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INCIDENCE OF SOME PESTS AND DISEASES ON SEVERAL PEACH AND NECTARINE CULTIVARS TRAINED IN TWO PLANAR CANOPIES

Alexandru BUCUR[1], Ana Cornelia BUTCARU[2], Cosmin Alexandru MIHAI[1], Florin STĂNICĂ[1, 2]

[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest, Faculty of Horticulture, 59 Mărăști Blvd, District 1, Bucharest, Romania
[2]Research Center for Studies of Food Quality and Agricultural Products, University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăști Blvd, District 1, Bucharest, Romania

Corresponding author email: anabutcaru@gmail.com

Abstract

Peach is a popular and important fruit tree widely produced in the world, and producing high-quality peach fruit requires the management of pests and diseases. This study was conducted over seven years (2018-2024) and aimed to examine the incidence of several fungal diseases, such as brown rot (Monilinia fructicola (G. Winter) Honey), powdery mildew (Podosphaera leucotricha (Ellis & Everh.) E.S. Salmon),), and leaf curl disease (Taphrina deformans (Berk.) Tul. and the peach twig borer (Anarsia lineatella Zellfungal) on 16 nectarine and 14 peach cultivars. Trees have been trained on two different canopies: Trident and Vertical Axis. The numbers of mummified fruit and pruned branches on the orchard floor were the main sources of primary inoculum, with Monilinia fructicola for the peach cultivars, while for the Anarsia lineatella, the number of shoots. Visual observations were made for powdery mildew and leaf curl disease.

Key words: *Monilinia fructicola, Anarsia lineatella, Podosphaera leucotricha, canopies, peach.*

INTRODUCTION

Peach cultivation is a key part of global fruit production, but growing high-quality peaches and nectarines comes with its challenges (Manganaris et al., 2022). Orchards need constant care to maintain strong, productive trees, but fungal diseases and insect pests often threaten yields and fruit quality (Anthony & Minas, 2021). Without proper management, these issues can weaken trees, reduce fruit development, and lower market value (Adaskaveg et al., 2023). One of the most damaging fungal diseases is brown rot, caused by (*Monilinia fructicola* (G. Winter) Honey), (Bevacqua et al., 2023). This pathogen spreads quickly and can lead to significant fruit losses both before and after harvest (Navrozidis et al., 2008). Another common issue is powdery mildew (*Podosphaera leucotricha* (Ellis & Everh.) E.S. Salmon), which reduces the tree's ability to photosynthesize, weakening shoots and slowing growth (Abdahlla et al., 2024). Peach leaf curl, caused by (*Taphrina deformans* (Berk.) Tul.) is especially problematic in early spring, distorting leaves and affecting overall tree health (Toca et al., 2005; Parveaud et al., 2012). These diseases tend to persist in orchards, often overwintering in mummified fruit or infected wood, making early prevention crucial. Beyond fungal diseases, insect pests like the peach twig borer (*Anarsia lineatella* Zeller) can cause severe damage (Kutinkova et al., 2016; Damos et al., 2022). The larvae tunnel into young shoots and developing fruit, harming the tree and creating entry points for infections (Asfers et al., 2016). How severe these infestations become depends on factors like climate, tree variety, and how well the orchard is maintained. Keeping peach trees healthy requires a balanced approach combining cultural practices, biological solutions, and, when necessary, chemical treatments (Luo et al., 2022). Understanding how these diseases and pests spread helps growers apply the right strategies at the right time. Research into resistant cultivars, improved training systems, and sustainable pest control methods constantly evolves, offering new ways to protect orchards and maintain high fruit quality while reducing reliance on chemical treatments (Maatallah et al., 2024; Anthony & Minas, 2021). In Romania, peach cultivation faces significant challenges, with the most dangerous disease being peach leaf curl (*Taphrina deformans*), which requires mandatory chemical treatments, and the peach twig borer (*Anarsia lineatella*), as well as the bacterial spot (*Xanthomonas arboricola* pv. *pruni*) (Ivascu & Buciumanu, 2006). To effectively manage these issues, current trends focus on implementing integrated control strategies tailored to local conditions and climate change impacts (Ză lă et al., 2022). This study aimed to evaluate the incidence of some pests and diseases on several peach and nectarine cultivars over six years (2018-2024). Specifically, it focused on assessing the impact of brown rot (*Monilinia fructicola*), powdery mildew (*Podosphaera leucotricha*), leaf curl disease (*Taphrina deformans*), and the peach twig borer *(Anarsia lineatella)*. Additionally, the study investigated the influence of two different planar canopies, Trident (T) and Vertical axis (Va), on disease severity and pest infestation levels. The research also aimed to identify the primary sources of inoculum of *Monilinia* spp. and the role of orchard sanitation practices in disease and pest management (Jinga et al., 2013; Damianov et al., 2024).

