

Biodiversity in orchards and conclusions for practical application – an overview about selected studies

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Abstract

During the last years various measures for increasing biodiversity in orchards were investigated concentrating on flower strips, flower areas, hedges and nesting boxes for birds and bees or a combination of these measures.

The aim of this literature study was to get an overview about selected studies and projects, summarize the main results with regard to increasing biodiversity in orchards and suitability for establishing the measures in the orchards.

An overview on research on flower strips, flower areas using different flower mixtures including annual or perennial species, methods of establishing the strips, maintenance works and the effects on biodiversity is given in the paper.

The studies are supported with knowledge, work or money by Universities, fruit growers and their associations, nature conservation associations, business stakeholders, governments or EU and in most cases a combination of different partners.

The main objectives differ in the studies. Promoting or increasing biodiversity or especially functional biodiversity in orchards thus recording flora and selected fauna is part of the research done. The main focus can be on insects in general, beneficial insects or pollinating insects or on birds. Practical guidance for fruit growers to increase biodiversity with suitable measures which can be established in the orchards should be one result.

Keywords: orchard, biodiversity, flower strips, seed mixtures

Introduction

As recently published studies show, there is a general decline in biodiversity. There are several reasons for this. In the 1960s, Stern et al. (1959) and Tischler (1951) recognized the consequences of the intensification of agriculture in terms of species loss. Stern et al. (1959) developed "Integrated Plant Protection". This was followed by further considerations on plant protection with regard to the environment. But other activities also demonstrated the efforts to conserve biological diversity. This became particularly clear at the political level with the "Convention on Biological Diversity" in Rio de Janeiro in 1992. The need to protect biodiversity was realized and agreements were established resulting in activities on different levels.

Fruit production taking into account the protection of biological diversity and at the same time reach secure yields and satisfy the needs of consumers is a challenge.

During the last years various measures for increasing biodiversity in orchards were investigated concentrating on flowering strips, flowering areas, hedges and nesting boxes for birds and bees or a combination of these measures.

The aim of this literature study was to get an overview about selected studies and projects, summarize the main results with regard to increasing biodiversity in orchards and suitability for establishing the measures in the orchards.

In this paper an overview on research on flower strips, flower areas using different flower

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mixtures including annual or perennial species, methods of establishing the strips, maintenance works and the effects on biodiversity is given.

Material and Methods

This study is based on a literature review on selected investigations about biodiversity in orchards including scientific or more practical studies and projects with different aims and partners using different methods with different duration of the observations. The results of the studies are often not published in scientific papers but in form of reports and not in any case with all results or detailed description of material and methods. It was decided to include these reports to get an overview about the work already done on this topic.

Results and Discussion

Studies were done in organic and integrated orchards and sometimes meadow orchards. Some of the studies include different aspects for example different kinds of flower areas and methods for supporting wild bees (Herrmann & Martz 2017, Ockermüller 2018).

Taking the main focus on flower areas the aspects of establishing the areas or strips, further cultivation, seed mixtures or the effect on biodiversity regarding different kinds of insects are investigated. Most of the intensive investigations run for three years.

Flower areas can be established on headland or on the edges of the orchards. Flower strips can be created in the tramline. In any case a good preparation of the seedbed by repeated milling of the soil is a necessary requirement for the successful establishment particular for perennial flower areas (Kienzle et al. 2014). Perennial flowering areas should only be mown once or twice a year and the mulch material should be removed. In order to achieve high species diversity strips in the tramline should be mown alternately to give the predominant fauna in the flowering areas the opportunity to migrate (Tischler 1951, Kronenbitter & Oppermann, 2013, Trötschler, 2015, Ockermüller, 2018). Flower areas in the tramlines should be mowed before insecticide application, but also not less than every five weeks (Trötschler 2015).

Annual flower mixtures are mainly used at the edges of the orchards or on headland. The seed mixtures are usually a composition of cultivated plants like buckwheat, sunflower, phacelia and borage for flower visiting insects or seed mixtures including not native plants or plants with double flowers usually between six and eleven species. Regarding flower visiting wild bees investigations often reveal high numbers of individuals but less species compared to perennial flower areas. In these investigations no differences between the seed mixtures could be found (Herrmann & Martz 2017). In annual flower strips at the edge of a leek field and in a tramline Esser (2016b) found in July and August insects of nine different orders including wild bees, butterflies or hoverflies. Annual flower mixtures are unsuitable for insect species that have annual and perennial development cycles or wish to spend the winter in the flowering areas. They can act as an ecological trap, as many insects use the flowering areas for their reproduction and overwintering. Data of Esser (2016b) show, that single phytophagous species with a shorter development and more generations per year can use the annual flower strips for successful reproduction and so biomass increases and offer food for birds.

In most investigations perennial flower mixtures are used. There are different seed mixtures usually a composition of 30 to 60 species preferable native species. These species often have a disadvantage towards grasses and faster growing weeds like dock or thistle or cultivated plants as they grow slower and successful establishment may be difficult, depending also on the species (Kienzle et al. 2014). The aim is to achieve a continuous flowering from spring until late summer to serve as an important food source also for early

flying insects like wild bees. The diversity of insect species is closely linked to the plant species available in the area. In all the evaluated studies in this paper, insect diversity is associated with a high plant diversity of the flowering areas (Herrmann und Martz, 2013; Trötschler, 2015; Campbell et al., 2017; Herrmann & Martz, 2017; Föll et al., 2015; Esser, 2016a; Herz & Mátray, 2018). The high number of insect individuals and the associated occurrence of parasitically living wild bees are also pointed out (Esser, 2016a; Herrmann & Martz, 2013). Particular for flower strips in the tramline the further cultivation can have an effect on the diversity of the plants as not all species are mulch tolerant (Föll et al. 2015). The flower forms of the plants found in the flower mixtures have an influence on the composition of the insect species found in the flowering areas. Open nectar plants, for example umbellifers, usually host beneficial insects. Hidden nectar plants, such as various types of clover, are attractive for pollinating insects (Campbell et al., 2017). Witt (2013) points out that for example threatened wild bee species in particular find their food in native species. These results could be used to improve flower mixtures taking also in account soil type, nutrient supply or light conditions. Flower mixtures with certified regional seeds should be selected if available.

Regarding flower areas, the following influencing factors on biodiversity can be described: lifetime of the flowering areas, seed composition, soil preparation, mowing, cross-linking and crop management. The promotion of biodiversity should always be seen in the context of the existing ecological structure. A combination of different supporting measures is of ecological advantage. If, for example, wild bees are to be promoted, it is not sufficient to set up nesting aids; food sources must also be available in nearby. Individual measures only make sense if a well networked ecological structure already exists. Well connected habitats increase the biological diversity in the orchards. For the future, improvements should be created to network habitats in order to promote and conserve biodiversity. The focus should also be on the surrounding structures of the orchards. The probable negative influence of mice and the costs for establishing and maintaining different measures should be part of further investigations.

The projects and investigations are the result of a combination of government, science and practice. For the future it would be important to increase the financial resources for projects and studies for the conservation and promotion of biological diversity.

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