

## Enhancing abundance of natural enemies in apple orchard using flowering strips

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### Abstract

*The selected nectariferous plant species were sowed into stripes between tree rows in apple orchard to increase biodiversity of agroecosystem. Influence of flowering plants upon the abundance of natural enemies was studied using transects. Higher occurrence of Syrphidae, Tachinidae, Ichnemuonidae and other species in established flowering stripes in comparison with conventional grass-covered rows was observed in the first year of trials.*

**Keywords:** orchard, natural enemies, flowering strips, biodiversity

### Introduction

Nature enemies play a key role in the effective pest control both in organic or IPM regimes and their suppression by chemicals can be source of problems in plant protection. One of the possibilities to enhance activity of predators and parasitoids in crops is to increase diversity of plant species (Andow, 1991). Higher plant species diversity influences nature enemies due to more favourable microclimate (Dyer & Landis, 1996), owing to presence of alternative hosts or prey in polyphagous parasitoids (MacLeod *et al.*, 2004) and due to production of nectar, pollen and honeydew (Wäckers, 2001, Winkler *et al.*, 2006). It has been confirmed a positive influence of nectariferous plants on the fitness of beneficials in a lot of studies (e.g. Heimpel *et al.*, 1997; Olson & Andow, 1998; English-Loeb *et al.*, 2003; Lee *et al.*, 2004; Berndt & Wratten, 2005). The aim of this study is to evaluate the effect of flowering strips on the predators in apple orchard. The first year results are presented in this paper.

### Material and Methods

*Location:* The trials were established in apple orchard situated in sugar beet growing area of the East Bohemia region with climatic features as follows: altitude 300 m, average temperatures 8°C to 9°C, rainfall totals vary from 250mm to 300mm per a year. The acreage of experimental plot was 2.7 ha (135 x 200 m).

*Crop:* Except dominating variety 'Melrose' the mixture of scab resistant cultivars ('Topaz', 'Rubinola', 'Karmina', etc.) are planted in the plot. Spacing of plantings was 4.5 x 1.8 m.

*Growing regime:* IPM; mating disruption against codling moth and leafrollers and selective insecticides against aphids within last 5 years; common fungicide treatments against apple scab, mildew and store diseases. 1 to 2 herbicide treatments in canopy strips per a year; strips between tree rows grassed and mulched 4 to 5 times seasonally.

*Experimental design:* In April 2009, the grass cover in three strips between tree rows was treated by glyphosate and the soil was cultivated cca after 4 weeks. The selected perennial nectariferous plant species were sowed into strips in late May 2009.

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Seeding amount for the both plant groups was 2g per 1m<sup>2</sup>. Herbs were 1x mowed at a high of 15 cm (June 2009). Spectrum of plants was assessed in autumn 2009 in randomly selected 1 square meters in 30 replicates (10 evaluations per each flowering strip). Frequency of perennial species found in squares was calculated. The evaluation of insect occurrence on herbs was started when the flowering plants appeared in established strips. The evaluations were carried out using transects in one week intervals from July 30 to October 2, 2009. To compare the effect of plant introduction on natural enemies the same evaluations were done in standard 3 grass covered rows situated between flowering strips. Arrangement of trial variant is shown in Figure 1. Differences between trial variants were tested using Duncan's test,  $p \leq 0.05$ .

