

Comparison of organic apricot cultivation under different cultivation systems

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Abstract

Over six years (2020–2025) organic apricot cultivation under three cultivation systems (open field, seasonal rain cover, tunnel) was compared and frost damage, pest and disease occurrence, yield and fruit quality assessed. The rain covers (seasonal rain cover, tunnel) significantly reduced blossom monilia infections, especially in susceptible varieties such as Samourai, Orangerubis and Lilly Cot. The cover also offers protection against *Pseudomonas*, although the differences only become apparent several years after planting (six and more). The advantages of a year-round cover (tunnels) were even more significant than those of the seasonal cover due to the more comprehensive protection against diseases (*Monilinia* spp. and *Pseudomonas* spp.) and better options for frost prevention. One disadvantage of growing apricots under tunnel is the increased risk of infections with powdery mildew. Overall, organic apricot cultivation in tunnels can be a profitable solution for direct selling farms thanks to higher yields and better quality.

Keywords: organic apricot cultivation, weather protection, diseases, pests

Introduction

In the Northern part of Switzerland, apricot (*Prunus armeniaca* L.) cultivation has so far been of minor importance. The main constraints have been recurrent yield losses and tree mortality associated with fungal and bacterial diseases, particularly *Monilinia* spp. and *Pseudomonas* spp., under the region's comparatively cool and humid climate. Additionally, no plant protection products available in organic production have been shown to be effective against these diseases (Häseli & Stefani, 2019). Even under drier conditions of South-Western Switzerland, *Monilinia* spp. and *Pseudomonas* spp. are the two biggest challenges, and very few varieties have been shown to be economically viable under no-spray conditions (Christen 2021).

Despite these limitations, apricots represent a highly attractive fruit for direct marketing due to their strong consumer acceptance and potential to generate premium prices when harvested ripe for eating (Häseli & Stefani, 2019). For small- and medium-scale farms, this crop could thus offer opportunities for diversification and improved economic viability. In recent years, however, research has led to the development of more robust varieties and cultivation systems that promise to significantly reduce production challenges (Häseli & Stefani, 2019). Weather protection systems in particular have shown potential to improve tree health, yield security, and fruit quality, while minimizing the need for plant protection measures. Nevertheless, growers in the region remain cautious, as the establishment of such systems requires considerable investment, while empirical data under local conditions remain scarce, particularly regarding the yield potential and fruit quality of different cultivar–rootstock combinations, as well as pest and disease incidence under protected and unprotected cultivation systems.

To address these knowledge gaps, the Research Institute of Organic Agriculture in Frick conducted a six-year field study (2020–2025) comparing three cultivation systems (open

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field without rain cover, seasonal rain cover, and plastic tunnel, Figure 1) and systematically monitoring frost damage, pest and disease occurrence, yield, and fruit quality.



Figure 1: Comparison of three different cultivation systems: tunnel (year-round cover), open field (no rain cover), and seasonal rain cover.

Material and Methods

The apricot trees were planted at the Research Institute of Organic Agriculture (FiBL) in Frick (Switzerland, annual mean temperature 11.1 °C, annual mean rainfall 920 mm) in 2018 on Wavit rootstock (in tunnels with a Reine-Claude interstem) as one-year-old hand grafts and trained using the Drapeau system. The trees were managed organically. A total of 19 apricot varieties were tested; eight varieties were planted in all three cultivation systems (Table 1). Two replicates of three trees were planted in the tunnel, and two replicates of two trees were planted under the seasonal rain cover and in the open field. In addition, two grafting heights were tested under the seasonal rain cover: 20 cm (two trees) and 60-70 cm (two trees).

In the tunnel, plant protection treatments were limited to the control of powdery mildew, and in some years, selective treatments on single trees were carried out against aphids and scale insects. In the open field and seasonal rain cover systems, treatments were carried out to control blossom monilia and shot hole disease, and selectively also against aphids. Data on susceptibility to frost, diseases and pests, as well as yield, were collected over six years (2020–2025).

The plastic foil for the seasonal rain cover was spread over the trees before flowering (mid-February) and rolled up again in October after leaf fall, but before there was any risk of snowfall. Commercially available frost candles were used in the open field and rain shelter cultivation systems (approx. 600 per hectare) when there was risk of frost damage for flowers or fruits. A frost oven “MUMO” (Pelliheat AG, Switzerland) was used in the tunnel. This frost oven is heated with wooden pellets and has an integrated fan that generates a convection current, which distributes the warm air, therefore particularly suitable for systems that can be completely closed. Trees were irrigated with sprinkler under all three systems and fertilized with 60 kg N/ha pelleted fertilizer (Bioilsa, 11% N) in two applications (mid-March and mid-April).

