

Assessment of alternative plant protection measures by farmers

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Abstract - In the PestiRed resource project, Swiss farmers, advisors and researchers are working together with the aim of reducing the use of plant protection products in a six-year crop rotation in arable farming. This is to be achieved through the consistent use and further development of integrated pest management. Farm managers are surveyed annually to assess the measures used with regard to their effectiveness and economic efficiency. The first results show effective measures to reduce the use of plant protection products. Farmers assess the economic efficiency of the measures implemented mostly also positive.

INTRODUCTION

The project PestiRed aims to significantly reduce the use of plant protection products (PPP) in arable farming through the consistent implementation and further development of integrated pest management practices. Reducing the risks associated with the use of PPPs is a political goal that is set out in Switzerland's national action plan (Bundesrat 2017) with specific requirements.

In this project, which is mainly funded by the Swiss Federal Office for Agriculture within the framework of the "resource program" (BLW 2022), 68 arable farms from three cantons, the regional agricultural extension services and researchers from various Agroscope departments are working together.

The project works with a co-innovative approach. Knowledge and experience flow from practice and consulting to research and vice versa. The three groups of actors closely exchange information in the project and further develop the project together and optimize the measures.

Through the application of alternative plant protection measures, the use of PPP, measured by the treatment frequency index, is to be reduced by 75%. At the same time, the economic efficiency should not be reduced by more than 10%.

The farms can apply various alternative measures (see Figure 1 and for details on the measures <https://pestired.ch/de/measures>): five basic measures are implemented by all farms and additional measures are selected from 15 specific measures on a regional and farm basis. Each farm uses these measures on a so-called innovative plot to reduce PPP use as far as possible. This plot is compared to a control plot, which is farmed as usual with the same crop. Regionally defined six-year crop rotations will form the framework of the final analysis.

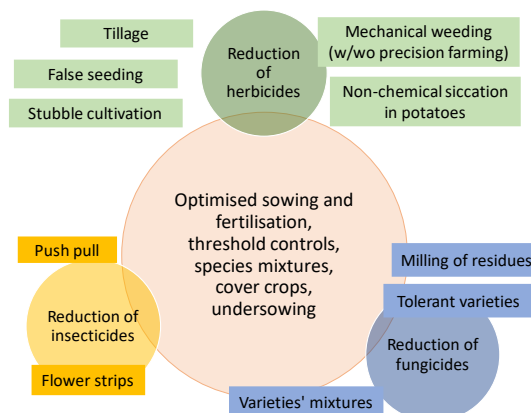


Figure 1. Plant protection measures in the project PestiRed and their expected impact on PPP use.

This article presents first results from the socio-economic research accompanying the project: How do farmers evaluate the measures they apply in terms of their costs, their potential to reduce the use of PPP and their economic efficiency?

METHODS

Farmers' experiences with the different alternative plant protection measures are collected each autumn via an online questionnaire. The farmers provide information on the crop and select the measures applied.

The measures are evaluated on 7-point Likert scales with regard to costs, economic efficiency, their plant protection effect, their effect on yield quantity and quality, their potential to reduce PPP use and to reduce health and environmental risks. In addition, the question is asked whether experience has already been gained with the measures and how professional colleagues reacted to the implementation of the measures.

For the time being, the data analysis is based on descriptive and rank correlation analyses (Spearman and Kendall); more in-depth statistical analyses are pending.

DATA

In the two growing seasons 2019-2020 and 2020-2021, a total of 13 crops were grown, in particular wheat (23 farms), rape (18), maize (15), barley (14) and peas (10).² The experiences of the farms in the project with the implementation and their assessment of the measures were surveyed annually in autumn or winter online. The response rate was 88% in 2020 and 85% in 2021. Overall, 109 responses are analysed.

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² In addition, spelt, sugar beet, sunflower, potatoes, soya, legume mixtures and chickpeas were cultivated. The cultivation of artificial meadows is not recorded in the survey because of the low use of PPPs.

