

## Towards a holistic and participatory approach to integrate flower strips in apple orchards

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### Abstract

*In a participatory project of fruit growers, researchers with expertise in entomology and organic fruit growing, vole control, and plant sociology developed a first concept for the establishment and management of narrow strips with flowering plants in the alley for the enhancement of aphid predators in orchards. In 11 environments it could be clearly shown that in orchards with flowering strips the abundance of aphid predators was significantly increased in comparison to orchards intensively mulched.*

*The experiences existing in German organic fruit growing reality gained in the BOELN projects Nr. 03OE178 and 06OE100 and the results of this project (DBU AZ 29250-34) were summarized in a brochure with recommendations for practice which is available for download.*

**Keywords:** functional biodiversity, flower strips, aphid antagonists

### Introduction

In 1986, an organic fruit grower in the Lake Constance region for the first time established strips with flowering plants in the alleys of his orchards (Kienzle, 1988). In the 90ies, several studies on flower strips in organic orchards to enhance functional biodiversity were published. However, this concept of habitat management has never been accepted in common fruit growing practice. Problems to manage vole control and/or mulching were mentioned as main obstacles.

Within the frame of the German working neton further development of organic fruit growing (BOELN-project 03OE178 and 06OE100) in 2006, a group of pioneer fruit growers and experts started to discuss new concepts for flower strips in orchards.

Based on these experiences, from 2012 to 2014 in a participatory project of pioneering practitioners, the Department of Applied Entomology of the University of Hohenheim, and experts for vole control and plant sociology, a new concept of habitat management to promote aphid predators in organic orchards in Southern Germany was developed.

### Material and methods

The studies were conducted in the years 2012-2014 in 16 organic orchards in Southern Germany. The establishment and management of strips of flowering plants in the alleys and their effect on the abundance of aphid predators were studied, using potted trees with colonies of green apple aphids as sentinels in coupled orchards with and without strips (Kienzle *et al.*, 2014). In total, 11 environments (orchard x year) were evaluated. Vole colonisation was estimated in all orchards. A new practicable grid method was developed and applied in the orchards with higher populations. Each grid was classified in the

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microhabitats tree line, traktor trace and flower strip. Presence or absence of voles was recorded by infestation signs, and categorized by magnitude.

## Results

### 1. Establishment and management of vegetation in the flowerstrips

Since the studies focused on enhancement of aphid predators, the establishment of plants attractive to this guild was previously tested. The following autochthonous plant species proved to be suitable for permanent establishment in orchards: *Achillea millefolium*, *Anthemis tinctoria*, *Carum carvi*, *Cichorium intybus*, *Crepis capillaris*, *Daucus carota*, *Galium album*, *Hypochoeris radicata*, *Geranium pyrenaicum*, *Leucanthemum ircutianum*, *Picris hieracoides*, and *Leontodon hispidus*. All these plants are growing spontaneously in the meadows of the regions investigated.

Flower densities in the permanent strips were not as high as in annual or biennial strips, however, the biodiversity of plants was always high.

A mulching regime with the first cut during the flowering period, the second cut at mid of July and the third cut before harvest seems suitable to delay the dominance of grass species in the weed strips. A first prototype of a special mulching machine adapted to the weed strips in the middle of the alley is actually tested.

### 2. Elaboration of a first concept for adapted vole management

Water voles (*Arvicola sp.*) colonised the orchards rarely and apparently rather independent from presence or absence of flower strips. Common voles (*Microtus arvalis*) settled strictly in flower strips and built narrow, drawn-out galleries whereas in orchards with intensively mulched vegetation the burrow systems had a broad range including machine tracks and tree lines. However, shelter for vole infestation is not only provided by vegetation but also by existing underground tunnel systems of voles and moles (*Talpa europaea*). In the orchards with narrow flower strips in the middle of the alley, vole control measures can be combined with mulching regime. Regardless of Water vole and Common vole infestation, control must be executed right after mulching to prevent shifting vole activity into the tree lines. Important dates for this are especially in midsummer and late autumn. These first experiences give hope that intelligent concepts for vole management can be combined with the flower strip management.

### 3. Abundance of aphid predators

In all 11 environments, the total number of aphid predators in sentinel trees were significantly higher in the orchards with flower strips compared to orchards with intensively mulched vegetation. Thus, it could be shown that also permanent flower strips with a rather low density of flowers are effective to increase functional biodiversity.

### 4. Risk of pest resurgence

A slight increase of leafhoppers in some orchards was observed. The occurrence of *Ceresa bubalus* was observed in two orchards, however without damage. *Amestategia glabrata* was not found in any orchard evaluated. However, the number of orchards and locations assessed is too low (28) to allow definitive conclusions on the probability of such damages.

## 5. Recommendations to practice

Based on these results and the German experiences gained in the BOELN-projects Nr. 03OE178 and 06OE100 first recommendations for the establishment and management of flower strips in orchards in Southern Germany were given in a brochure for practitioners.

There is still much work to do: The participatory approach to elaborate this tool should be continued with more orchards and more regions involved. Flower strips offer the opportunity to enhance both, functional and general biodiversity and to integrate aims of nature conservation in fruit production systems. These approaches must be tested and optimized in a large number of environments before reliable recommendations are possible. Organic fruit growing is a holistic system approach. This means, that aspects of soil melioration and a possible production of fertilizing material in the alleys must also be considered in the development of concepts for the vegetation management in the orchards.

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## Citation of the full publication

Brochure for practitioners: <https://www.uni-hohenheim.de/publication/bluehstreifen-mit-heimischen-wildkraeutern-in-apfelanlagen-zur-foerderung-natuerlicher-gegenspieler-von-blattlaeusen-1>

The citation of the full publication in scientific journals will be found on ecofruit website as soon as available.

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