Mining data from the national DEPHY farm network : potential for reconciling low pesticide use and high economic profitability

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MINING DATA FROM THE NATIONAL DEPHY FARM NETWORK: POTENTIAL FOR CONCILING LOW PESTICIDE USE AND HIGH ECONOMIC PROFITABILITY

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Introduction

Reducing pesticide use in agriculture is a major challenge to improve sustainability that requires a holistic approach. Agronomists have addressed the question using field experiments at the cropping system level for decades. Another emerging approach relies on large commercial farm networks producing data for contrasted management strategies in various production situations (Lechenet et al., 2014). Here we used data from the French DEPHY farm network to address two major questions: (i) what management strategies are associated to low pesticide use in arable farming, in different farming contexts? (ii) Is the objective of reducing pesticide use antagonistic with maintaining economic profitability at the cropping system level?

Materials and Methods

The DEPHY network is based on 1000 arable farms throughout the French territory, with much contrasted levels of pesticide use. The treatment Frequency Index (TFI = number of treatments weighted by the relative dose to registered dose and by the proportion of sprayed area) computed at the cropping system level varies in the range [0-15] (mean=3.3) in conventional farms. First we used regression tree methods to partition TFI according to variables describing the farming context (soil type, climatic feature, local markets…), to identify types of situations favoring high vs. low TFI. Then, in each type of production situation, we used similar methods to identify management strategies (combinations of technical options) associated with high vs. low TFIs. Finally, we performed a LASSO regression to estimate for each farm of the network the marginal effect of TFI on yield and profitability (net margin).

Results and Discussion

We identified six groups of production situations, with increasing average level of pesticide use from PS1 to PS6. The main aspects of the farming context associated with low pesticide requirement were (i) the combination of arable crops with livestock breeding, (ii) the absence of local market opportunities for industrial crop outlets, and (iii) climatic conditions characterized by high solar radiation and low precipitations.
Our results reveal that the range of TFI was large within each production situation. Across the whole dataset, we identified 54 profiles of management strategies with contrasted TFI (see the distribution of TFI for the 21 strategies identified in PS2, fig. 1). The main technical options associated with low TFI were related to crop rotation (high proportion of grasslands and rustic crops, diversity of sowing periods), spraying at low doses, low

level of fertilization and tillage strategies based on ploughing. However, strategies with low TFI differed from one farming context to one another. As an example, in cereal-based regions, both diversification of crops with legumes and spring crops, and diversification of cultivars, were majors options associated with low TFI, whereas in maize-based areas, diversification was not such a major issue. Low TFI were there mostly associated with mechanical weeding and low doses applications, combined with ploughing.

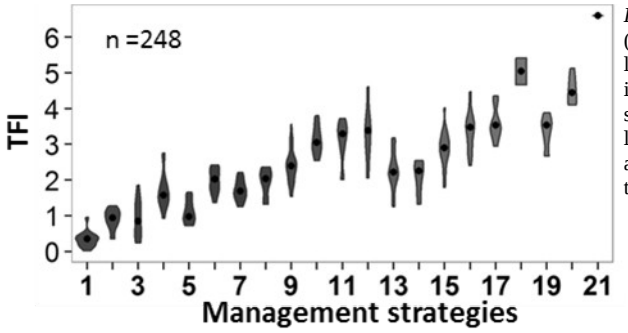

Figure 1. Distribution of TFI (computed at the cropping system level) for the 21 management strategies identified in the type of production situation PS2 (mixed farms with livestock, with medium temperatures and precipitations, mostly in the temperate western part of the country).

Our statistical analysis of the relationship between TFI and profitability failed to detect any antagonism between high profitability and low TFI in 82% of farms of the network. The main exception concerned farms producing industrial crops with both high added value and high pesticide requirements, mainly in northern France (sugar beet, potatoes), and in south-western France (seed maize).

Conclusions

The analysis of data from this large farm network proved to be very powerful to produce knowledge on cropping systems. We identified management strategies with low pesticide use, but we also showed that combinations of IPM-based measures should be adapted as the function of the farming context. Finally we were able to quantify the potential decrease of pesticide use, and its distribution at the national scale, that would not affect the profitability for farmers.

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References

Lechenet et al. : 2014. Reconciling pesticide reduction with economic and environmental sustainability in arable farming. Plos One, 9 (6).