MATERIALS AND METHODS

The research was carried out in the experimental orchard of the Faculty of Horticulture in Bucharest, located at coordinates 44°28′18.14″N and 26°4′13.61″E. The observations were made on two species of stone trees: peach and nectarine. They noted 14 peach and 16 nectarine cultivars (Bucur et al., 2024). Peach trees were approximately 7 years old, planted in 2017, Trident (4.0 x 2.0 m - 1,250 trees/ha - 3,750 axes/ha) and Vertical Axis (4.0 x 1.5 m - 1,666 trees/ha -1,666 axes/ha). Visual inspection is the quickest method for identifying diseases and pests by observing symptoms of infected fruit tree species (Xing et al., 2023). For *A. lineatella*, the number of infested shoots per tree was recorded annually from December 2019 to 2024. Observations were conducted for the pest's first, second, and third generations. In 2020, the CheckMate® SF dispensers were installed in the trees, one at seven trees for mating disruption for management of *A. oriental* fruit moth and peach twig borer in stone fruit crops (Erhaft et al., 2021). For leaf curl disease, each infected leaf on each tree showing visible symptoms of *Taphrina deformans* (Berk.) Tul infection was collected and counted in April 2021-2024. Regarding powdery mildew disease, each affected fruit on each tree shows visible symptoms of *Podosphaera leucotricha* (Ellis & Everh.) E.S. Salmon was collected and counted in June 2021-2024. For brown rot (*Monilinia fructicola* (G. Winter) Honey), the number of mummified fruits left on the tree from each tree was counted in December 2018-2024. The orchard was maintained under a conventional treatment scheme. The phytosanitary treatment scheme for the peach and nectarine experimental orchard at USAMV of Bucharest includes strategic applications throughout the year, targeting major fungal and bacterial diseases and key insect pests. Treatments were applied from January to December, following the phenological stages of the crop based on the BBCH scale. A combination of fungicides, bactericides, and insecticides, including Dithane M45, Captan, Syllit 400 SC, Score 250 EC, Vertimec 1.8 EC, Movento 100 SC, and other protective substances, was used. The main diseases controlled were brown rot (*Monilinia fructicola* (G. Winter) Honey), bacterial spot (*Xanthomonas arboricola* pv. *pruni*), powdery mildew (*Podosphaera leucotricha* (Ellis & Everh.) E.S. Salmon), leaf curl (*Taphrina deformans*), and others. Additionally, treatments aimed to mitigate pest attacks. Treatments were applied in pre- and post-harvest periods, during dormancy and active growth, ensuring crop protection.

For data statistical analysis, the R program (with RStudio 2024.04.2+764) and MS Office (Microsoft Excel, 2016) were used, with a significance level of $p = 0.05$, for the descriptive statistics of the data. ANOVA and Tukey post-hoc tests were applied.

RESULTS AND DISCUSSIONS

Comparing peach and nectarine of *Anarsia lineatella* attack, shows that the nectarine trees exhibited a more severe initial infestation compared to peaches, with certain cultivars ('Nectabelle/GF677') showing over 200 infested shoots per tree in 2019. Following the installation of CheckMate® SF Dispenser, a major decrease in infestation was recorded across both peach and nectarine cultivars. By