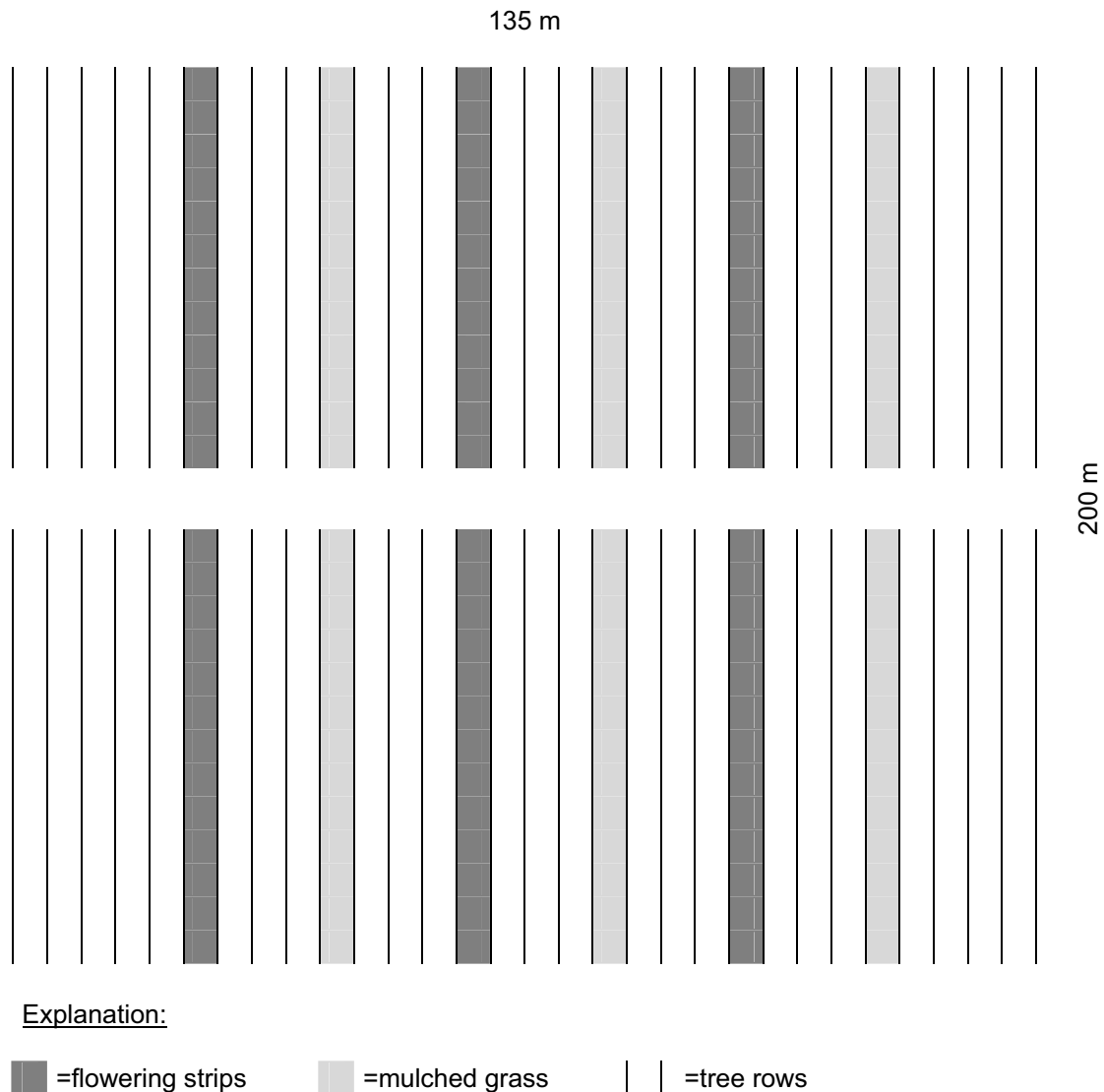


Figure1: Arrangement of trial variants.

## Results

### 1) Evaluation of plant species spectrum.

The most frequent species observed in squares were *Anthriscus silvestris* (100%), *Sanguisorba minor* (93%), *Achillea millefolium* (90%), *Daucus carota* (80%), *Silene vulgaris* (80%), *Trifolium arvense* (73%), *Lotus corniculatus* (70%), *Arabis glabra* (70%). On the contrary, to the less frequent species belonged: *Hesperis matronalis*, *Hypericum perforatum*, *Chrysanthemum album*, *Vicia cracca*, etc. (Table 1) Several of sowed species (*Ballota nigra*, *Coronilla varia*, *Malva alcea*, *Picris hieracioides*, *Saponaria officinalis*) was not found in evaluated squares. This herb spectrum was a result of seed composition and of the weather conditions in the experimental season.