RESULTS

The presentation of the results from the farmer surveys focuses on the two objectives of the project: the potential of the measures to reduce the use of plant protection products and the economic efficiency of the measures. The nine most frequently applied measures, including the five basic measures, are presented in Table 1.

According to the farmers' evaluation, mechanical weed control is the most effective measure to reduce the use of PPP in the PestiRed project (5.8 is close to the scale value 6 "positive"). The economic efficiency of this measure is rated as almost neutral, but with a slight tendency towards the negative range.

Two basic measures, the consistent application of threshold values (decision rule whether to spray or not to spray relying on pest population levels) and the use of resistant varieties, are assessed quite positively both in terms of PPP reduction and in terms of their economic efficiency. Other basic measures such as optimising sowing (date, density) and fertilisation also contribute to the project's goals.

Table 1. Farmers' evaluation^a of the measures with regard to their potential to reduce PPP and their efficiency.

Measure ^b	PPP reduction	Economic efficiency	N
Mechanical weeding	5.8	3.9	65
<i>Threshold levels</i>	5.3	4.9	100
<i>Tolerant variety</i>	5.3	5.0	105
False seeding	5.2	4.0	44
<i>Drift-reducing techniques</i>	5.0	4.4	97
Stubble cultivation	4.9	4.4	57
Undersowing	4.7	3.9	40
<i>Optimised sowing</i>	4.7	4.6	104
<i>Optimised fertilisation</i>	4.5	4.6	103

^a Shown are mean values of a 7-scale Likert rating from 1 - very negative... 4 - neutral... 7 - very positive.

^b Basic (compulsory) measures are in *italics*.

Source: Survey data on the harvest years 2020 and 2021.

Farmers' evaluation of the measures' effect on the yield quantity and the yield quality is mostly neutral with a tendency towards the positive range. Critical evaluations of the economic efficiency (mechanical weeding, undersowing) can be explained by critical evaluations of yield quantity (mechanical weeding, undersowing) and the yield quality (undersowing).

DISCUSSION AND CONCLUSIONS

Farmers see great reduction potential especially in non-chemical weed control measures, such as mechanical weeding, false seeding and stubble cultivation. Preventive measures are also seen as having a positive effect on the reduction of PPPs, including in particular the choice of resistant varieties and the consistent use of control thresholds and forecasting systems, both of which are basic measures and integral parts of integrated pest management. Other basic measures, such as seed

optimisation or adapted nitrogen use, are rated as less effective but still positively.

Although the past year was very rainy and posed great challenges for crop protection in arable farming (especially protection against fungal diseases), the evaluation of the measures did not vary strongly: The ranking of the measures with regard to PPP reduction and efficiency is quite stable over the years.

The two basic measures, threshold levels and tolerant variety, which scored positively with regard to PPP reduction are also rated well in terms of their efficiency. This result suggests that the approach of the project to improve the implementation of integrated pest management is accurate. This potential to realise PPP reductions at low cost is a challenge for research as well as for extension services (Ramseier, Lebrun et al. 2016): research should develop a sound basis, which then must be communicated to farmers via extension.

The challenges to reduce PPP differ between crops. These challenges are particularly great for crops that are susceptible to insects and fungal diseases, such as potatoes.

When considering the economic evaluation, it should be noted that the farmers receive contributions from the project for the implementation of specific measures in order to compensate for additional costs; these contributions are presumably included in the evaluation and contribute to the rather positive evaluation of the measures' economic efficiency. The project also includes an economic analysis (comparison of two plots on farm and crop level and finally the crop rotation). The linking of the results from the economic analysis with the survey's results is currently pending.

The first results of the PestiRed project provide starting points for upscaling effective measures to reduce the use of PPP in arable farming. These results are also of great relevance for other countries with similar cultivation conditions in their endeavour to improve the sustainability of their crop cultivation systems.

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