Table 1: Number of trees per variety tested under the different cultivation systems.

Variety	Tunnel	Seasonal cover	Open field
ACW 4353 (Elsa)	6	4	4
ACW 4477 (Mia)	6	4	4
Bergeron	6	4	4
Flopria	6	4	4
Harogem	6	4	4
Lilly Cot	6	4	4
Orangerubis	6	4	4
Samourai	6	4	4
ACW 4527	6	-	-
Early Blush	6	-	-
Goldrich	6	-	-
Lady Cot	6	-	-
Précoce de Millet	6	-	-
Valla must	6	-	-
Vertige	6	-	-
Apribang	-	4	4
Bergarouge	-	4	4
Farely	-	4	4
Wondercot	-	4	4
Row distance	2.45 (middle rows) 1.80 (outside rows)	3.0 m	3.0 m
Tree distance	2.2 m	2.0 m	1.8 m
Tree density	2139 trees/ha	1667 trees/ha	1852 trees/ha

Results

Frost protection

In a year without heating, the seasonal rain cover and tunnel alone had no protective effect against frost damage as the percentage of flowers damaged was similar to the trees with no rain cover. In combination with heating, however, the rain cover helps to reduce frost damage. In 2022, frost damage was reduced from 62% in the open field to 18% under the seasonal rain cover and 1% in the tunnel when heating was used (assessment date 06.04.22). The tunnel provided a more comprehensive frost protection than the seasonal rain cover because it is completely closed at the sides, allowing the heat generated by the frost oven to be retained. Temperature measurements inside and outside the tunnel showed, that the pellet oven in the tunnel was able to keep the temperature in the tunnel above 0 °C for around 10 hours (overnight) at an outside temperature of -4 °C.

Monilia

Blossom monilia (*Monilinia laxa*) is, alongside Pseudomonas bacterial blight, the most important disease in organic apricot cultivation (Anselmo 2022). The fungus penetrates via the blossom and can lead not only to the death of the blossoms, but also of shoots and even large branches. Monilia infestation can vary greatly from year to year, depending on the weather. In years with wet weather during the flowering phase, such as in 2023, Monilia infestation was high in the open field, with up to 90 infested shoots per tree for the variety Samourai (Figure 2). A multi-year plant protection trial (2020–2024) showed that two to four

treatments with copper, sulphur and potassium hydrogen carbonate in the open field did not reduce the incidence of infection. Rain protection significantly reduced monilia: under the seasonal rain cover, there was about 50% less infected branches, and in the tunnel, about 90% less. Nevertheless, infections are also possible under covers, when air humidity is high. The varieties Samouraï, Orangerubis and Lilly Cot proved to be particularly susceptible.

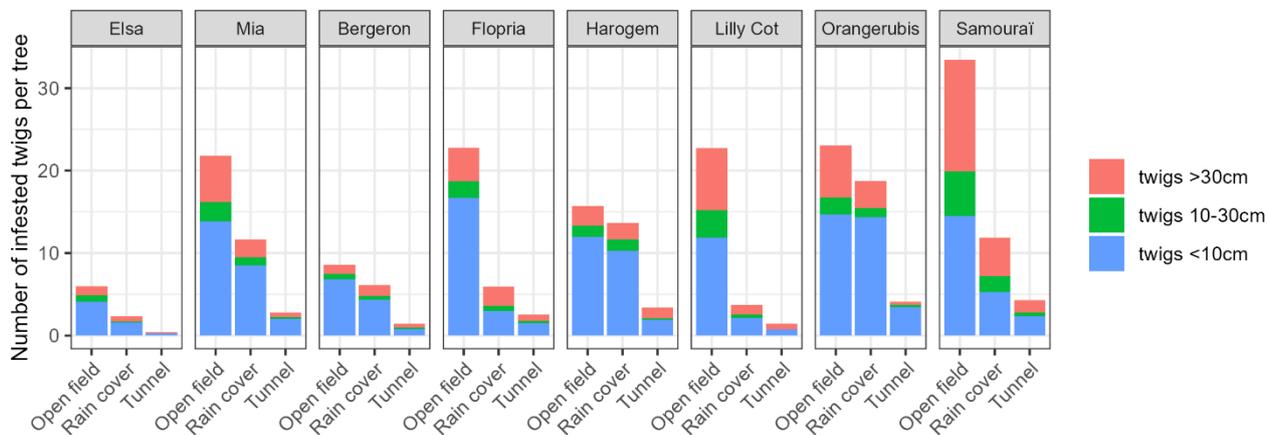


Figure 2: Average monilia shoot infestation of eight varieties in open field (no cover), under seasonal rain cover and under the tunnel 2020–2025. The infested shoots were divided into three size classes: shoots <10 cm, shoots between 10 and 30 cm and shoots >30 cm.