Table 1: Frequency of plant species in 30 randomly selected squares (species in columns listed in descending order according to their frequency).

| FREQUENCY OF SPECIES         |                              |                                    |                             |
|------------------------------|------------------------------|------------------------------------|-----------------------------|
| ≥70%                         | 20-70%                       | 10-20%                             | <10%                        |
| <i>Anthriscus silvestris</i> | <i>Malva moschata</i>        | <i>Prunella vulgaris</i>           | <i>Epilobium montanum</i>   |
| <i>Sanguisorba minor</i>     | <i>Plantago major</i>        | <i>Scrophularia nodosa</i>         | <i>Euphorbia esule</i>      |
| <i>Achillea millefolium</i>  | <i>Centaurea jacea</i>       | <i>Origanum vulgare</i>            | <i>Knautia arvensis</i>     |
| <i>Daucus carota</i>         | <i>Leontodon hispidus</i>    | <i>Poaceae</i>                     | <i>Agrimonia eupatoria</i>  |
| <i>Silene vulgaris</i>       | <i>Salvia pratensis</i>      | <i>Pseudolysimachion maritimum</i> | <i>Hesperis matronalis</i>  |
| <i>Trifolium arvense</i>     | <i>Galium album</i>          | <i>Stachys germanica</i>           | <i>Hypericum perforatum</i> |
| <i>Arabis glabra</i>         | <i>Galium verum</i>          |                                    | <i>Chrysanthemum album</i>  |
| <i>Lotus corniculatus</i>    | <i>Onobrychis viciifolia</i> |                                    | <i>Vicia cracca</i>         |
|                              | <i>Plantago lanceolata</i>   |                                    |                             |
|                              | <i>Taraxacum officinale</i>  |                                    |                             |

### 2) Evaluation of beneficial and other insects.

The most abundant species or families were Syrphidae, Tachinidae and also Ichneumonidae. Differences between variants were obvious and statistically significant ( $p=0,05$ ). Other presented nature enemies (Asilidae, Coccinellidae, Anthocoridae, Braconidae, *Chrysopa* spp.) were observed sporadically and statistical evaluation was not possible due to lack of data.

Table 2: Total number of natural enemies in flowering strips and rows with mulched grass recorded during 9 transect evaluations in season 2009.

| Nature enemies                   | Flowering strips | Mulched grass |
|----------------------------------|------------------|---------------|
| Syrphidae                        | 1693*            | 42            |
| Asilidae                         | 2                | 0             |
| Tachinidae                       | 404*             | 8             |
| <i>Coccinella septempunctata</i> | 2                | 5             |
| <i>Harmonia axyridis</i>         | 1                | 2             |
| Anthocoridae                     | 1                | 0             |
| Ichneumonidae                    | 43*              | 15            |
| Braconidae                       | 2                | 0             |
| <i>Chrysopa</i> spp.             | 2                | 1             |

\*) Differences between variants were statistically significant at  $p=0.05$  (Duncan's test)

## Discussion

The presented 1-year results confirm the evident differences between common grassed strips and the proposed regime with flowering herb species upon the presence of Syrphidae, Tachinidae, and Ichneumonidae species. This finding corresponds to general conclusions in cited literature. All species found in these experiments are known as the key factors in functional biodiversity of orchard, however, more detailed and long term study will be necessary in future to confirm the impact of proposed measure in orchard on the pest control effectiveness. In addition, spectrum of natural enemies was probably linked to the composition of herb species from which *Anthriscus silvestris*, *Saguisorba minor*, *Achillea millefolium*, *Daucus carota*, *Trifolium arvense*, *Arabis glabra* and *Lotus corniculatus* were most frequent.

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