IPM RESEARCH FACTSHEETS

Arable crops sector

The DEPHY network in France is one of the five national IPM demo farm networks affiliated to IPMWORKS. During the course of the IPMWORKS project (2020-2025), two PHDs analysed data produced by DEPHY farms in the sector of arable crops, to produce knowledge about cropping systems with reduced reliance on pesticides.

This factsheet synthetizes the main results of the PhD by Yaoyun ZHANG (INRAE – Research unit Agroecology in Dijon, France), about the benefits of diversifying crop rotations to regulate pest pressure and reduce the need for chemical pesticides.

COUNTRIES

FRANCE

ÉCOPHYTO PIC | RÉDUIRE ET AMÉLIORER L'UTILISATION DES PHYTOS

HUBS

About **150** hubs distributed across the French territory. Data from 795 farms were used for the PhD

RESEARCH QUESTIONS

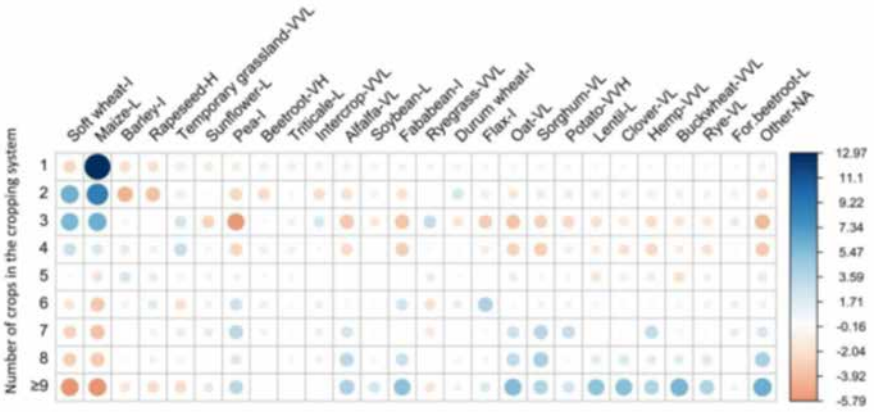
Crop diversification is known to be a major factor impacting the development of weeds, invertebrate pests, and diseases, but the expected impact of the diversification of crop rotations in arable field crops had not been quantified so far. Yaoyun Zhang analysed the large database of farms engaged in the DEPHY network (sector Arable farming), with contrasted cropping systems, contrasted crop rotations, and contrasted levels of pesticide use.

The treatment Frequency Index (TFI) was used to monitor PPP inputs.

CORRELATION BETWEEN CROP DIVERSITY AND THE NATURE OF CROPS GROWN

Crops grown are not independent of crop diversity

Monoculture in DEPHY farms are always maize-based. Maize and wheat are over-represented in poorly diversified crop rotations, whereas hardy crops such as buckwheat, rye, oat… are over represented in very diversified cropping systems



X² table of the link between crop diversity (number of crops in the rotation, Y-axis) and the nature of crops. Blue dots indicate over-representation, whereas red dots indicate under-representation

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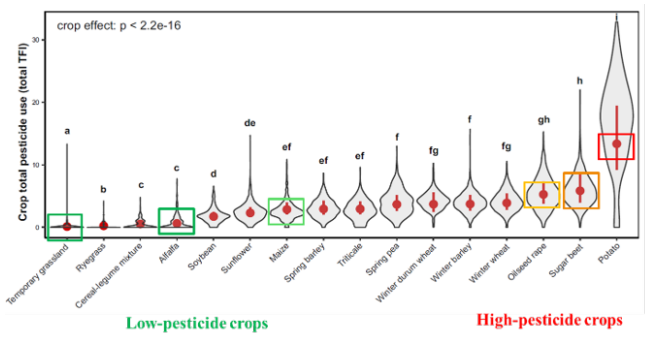
ANALYSING THE LINK BETWEEN CROP DIVERSITY AND PPP USE REQUIRES TO DISENTANGLE THE EFFECT OF THE NATURE OF CROPS GROWN

Indeed crops species have contrasted levels of pesticide requirements, because many plant pathogens and insect pests are very species-specific

Distributions of Treatment Frequency Index over a range of crops with contrasted pesticide requirements.

From Guinet et al., Nature Com., 2023

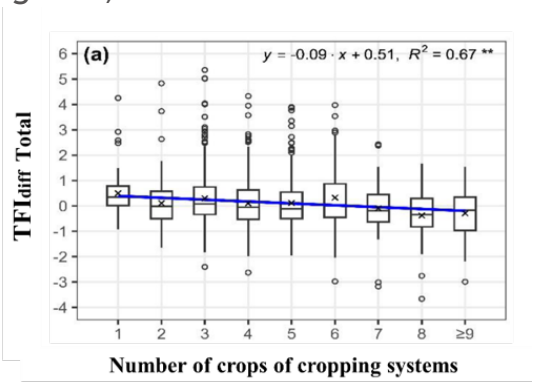


TFI_{diff} represents pesticide use assessed at the Cropping System level, after removing the effect of the nature of crops grown.