Shot hole disease, *Pseudomonas* spp., *Xanthomonas* spp.

Leaf spots (shot hole disease, bacterial spots caused by *Pseudomonas* spp. or *Xanthomonas* spp.) occurred more frequently in the open field, with significant infestation in the varieties Flopria, Lilly Cot and Harogem (score 3.5 out of 9). *Pseudomonas* bacterial canker occurred for the first time in 2024, with visible infestation in the variety Flopria in the open field (score 2.5 out of 9). The other trees remained free of infestation until 2025, so no differences between the systems and high or low grafting could be detected. However, it is expected that the tunnel provides a better protection against *Pseudomonas* spp. infections, as it also protects the trees all year round from rain, also in autumn and winter, when primary infections can occur, and not only during the season, when secondary infections can occur (Boutillier 2024).

Powdery mildew

The dry conditions in the tunnel favoured powdery mildew (*Sphaerotheca pannosa/ Podospaera tridactyla*) on fruits, with first symptoms appearing in 2020. Plant protection trials were carried out in 2022 and 2023. Three sulphur treatments every two weeks starting mid-April significantly reduced infestation in 2022 compared to the untreated control. The trial in 2023 showed that three treatments are needed and two are not enough, and there were significant differences between varieties (Figure 3). Under the rain cover, the infestation remained low, and in the open field, virtually all varieties were free of infestation.

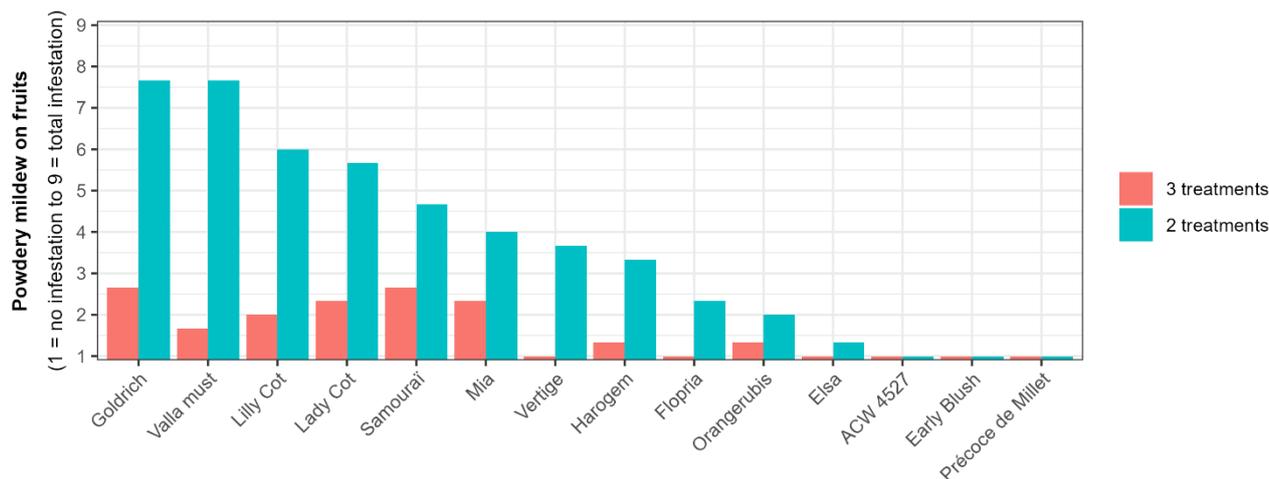


Figure 3: Powdery mildew infestation on fruits (1-9) of the varieties in the tunnel in 2023 in an experiment with 2 or 3 sulphur treatments.

Pests

In apricot cultivation, different aphid species appear at different times. The most important ones are the green peach aphid (*Myzus persicae*) in spring and the mealy plum aphid (*Hyalopterus pruni*) in summer. The former causes damage by severely curling the leaves, while the latter secretes honeydew, on which sooty moulds grow and impair fruit quality. The cover influenced the occurrence of aphids: in the open field, infestation with green peach aphids was higher, while under the rain cover, mealy plum aphids dominated. In the tunnel, aphid infestation was low to non-existent, which could be attributed to the release of beneficial insects in 2021, 2022 and 2024 (hoverfly pupae, lacewing larvae, ladybird larvae) and a flower strip established in autumn 2022. In the winter of 2022 and 2025, scale insects appeared sporadically on certain trees in the tunnel, which were successfully controlled with one paraffin oil treatment during budding.

