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Short communication

# Effect of different practices enhancing biodiversity on pest and beneficial organism populations in organic strawberry and raspberry production

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## Abstract

*Three companion plant cultivation systems, i.e.: 1. flower strips (a mixture of flowering plants grown as one-sided patches adjacent to the outer part of the crop); 2. flower islands (the same mixture grown within the crop, as small patches in the plant rows); 3. cover crop in inter-rows (a dwarf variety of white clover), are being evaluated in organic raspberry and strawberry plantation. Factors studied include the impact on selected pest species, the size and species composition of beneficial insect population, the pollinator activity and diversity, the yield and its quality. Preliminary results indicate lower aphid pressure in raspberry in all companion plant treatments compared to the control. Also, each of the biodiversity-enhancing practices increased the abundance and diversity of pollinating insects out of strawberry blooming stage.*

**Keywords:** functional biodiversity, flower strip, flower island, cover crop, pollinators, beneficial entomofauna

## Introduction

A major problem that can limit the development of organic fruit production is the low number of solutions available for the effective pest control. Among agricultural practices that can address this issue there is the cultivation of companion plants (e.g. living mulches and cover crops), which facilitates crop protection in agroecosystems (Cohen, Crowder 2017) also providing important ecosystem services (Sigsgard et al. 2013, Campbell et al. 2017, Jacobsen et al. 2019). Although this practice has been quite well studied in fruit orchards (e.g., Cahenzli et al. 2019), results on its implementation in berry crops are still limited. A trial in organic strawberry and raspberry plantations has been established to evaluate and compare three biodiversity-based practices potentially facilitating pest management, i.e. flower strips or islands and cover crops. Their impact on both pest and beneficial organism populations and key fruit production indicators is being assessed.

## Material and Methods

The field trial was established in 2022 at the National Institute of Horticultural Research in Skierniewice (Łódź Voivodeship, 51° 95' N 20° 19' E). The experimental set-up is shown in Figure 1. Strawberries were planted at a spacing of 0.9 × 0.2 m, while raspberries were planted at 2.5 × 0.5 m. The 'Lycia' strawberry and 'Poemat' primocane-fruiting raspberry varieties were used in trials. For both crop species the following companion plant combinations were established: flower islands (*fi*), flower strip (*fs*) and cover crop (*nc*), each represented by a single plot of approx. 200 $m^2$ in size. In *fs* treatments, one-sided flower strips with a size of 2 × 20 m were sown along the longer edge of the plot. In *fi* treatments, two (raspberry) or four (strawberry) flower islands of 2 m length and row width were located in the central part of the plots, within the crop plant rows. In the *fs* and *fi* combinations, the same mixture of flowering plants containing annual (*Anethum graveolens*, *Tagetes* spp., *Lobularia maritima*, *Tropaeolum majus*, *Matthiola longipetala*) and perennial species

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(*Pulmonaria officinalis*, *Stachys officinalis*) was used. In the *nc* combinations, a dwarf variety of *Trifolium repens* was used as a perennial cover crop. In strawberry plots, the cover crop was established in every second inter-row, while in raspberry plots the clover was sown over the entire inter-row area. The cover crop is managed by three- or four-time mowing during the growing season. Distant, regularly weeded plots without companion plants are considered the control (*ct*) for each crop species.

The experimental plantation is managed in accordance with the organic fruit production principles. Manual weeding is used as a weed control method. Plant protection treatments are performed as needed, but no pest control products are used to prevent their potential impact on pest and beneficial organism populations studied.

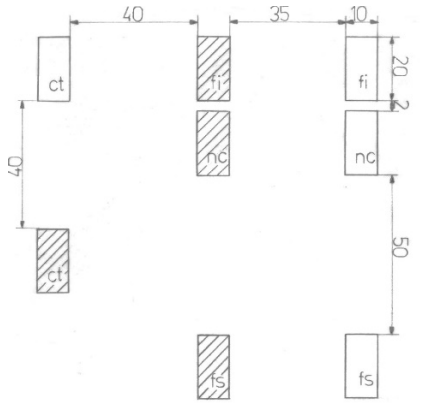


Figure 1: Experimental site plan (scale drawing). The hatched rectangles show raspberry plots, the empty rectangles show strawberry plots. Particular combinations are marked with letter symbols: *ct* – control, *nc* – cover crop, *fi* – flower islands, *fs* – flower strip. All dimensions are in meters

In the second year of the plantations, the aphid pressure on raspberry was measured on 9. June 2023 by counting the number of shoots infested per plant. Thrips population was assessed using blue sticky traps, positioned in the central part of each raspberry plot, at a height of approx. 30 cm above the plants. The abundance and diversity of pollinating insects out of strawberry blooming phase was determined monthly, from July till September, by moving in transects and counting for 8 min in each plot all insects visiting flowers of companion plants and weeds. The insects observed were assigned to four groups basing on their systematic classification, i.e. *Bombus*, *Apiformes*, *Syrphideae* and *Lepidoptera*.

## Results and Discussion

A decrease in aphid pressure in all companion plant combinations compared to the control was observed (Figure 2). This may be related to the higher activity of pest natural antagonists which is promoted by the ecological infrastructure providing beneficial entomofauna with shelter and feeding resources (Cohen, Crowder 2017), also documented in other studies in strawberry and raspberry crops (Hanni, Luik 2006 and Jacobsen et al. 2019).

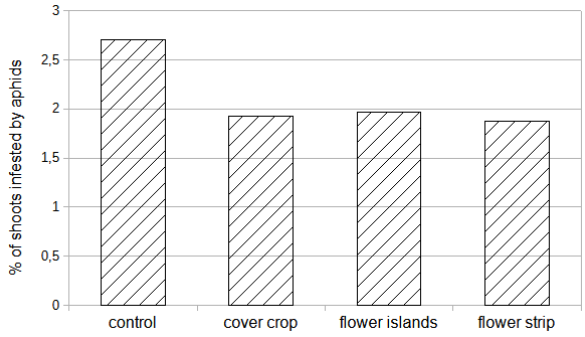


Figure 2: Percentage of raspberry shoots infested by aphids in 2023.

In 2023, abundant thrips population was observed in all raspberry trials, possibly driven by high temperatures during the growing season.

The number of thrips caught on blue sticky traps fluctuated widely over the three months of observations: the highest total number was recorded in the *nc* treatment (5516 individuals) and the lowest in the *fs* treatment (2023 individuals), about half that of the control or *fi* treatment (4172 and 4639 individuals, respectively). The result could be related to the vegetative growth of raspberry shrubs due to nitrogen release from clover or impact on raspberry volatilome, as its effect in modifying host-plant selection was effective in other cropping systems (den Belder et al. 2000).

The abundance and diversity of pollinating insects was higher in companion plant treatments compared to the control during all observations (Table 1), as found in other cropping systems (Campbell et al. 2017), and supporting the populations of different pollinator groups also in the period beyond the flowering of main crop species.

Table 1: Total number of pollinators counted in transects on three dates from July until September.

| | ***Bombus*** | ***Apiformes*** | ***Syrphideae*** | ***Lepidoptera*** |
|---|---|---|---|---|
| **control** | 3 | 1 | 6 | 7 |
| **cover crop** | 11 | 49 | 6 | 3 |
| **flower islands** | 6 | 4 | 10 | 11 |
| **flower strip** | 9 | 4 | 15 | 10 |

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## Citation of the full publication

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