Evaluation and improvement of measures for the enhancement of biodiversity in German organic orchards

J. Kienzle[1], A. Krismann[1], M. Zimmer[1], F. Eisenreich[1], E. Haseloff[1], C.P.W. Zebitz[1], J. Berger[1] and B. Benduhn[2]

Abstract

As part of a German project started in Juli 2016 funded by the German Federal Agency for Nature Conservation and six federal states, measures to enhance the biodiversity in organic orchards are tested in six German regions. In twenty farms plots or orchards with a standard set of measures, e.g. flowering strips in the alley and at the borders, shrubs at the top of each second row, are compared with control plots without these measures. Additionally, experience with such measures is gained in on farm tests without control plots.

In the year 2017, 61 organic fruit farms participated in the project with a total acreage of 99 ha. In the year 2018, the number of participating farms and the surface will increase considerably. In the standard evaluation, in 2017 in most regions the flowering strips sown in autumn 2016 or in spring 2017 established successfully. First results in some regions show a positive effect of these strips on the attraction of aphid predators from adiacent habitats.

Keywords: biodiversity, flower strips, predators

Introduction

The idea to implement measures to enhance biodiversity in orchards was discussed since the first pioneers started the conversion of their orchards to organic farming.

However, most measures recommended in the literature have never been really accepted in common practice of organic fruit growing. The risk of an increasing population of voles or of new pests such as *Ametastegia glabrata* and management problems of the intended measures, as flowering strips in the alleys, did not allow the introduction in practice.

Within the frame of the German working net on 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 to enhance the biodiversity in their orchards. Farmers realized the loss of flora and fauna in agricultural environment and their concepts aim to enhance not only the population of predators but also the general biodiversity in their orchards.

A project funded within the framework of the Federal Programme for Biological Diversity by the German Federal Agency for Nature Conservation with recources from the Federal Ministry of the Environment, Nature Conservation, Building and Nuclear Safety and started in July 2016 has two subprojects: One for IPM-farmers and one for organic farmers. It is focused on measures to enhance biodiversity in orchards. The organic subproject aims towards the evaluation and improvement of these measures in a participatory process with the organic fruit growers organized in FOEKO in the main fruit growing regions of Germany and in close cooperation with scientists experienced in different scientific disciplines. At the end of the evaluation, a catalogue with evaluated measures, which can be integrated in the organic fruit growing system to enhance biodiversity will be published.

[1] University of Hohenheim, Institutes 320 and 360, D-70593 Stuttgart, mail jutta@jutta-kienzle.de
[2] OEON e.V., Moorende 53, D-21635 Jork

Material and Methods

The on farm studies are conducted mainly in six fruit growing regions in Germany: Southern region with the areas Lake Constance, Neckar valley and Baden, the regions Rhine valley, Northern Germany and Saxony.

In each region five farms participate in the standard evaluation with two comparable orchards of almost 1 ha or with two plots of the same orchard with a distance between the plots of at least 100 m. In one orchard/plot a standard combination of measures to enhance biodiversity is tested, the other plot serves as "untreated control".

The combination of measures includes:

- Flowering strips in the alleys
- Flowering strips at the border
- Shrubs at the top of each second row (*Euonymus europaeus, Viburnum opulus, Ligustrum vulgare*)
- Nest boxes for different species of wild bees and birds

It is intended to cut the **flowering strips in the alleys** 2-3 times a year, the rest of the vegetation in the alleys is mulched more often. For this purpose, special mulching machines (HUMUS OMB, Maschinenfabrik Bermatingen) were acquired in each region that allow to leave the strips unmulched if necessary.

In these strips, actually the following plant species are tested using certified autochthonous seed for their successful establishment in the strips in the different regions: *Achillea millefolium, Alchemilla xanthochlora, Campanula patula, Campanula rapunculus, Carum carvi, Cichorium intybus, Crepis biennis, Crepis capillaris, Daucus carota, Euphorbia cyparissias, Galium album, Hypochaeris radicata Geranium pyrenaicum, Knautia arvensis, Leontodon hispidus, Leucanthemum ircutianum, Lotus corniculatus, Malva neglecta, Medicago lupolina, Medicago sativa (*cultivated species*), Picris hieracioides, Prunella vulgaris, Salvia pratensis, Sanguisorba minor, Silene vulgaris, Trifolium dubium, Trifolium pratense.*

The **flowering strips at the border of the orchard** are intended to be mulched only once a year at the end of the vegetation period.

In these strips, actually the following plant species are tested using certified autochthonous seed for their successful establishment in the strips in the different regions: *Achillea millefolium, Agrimonia eupatoria, Anthemis tinctoria, Aquilegia vulgaris, Barbarea vulgaris, Borrago officinalis, Campanula glomerata, Carum carvi, Centaurea jacea, Centaurea nigra, Chaerophyllum aureum, Cichorium intybus, Clinopodium vulgare, Crepis biennis, Dianthus carthusianorum, Echium vulgare, Filipendula vulgaris, Foeniculum vulgare, Galium album, Galium verum, Helianthemum nummularium, Hypericum perforatum, Isatis tinctoria, Knautia arvensis, Leontodon hispidus, Leucanthemum ircutianum, Lotus corniculatus, Malva alcea, Malva moschata, Medicago sativa, Melilotus albus, Mentha longifolia, Oenothera biennis, Onobrychis viciifolia, Origanum vulgare, Pastinaca sativa, Reseda lutea, Reseda luteola, Salvia officinalis, Saponaria officinalis, Scabiosa columbaria, Scrophularia nodosa, Silene dioica, Stachys recta, Stachys sylvatica, Tragopogon pratensis, Trifolium pratense, Valeriana officinalis, Verbascum densiflorum, Verbascum lychnitis, Verbascum nigrum, Verbena officinalis.*

The species *Centaurea cyanus, Matricaria recutita, Papaver rhoeas, Sinapis arvensis (wild species), Fagopyrum esculentum* (cultivated species),*Calendula officinalis,* (cultivated species) *and Lepidium sativum* (cultivated species) were added in both kinds of strips to provide a flowering aspect from the start and to protect the surging of the seedlings.

The measures are evaluated from an **agronomic point** of view regarding their effect on the enhancement of beneficial arthropods or of undesired species. For the development of a concept for a feasible vole and vegetation management the occurrence and abundance of voles is assessed.
Furthermore, the success of the measures regarding the enhancement of biodiversity in the orchard is evaluated using several key species as indicators.

In addition to the orchards under the standard evaluation a growing number of organic fruit growers participate in the project in on farm trials without control plots. These trials are only assessed extensively and aim to gain more experience with the different measures, to contemporaneously introduce them gradually into practice and to explore individual ideas of the fruit growers.

Results and Discussion
In the year 2017 61 organic fruit farms participated at the project with a total surface of 99 ha. In the year 2018, the number of participating farms and the surface is increasing considerably. This shows the high interest of German organic growers for this topic.
In the standard evaluation, in 2017 in most regions the flowering strips sown or in autumn 2016 or in spring 2017 established successfully. First results in some region show an effect of these strips on the attraction of aphid predators from the surroundings. However, it is too early to observe any effects on their establishment in the orchards. First experiences with integrated vole and vegetation management strategies are promising and will be explored further in the following years.

Acknowledgement
The Authors like to thank the German Federal Agency for Nature Conservation, the Federal Ministry of the Environment, Nature Conservation, Building and Nuclear Safety and the Federal states of Baden-Württemberg, Hamburg, North Rhine Westphalia, Rhineland-Palatinate, Saxony and all organic fruit growers that engage in the project.