2021, the number of infested shoots dropped to near-zero levels in most cultivars, and this trend continued through 2024. Most susceptible cultivars (with the highest infestation levels) in peach were 'Sugar Time/Adesoto' (11.56%) (Figure 2), and for nectarine, 'Nectabelle/GF677' (48.58 %) (Figure 1). Also, these cultivars exhibited the highest attack levels before the application of mating disruption, indicating a high susceptibility to *A. lineatella*. Most tolerant cultivars (lowest infestation levels) in peach, were 'Cardinal/M29C' (T) (0.67%) (Figure 2), and for nectarine, 'Nectareine/M29C' (Va) (1.11%), but trained on Trident 'Nectareine/M29C' was registered with (13.83%) infection level (Figure 1). These cultivars maintained the lowest infestation rates throughout the study period, suggesting a degree of resistance. The 'Royal Summer/GF677' (6.17%), cv./rootstocks combination exhibited higher infection levels than the 'Royal Summer/SJA' (1.33%) on attacked shoots (2019-2024) (Figure 2). Regarding Trident canopy, the most susceptible cultivar in peach was 'Sugar Time/Adesoto' (11.56%), and the most tolerant was 'Royal Summer/SJA' (1.33%) (Figure 3). For the Vertical axis, the most susceptible cultivar was 'Gladys' (4.22%), and the most tolerant was 'Cardinal/M29C' (0.67%) (Figure 3). For the nectarine cultivars, trained on Trident canopy, the most susceptible cultivar was 'Nectabelle/GF677' (48.58%), and the most tolerant was 'Nectagrand 4/SJA' (9.00%) (Figure 4). For the Vertical axis, the most susceptible cultivar was 'Big Bang/GF677' (6.39%), and the most tolerant was 'Nectareine/M29C' (1.11%) (Figure 4). Relating to observations for the first, second, and third generations of the pest (Figure 5), the results for the nectarine cultivars trained on Trident canopy showed higher levels of infestation, particularly in early years (2019-2020) and especially in generation two. The Vertical axis canopy exhibited a lower infestation, with the least minimal attack. Overall, some cultivars such as 'Nectabelle/GF677', 'Guerriera/SJA', 'Early Sun Grand/SJA', 'Big Bang/GF677', 'Big Top/GF677', and 'Big Fire/GF677' appear to be more vulnerable. Other cultivars such as 'Maria Anna/SJA', 'Nectagrand 4/SJA', and 'Caldessi2000/SJA' showed consistently lower infestations. For peach cultivars, attack based on generations was the same as that of nectarine cultivars, with much lower intensity overall. In the first generation, the attack levels were generally low across all years, with very few occurrences of moderate infestation. Under the Trident canopy, the second generation was the most severe attack (Figure 6). In the third generation, the attack level was minimal across all years, with little to no impact. Some cultivars, such as 'Sugartime/Adesoto', 'Sweet Henry/Adesoto', 'Lucius/GF677', and 'Gladys/GF677', expressed higher attack, and the attack levels on the cultivars 'Royal Summers/SJA', 'Springbelle/M29C', and 'Red Top was low.

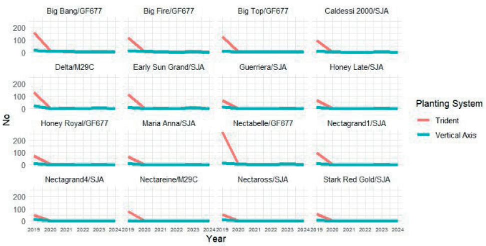

Figure 1. *Anarsia lineatella* attack of shoots in nectarine cultivars (2019-2024)

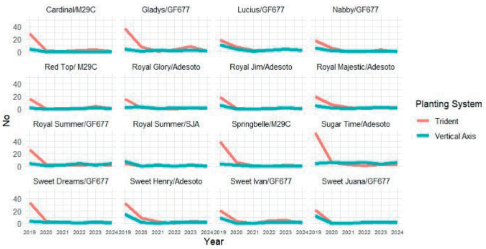

Figure 2. *Anarsia lineatella* attack on shoots in peach cultivars (2019-2024)

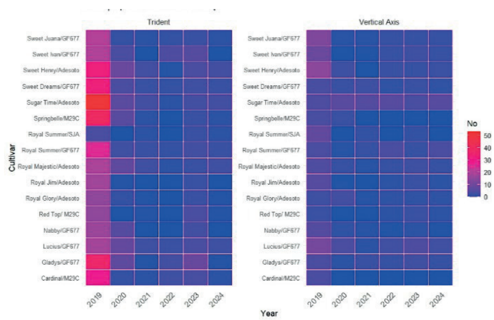

Figure 3. The evolution of *Anarsia lineatella* attack in peach cultivars trained under two different planar canopies (T-Va)

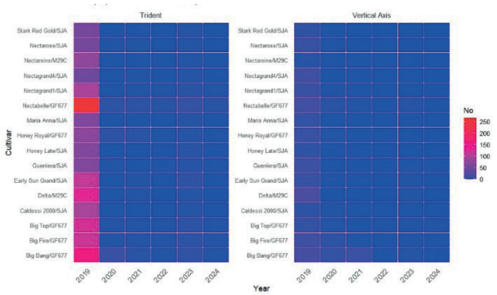

Figure 4. The evolution of *Anarsia lineatella* attack in nectarine cultivars trained under two different planar canopies (T-Va)

