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## The State of the Art

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## **Analysis of pesticide use in reference farms with regard to necessary minimum**

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### **INTRODUCTION**

With the passage of the German Action Plan for Reduction of Pesticide Use in 2004, the treatment frequency index (TFI) was introduced in Germany as an instrument to measure the intensity of use of plant protection products. One advantage of the TFI is that it makes it possible to compare different units such as kilograms, litres and grams. Furthermore, it makes it possible to determine whether any actual reductions in pesticide use have been achieved. It was decided that the intensity of plant protection product usage at reference farms should be analysed over a period of 8 years, in order to determine the potentials for reduction to the necessary minimum. Potential correlations between the intensity of pesticide use and relevant agricultural factors such as the time of sowing, preceding crops and the type of tillage were further questions for analysis. The relationship between conservation tillage and the use of glyphosate herbicides was of particular interest.

### **METHODS**

To answer the aforementioned questions, from 1998 to 2005, our group conducted an analysis of pesticide use in various crops, especially winter wheat and winter rape, at five German reference farms with different climate and soil characteristic. TFIs were calculated for each farm, year and crop, as described previously (Kudsk, 1989). The TFI data were then used to calculate the mean and annual intensities of pesticide use for all the main crops. Potential correlations between the TFI and the time of sowing, preceding crops and kind of tillage were investigated by defining factors of influence and calculating Spearman's correlation coefficient.

### **RESULTS**

Our findings show that in none of the investigated crops (winter wheat, winter rape, barley and sugar beet) had a decrease in pesticide use been achieved within the last 8 years. In fact, the intensity of pesticide use in winter rape and winter wheat even increased in two of the five farms studied. The mean intensity of pesticide use at the five farms was generally higher in winter wheat and winter rape than in sugar beet and barley. The variation between the years was less pronounced in herbicides and more pronounced in insecticides than in other plant protection products. The highest TFIs were found in sugar beet herbicides, winter wheat fungicides and winter rape insecticides. In the investigated crops, TFIs below a mean of 1.0

were achieved in growth regulators, in fungicides (except in winter rape) and in insecticides. In winter wheat, there was a correlation between the date of sowing and the intensity of fungicide use in two out of five farms, and between the date of sowing and the intensity of herbicide use in two of the farms. Furthermore, the intensity of growth regulator use correlated with the date of sowing in one farm, and with variety properties in another. farm. During the investigated period (1998 to 2005), for this crop, there was a measurable increase in growth regulator use at two farms, in herbicide use at two farms and in fungicide use at three farms.

Table 1. Intensity of pesticide use at different reference farms in Germany.

Farm	Crop	Pesticide type	TFI
Klützer Winkel	sugar beet	herbicides	3.73
Klützer Winkel	winter wheat	fungicides	2.90
Magdeburg	sugar beet	herbicides	2.60
Halle	winter oilseed rape	insecticides	2.31
Halle	winter wheat	fungicides	2.24
Halle	sugar beet	herbicides	2.21
Halle	sugar beet	insecticides	0.10
Macham	barley	insecticides	0.09
Macham	sugar beet	fungicides	0.00
Klützer Winkel	sugar beet	fungicides	0.00
Klützer Winkel	barley	insecticides	0.00

## DISCUSSION AND CONCLUSIONS

The TFI is more suitable for representing the intensity of pesticide use than the quantity of plant protection products. As expected, the intensity of pesticide use varied between fields, farms and years. Early sowing, conservation tillage and unfavourable preceding crops led to higher herbicide indices in winter wheat within the investigated period, owing to intensive use of glyphosate herbicides and herbicides for control of *Bromus* weeds. Significant increases in TFIs for growth regulators were observed in years with early sowing of winter wheat. Fungicide TFIs rose over the years in half of the investigated farms. Early sowing was shown to be associated with higher TFI values.

At the present state of research, it still is not possible to define local necessary minimum application values for plant protection products based on TFI values. The question of whether soil protection or reduction of pesticide use should be given more attention must still be decided, depending on local conditions for soil erosion.

## REFERENCES

- Kudsk P (1989). Experiences with reduced herbicide doses in Denmark and the development of the concept of factor adjusted doses. *Proceedings of the Brighton Crop Protection Conference, Weeds* 2, 545-552.