Yield

The first fruits were harvested in 2020 (third leaf). Over the years, differences in yield started to show with the highest yield under tunnel, followed by the rain cover, and then the open field (Figure 4). Yields declined in the open field and under the rain cover after 2022 (fifth leaf), while they continued to increase in the tunnel. The yield differences between the three systems increased over the years, as the yield potential of the trees increases until they reach their final volume and full yield, and negative influences such as frost damage and diseases had a greater impact on tree vitality and thus yield potential. The differences in yields between the open field, seasonal rain cover and tunnel in 2024 (seventh leaf) were approximately 1:2:4. In addition, the proportion of non-marketable fruits due to fruit monilia, fruit spots (shot hole disease, bacterial spots caused by *Pseudomonas* spp., *Xanthomonas* spp.) (open field, seasonal rain cover) and bursting (open field) was higher in the open field and under seasonal rain cover than under the tunnel.

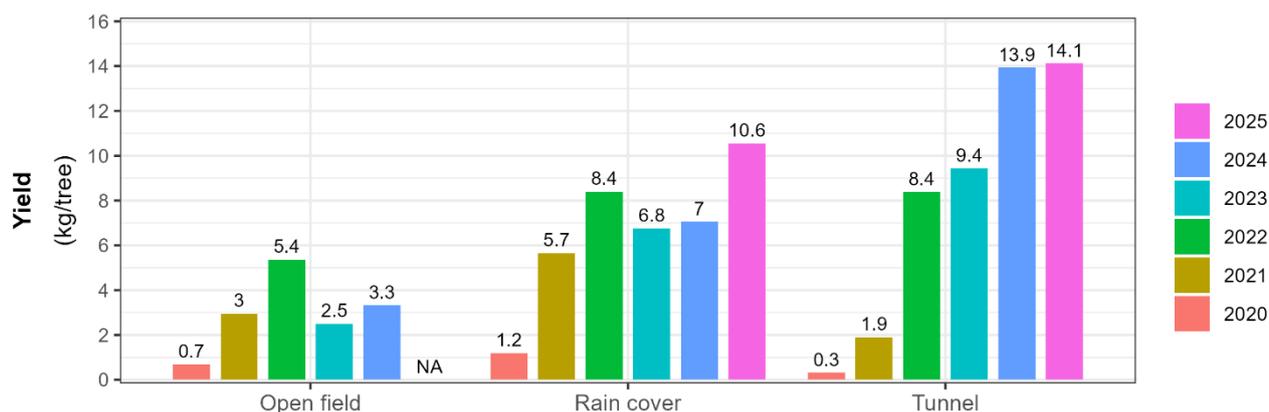


Figure 4: Average yields (kg/tree) of the varieties Elsa, Mia, Flopria, Harogem, Lilly Cot, and Samouraï (Orangerubis was replanted in 2019 and Bergeron did not establish well, therefore these varieties are not shown) for the three systems in the years 2020–2025. In January 2021, the tunnel collapsed due to heavy snowfall, damaging some trees and leaving the trees without rain cover for a long period of time, resulting in low yields in 2021. Yield was not assessed in 2025 in open field (no cover) as there were barely any fruits, and the few fruits were highly infested with diseases.

Discussion

The rain cover (seasonal rain cover, tunnel) significantly reduced blossom monilia infections, especially in susceptible varieties such as Samouraï, Orangerubis and Lilly Cot. The rain cover also offers protection against *Pseudomonas* bacterial canker, although the differences only become apparent several years after planting. The advantages of year-round cover (tunnel) are even more significant than those of a seasonal rain cover due to the more comprehensive protection against diseases (Monilia blossom blight and fruit rot, shot hole disease, bacterial leaf and fruit spots due to *Pseudomonas* spp. and *Xanthomonas* spp., *Pseudomonas* bacterial canker) and better frost protection. Yields under the rain cover and in the tunnel were higher than in the open field with no cover, and in the tunnel higher than under rain covers. One disadvantage of growing in tunnels is the increased risk of powdery mildew infections, therefore varieties with a low powdery mildew susceptibility should be chosen. The dry conditions under tunnel can also promote secondary pests such as aphids and scale insects, consequently a close monitoring of these pests is needed. Organic apricot cultivation in tunnels can be a profitable solution for direct selling farms thanks to higher yields and better quality.

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