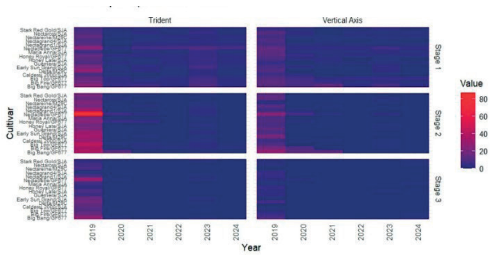

Figure 5. Observations in nectarine cultivars for the pest's first, second, and third generations regarding two canopies (2019-2024)

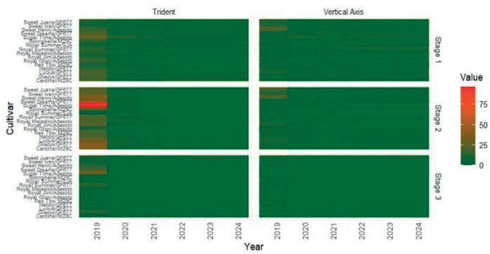

Figure 6. Observations in peach cultivars for the pest's first, second, and third generations regarding the two canopies (2019-2024)

Taphrina deformans had been present in peach and nectarine since the end of March and early April. Leaf curl disease appeared on young leaves, shoots, and sometimes on fruits. A clear distinction was observed between the two canopies, with the Trident canopy exhibiting higher infection levels in most cultivars than the Vertical axis canopy. This trend was particularly evident in the first two years (2021-2022), where the number of infected leaves was significantly greater under the Trident canopy. Among nectarine cultivars, 'Big Top/GF677' (T) (1005 infected leaves) exhibited the highest infection levels (Figure 7).

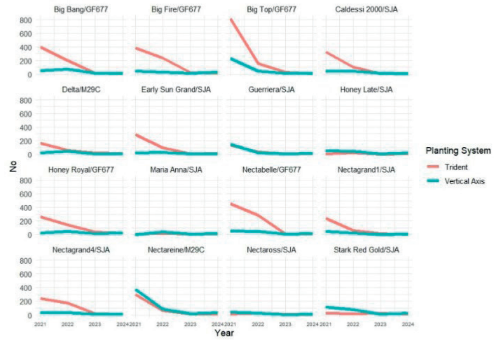

Figure 7. *Taphrina deformans* infestation in nectarine cultivars (2021-2024)

'Lucius/GF677' (Va) (431 infected leaves) recorded the most severe infections for the peach cultivars. Moreover, the lowest infection rates were recorded on 'Maria Anna/SJA' cv. (T) (37 infected leaves)-(nectarine) and 'Red Top/M29C' (Va) (35 infected leaves)-(peach) (Figure 8).

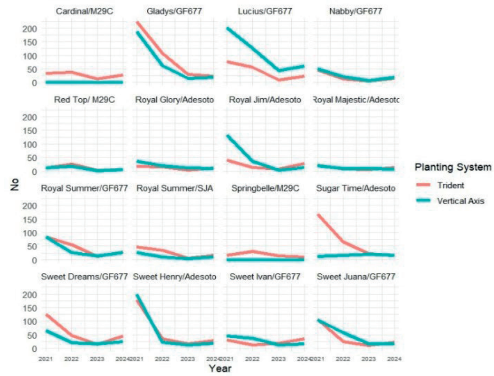

Figure 8. *Taphrina deformans* cultivars infestation in peach cultivars (2021-2024)

For the Trident canopy, the most susceptible nectarine cultivar was 'Big Top/GF677' (1005 infected leaves), and the most tolerant was 'Maria Anna/SJA' (37 infected leaves) (Figure 9). For the Vertical axis, the most susceptible nectarine cultivar was 'Nectareine/Adesoto' (516 infected leaves), and the most tolerant was 'Early Sun Grand/SJA' (66 infected leaves) (Figure 9). Regarding the Trident canopy, the most susceptible peach cultivar was 'Gladys/GF677' (384 infected leaves), and the most tolerant was 'Red Top/M29C' (47 infected leaves) (Figure 10).

