator *Nesidiocoris tenuis*. *J. Appl. Entomol.* **2012**, *136*, 401–409.
176. Katsoulas, N.; Løes, A.K.; Andrivon, D.; Cirvilleri, G.; de Cara, M.; Kir, A.; Knebl, L.; Malińska, K.; Oudshoorn, F.; Willer, H.; et al. Current use of copper, mineral oils and sulphur for plant protection in organic horticultural crops across 10 European countries. *Org. Agric.* **2020**, *10*, 159–171. [[CrossRef](#)]
177. Pérez-Guerrero, S.; Molina, J.M.; Montiel, C.; Redondo-Villa, A.; Avivar-Lozano, L. Laboratory evaluation of effects of powdered sulphur on the oviposition, fruit detection and behaviour of *Drosophila suzukii* (Diptera: Drosophilidae) on strawberry. *Eur. J. Entomol.* **2020**, *117*, 210–215. [[CrossRef](#)]
178. Scaccini, D.; Fornasiero, D.; Lombardo, V.; Galli, G.; Mirandola, E.; Pozzebon, A. Application of sulfur-based products reduces *Halyomorpha halys* infestation and damage in pome fruit orchards. *Pest Manag. Sci.* **2024**, *80*, 6251–6261. [[CrossRef](#)] [[PubMed](#)]
179. Scaccini, D.; Mirandola, E.; Sirapu, S.; Simoni, F.; Fornasiero, D.; Duso, C.; Pozzebon, A. Wettable sulphur application for *Halyomorpha halys* (Stål) (Hemiptera: Pentatomidae) management: Laboratory and semi-field experiments. *Pest Manag. Sci.* **2024**, *80*, 3620–3627. [[CrossRef](#)] [[PubMed](#)]
180. Bavaresco, L.; Squeri, C. Outlook on disease resistant grapevine varieties. *BIO Web Conf.* **2022**, *44*, 06001. [[CrossRef](#)]

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