The simple indicator of diversity 'Number of crops' is slightly correlated to pesticide use, with 0,09 TFI saved for one additional crop.

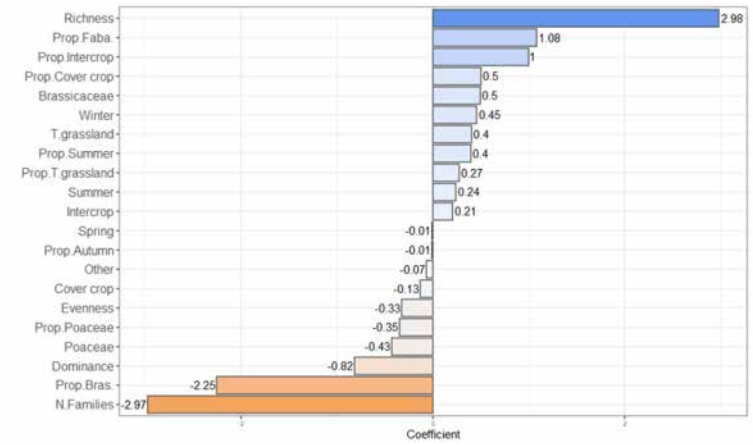
The number of crops explains 1,3 % of the total variance of PPP use

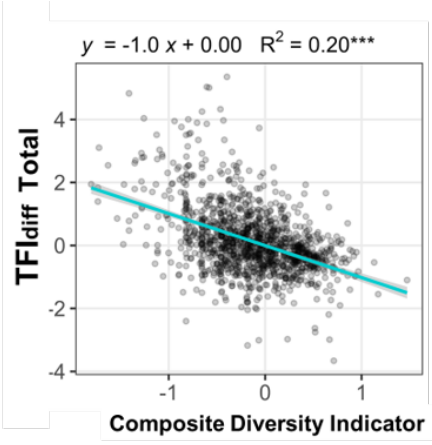
Zhang et al., EJA 2024



A MORE COMPLEX COMPOSITE DIVERSITY INDICATOR EXPLAINS 7,9% OF TOTAL VARIANCE OF PESTICIDE USE

A statistical method (LASSO) was used to select diversity indicators composing a Composite Diversity Indicator (CDM). The selected variables are shown below with their contribution to CDM richness, evenness, number of taxonomic families and proportion of each family, number of growing seasons and proportion of each growing season, proportion of temporary grasslands, intercropping…)





The Composite indicator CDM explains 7,9% of the total variance of PPP use over the whole dataset

Zhang et al., under revision

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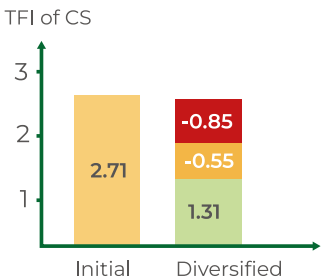
REGION A
Western France

Typical crop rotation

Soft wheat
Maize

Suggested diversified crop rotation
(including 3 years of Temporary Grassland (TG).

Soft wheat
Maize
Faba Bean
Soft wheat
3-year TG
3-year TG
3-year TG



-32% by crop species
-20% by crop diversity
Total of -52%

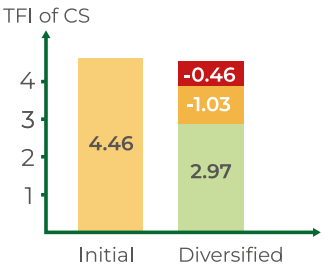
REGION B
Eastern France

Typical crop rotation

OSR
Soft wheat
W. barley

Suggested diversified crop rotation

OSR
Soft wheat
Soybean
Soft wheat
S. barley
Faba Bean



-10% by crop species
-23% by crop diversity
Total of -33%

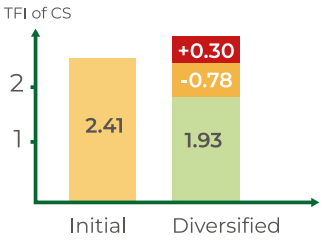
REGION C
South-western France

Typical crop rotation

Maize
Maize

Suggested diversified crop rotation

Soft wheat
Maize
Sunflower
Sorghum



+12% by crop species
-32% by crop diversity
Total of -20%

The estimates of PPP use reduction, distinguishing the effect of the nature of crop introduced from the effect of diversity per se, demonstrate the high potential of crop diversification for reducing PPP inputs
Zhang et al., under revision

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