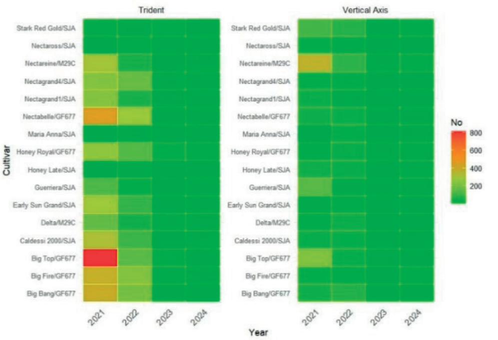

Figure 9. The evolution of *Taphrina deformans* infestation in nectarine cv. trained under two different planar canopies (2021-2024)

Figure 10. The evolution of *Taphrina deformans* infestation in peach cv. trained under two different planar canopies (2021-2024)

For the Vertical axis, the most susceptible cultivar was 'Lucius/GF677' (431 infected leaves), and the most tolerant was 'Red Top/M29C' (65 infected leaves) (Figure 10). The 'Royal Summer/GF677' cv./combination again showed higher infection than the 'Royal Summer/SJA' combination regarding *Taphrina deformans* (Figure 10).

Powdery mildew has been present mostly in nectarine cultivars since mid-May (Figure 11). The severity of *(Podosphaera leucotricha* (Ellis & Everh.) E.S. Salmon) infection varied depending on the training system. In the Trident canopy (Figure 13), the highest infection level was observed in 'Guerriera/SJA' (35,5%) while the lowest was recorded in 'Nectagrand 1/SJA' (6.50%). In the Vertical Axis canopy (Figure 13), 'Nectareine/Adesoto' (35.00 %) showed the highest susceptibility, whereas 'Nectagrand1/SJA' (6.50 %) showed the lowest infection levels. The annual distribution of the infection rate under the two planar canopies was higher in 2023, with no significant differences regarding the canopies (Figure 12).

Figure 11. *Podosphaera leucotricha* infestation in nectarine cultivars (2020-2024)

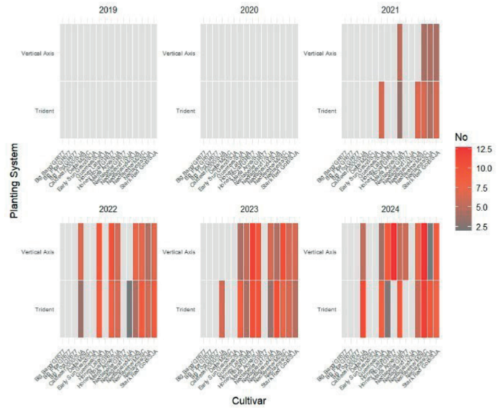

Figure 12. Annual distribution of powdery mildew (*Podosphaera pannosa*) infestation in nectarine cultivars under different canopies (2019-2024)

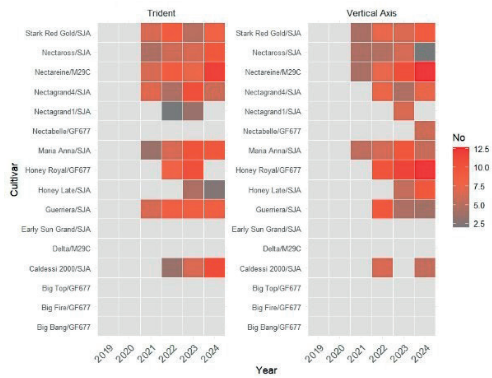

Figure 13. Incidence of powdery mildew (*Podosphaera pannosa*) in nectarine cultivars under Trident and Vertical Axis training systems (2019-2024)

Monilinia fructicola (G. Winter) Honey felt its presence in peach and nectarine at the end of the ripening stage of the fruits, mostly in late-ripening cultivars. The incidence of *Monilinia* spp. infection varied among peach and nectarine cultivars, with significant differences observed between the Trident and Vertical Axis canopies. The highest infection levels in peaches were recorded in 'Gladys/GF677' (T) (10.2%), showing a progressive increase in disease incidence, particularly from 2022 to 2024. Similarly, 'Lucius/GF677' (Va) (9.5%) exhibited consistently high infection rates, and the lowest infection levels were in 'Royal Summer/SJA' (T) (3.5%) (Figure 14).

In nectarines, the highest infection levels were recorded in 'Nectareine/Adesoto' (Va) (7.4%), and the lowest infection levels were 'Caldessi2000/SJA' (T) (3.3%) (Figure 15).

