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First experiences with almond cultivars in the Neckar valley under organic cultivation

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Abstract

In view of climate change, rising temperatures and increasing frequency of drought periods in Germany over recent years, the cultivation of drought-tolerant fruit species may gain growing importance. The cultivation of the sweet almond (Prunus dulcis) has a long tradition in Germany, especially in wine-growing regions, and may offer renewed potential under changing climatic conditions. The almond ranks among the most drought-tolerant fruit species and exhibits low soil demands. In recent years, the total area under viticulture has been declining in several traditional wine-growing regions, creating opportunities for alternative crops. Almond cultivation could therefore represent a promising and climate-resilient option for the re-use of these sites, particularly in regions prone to water scarcity. Consequently, in such areas, almond cultivation may serve as a valuable complement to existing fruit crops in organic commercial production systems.

This study aims to scientifically evaluate and compare the performance and suitability of a selection of modern sweet almond cultivars under conditions of certified organic fruit production, without the use of permanently installed supplemental irrigation. The experiment started at the Heuchlingen Fruit Research Station in 2023. First results of cultivar characteristics are presented, and further outlooks provided.

Keywords: Prunus dulcis L., almond, late-flowering cultivars, organic fruit production

Introduction

Due to structural changes in the wine market, the area under grapevine cultivation in the wine-growing regions of Baden-Württemberg has been steadily declining in recent years. While the future management of many of these abandoned vineyard sites remains unclear, almond (*Prunus dulcis* Webb.) cultivation may represent a viable alternative crop, provided that site conditions are suitable. One driver of this perspective is the development of super-high-density (SHD) orchard systems, which allow orchard management and harvesting techniques comparable to those used in viticulture (Miarnau et. al. (2013)).

The sweet almond is still largely unknown in commercial fruit production in Germany; historically, however, the almond itself has been cultivated for centuries in traditional wine-growing regions (Eisenbarth 2020). Locally known cultivars such as ‘Pfälzer Krachmandel’ no longer play any role in modern almond production. Analogous to the focus on late-flowering cultivars in apple breeding programs, delayed flowering has long been a major breeding objective pursued by several research institutes and has already resulted in the release of multiple agronomically optimized almond cultivars (cf. IRTA (2021), Socias i Company (2010)). Due to their delayed flowering time, the highly sensitive flowering and fruit set stages may be less exposed to frost-prone early spring periods. As a result of these breeding efforts, many cultivars now exist which could meet key agronomic requirements for cultivation in the wine-growing regions of southwestern Germany. However, the suitability of these cultivars under local conditions remains unclear due to a lack of prior experience, particularly with regard to yield performance and plant health characteristics under organic management.

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Material and Methods

The trial was planted in early 2023 on certified organic plots at the Heuchlingen fruit research station near the city of Heilbronn. The site is characterized by a mean annual temperature of 10.5 °C, approximately 700 mm of annual precipitation, and very fertile loess loam soils with soil quality ratings exceeding 70–80 points. The trees, supplied as two-year-old grafts on the GF677 rootstock, were planted in groups of five per cultivar. Where sufficient trees were available, some plots were planted in duplicate (e.g. 10 trees). The planting distance within the row was 3.5 m, with a row spacing of 4 m. The trees were assessed in 2024 and 2025 for phenological development (flowering time), fruit set, incidence of shot hole (suspected *Alternaria alternata*) disease symptoms, premature defoliation, and yield performance. The evaluations were carried out according to the guidelines of the German working group for fruit-growing performance tests (AK OL 2003). No plant protection applications were carried out, and fertilization was only done through the sowing of legumes during the winter months.

Results and Discussion

All cultivars tested have developed well at the trial orchard site since planting. However, they exhibited considerable variation with respect to flowering time, fruit set, initial phytosanitary observations (in particular shot hole symptoms), and yield performance. The highest fruit set and corresponding yields in 2023 and 2024 were recorded for the well-established French cultivar ‘Ferragnès’ as well as for the later-flowering cultivar ‘Lauranne ® Avijor’, which additionally showed high visual fruit quality in the uncracked shell. A similarly high fruit set and yield were observed for the late-flowering cultivar ‘Marinada’; however, this cultivar ripens only in late October or early November. As a consequence, in 2025 the nuts could not be released from the hull and therefore could not be harvested at marketable quality. The latest-flowering, self-fertile cultivars ‘Pentacebas’ and ‘Makako’ have so far shown a low fruit set, despite exhibiting a high density of flower buds. This phenomenon will be observed in the upcoming years. In both 2024 and 2025, shot hole symptoms were observed from early July onwards, with varying levels of severity among cultivars. In late June 2025, approximately 10–15% of the unripe fruits were cracked or damaged by birds or rodents, although the exact cause could not be clearly differentiated. This observation is consistent with reports from major almond-growing regions, such as Australia (Almond Board of Australia 2021), Spain, and California (Emlen 1937; Luck et al. 2013).

Overall, the results already demonstrate the general suitability of almond cultivation under the given conditions, especially with modern cultivars selected for late flowering. However, based on the observations to date, cultivar recommendations cannot yet be derived, as the trial will require additional years to generate sufficient experience. In addition to yield and fruit quality parameters, particular attention must be paid in the coming years to the susceptibility to fungal and bacterial diseases such as *Monilinia*, *Blumeriella*, *Alternaria*, and *Xanthomonas*, as well as to damage caused by pests, which are more difficult to control under organic management.

Overall, the first experiences indicate that almond cultivation and the currently available cultivars show good potential under the viticultural climate conditions of the Neckar Valley.

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