

Plant protection products in field margins and exposure of beneficial insects

Measures and method/work description

1) Mapping the spread of plant protection products to margin vegetation during spraying in apple orchards

The survey will be carried out in established fruit-growing areas that are representative of Norwegian apple production and will capture any differences resulting from management practices, soil conditions, and weather conditions. Relevant locations will be identified in consultation with NIBIO Ullensvang. It will, among other things, be relevant to use the same fields that are being investigated in the project “Plant protection products in the aquatic environment in fruit-growing areas and impacts on biological parameters” (2022/75059, Agros 209889). We plan to collect samples of air, vegetation, and topsoil in field margins/flower strips over two growing seasons in three to four apple orchards, all located in Western Norway (Hardanger).

Air

Spraying in apple production may lead to more spray drift and higher exposure than spraying in other crops, in addition to the fact that apples are sprayed repeatedly throughout a season and also more often with insecticides. It has been shown that exposure over time may be the most important factor for the effects observed in insect populations (Henry et al., 2012; Milford et al., 2021), so air samples will be collected using passive samplers to provide a picture of the average exposure in air over a season. These samplers must remain outdoors for a long period, at least one month (Anne Karine Halse, NILU, 2021, pers. comm.), to ensure that enough air passes through them. Such samplers often consist of polyurethane foam (PUF) (Bidleman and Melymuk, 2019; Hayward et al., 2010). To capture the direction of any spray drift and ensure representative samples, we will set up 4–5 such samplers at the edge immediately surrounding each orchard. The samplers will remain outdoors throughout the season, i.e. they will be installed before spraying begins and collected after the final treatment has been completed.

Soil and vegetation

Sampling of topsoil (0–10 and 0–20 cm) and vegetation in field margins will take place at regular intervals throughout the growing season to provide insight into whether and where the plant protection products are present in the field margins, as well as variation in exposure over a season. It will be relevant to take samples in early spring, early summer, mid-season, and early autumn. Depending somewhat on the width of the field margins, sampling will be carried out approximately 0.5–1 metre into the margin.

Analyses and method development

Necessary method development/optimisation of chemical analytical methods will be carried out in NIBIO’s laboratories for the various sample types to be analysed (sorbents for air samples, soil, and plant material). We will build on already established methodology for soil and plant samples, and for analyses of air samples we will use experience with different sorbents for sample preparation in consultation with colleagues at NILU.

2) Mapping variation in beneficial insect population(s) in margin vegetation near sprayed orchards and analysing plant protection product levels in the insects

Insect traps (“pan traps” and “vane traps”) will be set up to investigate hoverfly populations in the field margins of the selected apple orchards (in the flower strips where these are present). The hoverflies will be identified to species and counted in order to say something about species diversity and distribution/abundance. This can be compared with previous and ongoing studies to describe which species communities are typically found in such field margins (the Research Council of Norway projects APPLECORE and GreenRoad). In addition, a number of the insects will be analysed together for plant protection products to determine which substances and concentrations the insects are exposed to. The procedure for these analyses will be based on work already carried out in the Action Plan-funded project “Pollination in fruit growing – effects of vegetation and plant protection products on pollinating insects” (completed in spring 2022), in which bumblebees and bees were analysed for the neonicotinoid thiacloprid. The methodology includes miniaturised sample preparation adapted to small sample amounts/single insects and analysis by liquid chromatography coupled with mass spectrometry (LC-MS/MS), and it is established in NIBIO’s laboratories. Necessary methodological adaptations will be made to include a selection of currently relevant plant protection products used in apple production.

3) Recommendations for improved protection of margin vegetation and habitats for beneficial insects

The results will provide a picture of how field margins and the beneficial insects living there are exposed to plant protection products throughout an entire growing season. The data will be used to assess what effects this may have on these insects, whether the risk-reducing measures used in the tested orchards work as intended, and/or whether there may be a need for additional measures. Support is provided, among other things, for the establishment of flower strips in agricultural areas, but if exposure to plant protection products is high in these strips, their usefulness may be questioned.

In the experimental design and interpretation of results in this project, we will take into account knowledge about drift-reducing measures that has emerged from previous projects funded under the Action Plan, including the NODRIFT project. We will also build on knowledge about sustainable measures in agricultural landscapes to ensure diversity of pollinators and other beneficial organisms in Norway, generated by an ongoing project on Integrated Plant and Pollinator Protection (IPPV) funded through NIBIO’s Future-Oriented Research Programme (2022–2024). In this programme, NIBIO will study IPPV through the establishment of flower strips in comparison with natural margin vegetation as a measure in cultural landscapes in several parts of the country, and this project will be able to complement the findings from the IPPV work.

Under this part of the project, we will also include input from and discussions with the industry, including subject coordinators and advisers in NLR, fruit growers in the study areas, other relevant industry actors, and the public administration. More specifically, the project results will be linked to plant protection plans in fruit growing in general, where spray timing and the availability/lack of alternative measures are relevant to the likelihood of exposure.

Plan for information and dissemination of results

The project results will be compiled in a NIBIO report and presented in short form in a NIBIO POP/article in the journal *Frukt og bær*, and as a feature article on NIBIO’s webpages on integrated pest management and IPPV. In addition, the results will be presented to users and the

public administration in relevant forums, including NLR professional meetings in the fruit-growing regions. Workshops are also planned at the beginning of and toward the end of the project, with participation from, among others, NLR, growers, agricultural authorities, and NIBIO.

Progress plan

The project is planned to be carried out over a period of 2.5 years, since field experiments/data collection must be conducted throughout 2024 and 2025. Necessary chemical analyses will be carried out in the autumn after each season. This is time-consuming work, and time will probably be needed in the first half of 2026 for final reporting and presentation of the final results.