Figure 14. *Monilinia fructicola* infestation in peach cultivars (2019-2024)

Figure 15. *Monilinia fructicola* infestation in nectarine cultivars (2019-2024)

For the Trident canopy, the lowest infection levels in peaches were observed in 'Red Top/M29C' (2.5%), which maintained relatively low disease incidence, and the highest infection levels were observed in 'Gladys/GF677' (10.2%). For the Vertical Axis canopy, the lowest infection levels were observed in 'Royal Jim/Adesoto' (4.5%), and the highest infection levels were observed in 'Lucius/GF677' (9.4%) (Figure 17). For nectarines, under the Trident canopy the most affected cultivars were 'Guerriera/SJA' (6.5%), the lowest infection levels was observed in 'Caldessi 2000/SJA' (3.3%), and for the Vertical Axis canopy, which exhibited a significant increase in disease incidence from 2022 the cultivars with the lowest infection levels were 'Guerriera/SJA', 'Necatross/SJA' (3.5%) and the highest infection levels was in 'Nectareine/Adesoto' (7.4%) (Figure 16).

Figure16. Incidence of *Monilinia* Infection in nectarine cultivars under Trident and Vertical Axis canopies (2019-2024)

Figure 17. Incidence of *Monilinia* infection in peach cultivars under Trident and Vertical Axis canopies (2019-2024)

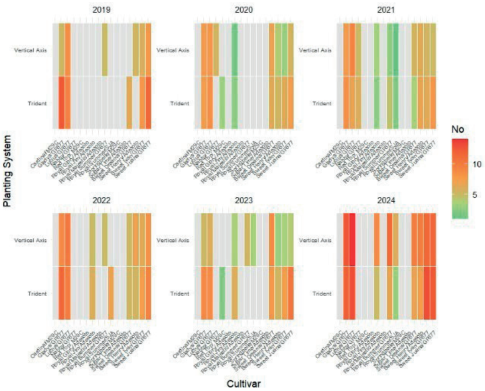

Figure 18. Yearly evolution of *Monilinia* infection in peach and nectarine cultivars under different training systems (2019-2024)

CONCLUSIONS

The study revealed the presence and variability of several diseases: *Taphrina deformans, Podosphaera leucotrica, Monilinia fruticola*, and pest: *Anarsia lineatella* generations attacks in peach and nectarine cultivars under natural infection conditions over the study period (2019-2024) (Rossi et al., 2007; Thomidis & Paresidou, 2023; Rossi et al., 2006). The intensity of disease and pest incidence was influenced by cultivar susceptibility, training system, and climatic factors, despite applying phytosanitary treatments (Zală et al., 2022; Costa et al., 2006). The increased shoot density and greater vegetative growth in the Trident canopy may have provided a more favorable microclimate for pest development and facilitated higher infestation levels for *Anarsia lineatella* attack. The presence of *A. lineatella* was detected across multiple cultivars, with 'Royal Summer/GF677' showing the highest infestation levels compared to the 'Royal Summer/SJA' overall. Moreover, the continued presence of *A. lineatella* in the second generation highlighted the importance of integrated pest management (IPM) strategies, including biological control methods, pheromone traps, and improved monitoring techniques (Abdahlla et al., 2024). The Trident system generally exhibited higher infection rates, particularly for *Taphrina deformans* and *Monilinia fruticola*, with cultivars such as 'Royal Summer/GF677' (peach), 'Big Top/GF677' (nectarine), and 'Gladys/GF677' (peach) being among the most affected. In contrast, the Vertical Axis canopy showed lower disease incidence, with cultivars like 'Nectaross/SJA' (nectarine) and 'Royal Summer/SJA' (peach) displaying greater tolerance. However, some cultivars 'Nectarine/M29C' and 'Lucius/GF677' recorded increased infection in 2024, suggesting the influence of environmental conditions and disease progression. For powdery mildew (*Podosphaera leucotrica*), the highest levels were recorded in 'Guerriera/SJA' (T) and 'Nectareine/M29C' (Va), while 'Nectagrand 1' (T/Va) exhibited the lowest incidence. Future disease and pest control measures should focus on: Adopting climate-resilient disease management techniques, particularly for *Monilinia* and *Taphrina deformans*; Enhancing IPM approaches for *Anarsia lineatella*, integrating biological control agents and cultural practices to reduce infestation levels sustainably.

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