An analysis of the duration, frequency and seasonal distribution of plant protection activities on German farms

Untersuchungen zu Umfang, Dauer und saisonaler Verteilung von Pflanzenschutzmaßnahmen in Deutschland

Alfons Janin Hoff1), Eberhard Hoernicke2), Dieter Westpha l3), Martin Schä fer4), Franz Stauber5), Heinrich Wicke6), Heinz-Rainer Brennecke7), Corina Schulze-Rosario8), Franz-Anro Becker9) und Joern Schrader10)

Abstract

All pesticide applications in the period from 1996 to 1998 were surveyed in 24 tillage farms (farm sizes ranging between 40 and 470 ha) in West Germany and evaluated with regard to the exposure of individual operator. The data base comprises 2,192 pesticide applications performed over the 3 years by 34 operators. Additionally, the technical agricultural equipment was surveyed. Areas treated per day by an individual operator increase from an average of 20 ha/day for smaller farms to an average of 40 ha/day for larger operations. On average, applications took place on 10 to 15 days per annum. In over 99% of the cases surveyed, one individual active substance was applied on maximally 5 days/year. Tractors with a driver’s cabin were used on 22 out of 24 farms. The potential impact of the outcome to the assessment of operator exposure in the official registration procedure for crop protection products in the EU is discussed.

Key words: Operator exposure, pesticide application, technical equipment

Zusammenfassung


Stichwörter: Anwenderexposition, Pflanzenschutzmittelapplikation, technische Ausrüstung

1 Introduction

Plant protection products are important inputs in Integrated Crop Management. Before they are authorised for use, extensive investigations are carried out to determine their potential impact on human beings and the environment. The results of these are used to specify the conditions of use which, if properly observed, will ensure that the products can be applied without adverse effects on human beings or the environment.

Users come in contact with plant protection products when mixing/loading and application of the spray liquid including cleaning the equipment. To establish the specific user protection requirements for a plant protection product, account must be taken not only of the toxicological properties of the product and its active substances but also of the nature and extent of possible exposure.

The first step in identifying and evaluating the risks involved by the handling of a plant protection product is to determine user exposure with the aid of deterministic models. If these do not supply a sufficient basis for a satisfactory evaluation, it will be necessary to model the application scenario in greater detail. Statistical data of the kind provided e.g. by the German Federal Statistical Agency are usually inadequate for this purpose, since they are obtained for farms and other agricultural units and are not concerned directly with individual users.

The aim of this investigation, therefore, was to generate user-related data giving a more detailed picture of the real conditions under which plant protection products are applied and at the same time offering practical approaches for adjusting existing risk assessments to actual application practice. This publication is the summarised version of an investigation conducted on behalf of the Industrieverband Agrar by the BIU-f. (Consulting Agency for Farm Management), Win desheim (JANINHOFF et al., 1999).

2 Materials and Methods

To ensure a representative group of persons, plant protection operators were selected from 24 farms participating in a private consultative project in the regions of Rhineland-Palatinate and Hessen. The farms were divided by size into three classes – up to 100 ha, 100–200 ha, and over 200 ha. Each class comprised 8 farms. The acreage of these farms is quite normal for German conditions, since 95% of German farms cultivate areas of up to 100 ha (ANON., 1998b). The crops on these farms are mainly cereals, sugar beets and oilseed rape, which in terms of plant protection measures can be described as “intensive treatment” crops. The investigation was carried out retrospectively for the 1996, 1997 and 1998 seasons. The data were compiled on the basis of...
Table 1. Extent of plant protection activities

<table>
<thead>
<tr>
<th>Size of farm (ha)</th>
<th>Season</th>
<th>Work rate (ha/day)</th>
<th>Working hours (h/day)</th>
<th>Days/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 100</td>
<td>1996</td>
<td>19.9</td>
<td>4.7</td>
<td>12.0</td>
</tr>
<tr>
<td></td>
<td>1997</td>
<td>19.6</td>
<td>4.8</td>
<td>10.6</td>
</tr>
<tr>
<td></td>
<td>1998</td>
<td>19.2</td>
<td>5.0</td>
<td>9.9</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>19.5</td>
<td>4.8</td>
<td>10.8</td>
</tr>
<tr>
<td>100-200</td>
<td>1996</td>
<td>23.8</td>
<td>5.3</td>
<td>16.9</td>
</tr>
<tr>
<td></td>
<td>1997</td>
<td>24.7</td>
<td>5.0</td>
<td>12.6</td>
</tr>
<tr>
<td></td>
<td>1998</td>
<td>24.4</td>
<td>4.9</td>
<td>17.3</td>
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<tr>
<td>Average</td>
<td></td>
<td>24.3</td>
<td>5.1</td>
<td>15.6</td>
</tr>
<tr>
<td>&gt; 200</td>
<td>1996</td>
<td>42.3</td>
<td>6.7</td>
<td>11.8</td>
</tr>
<tr>
<td></td>
<td>1997</td>
<td>40.6</td>
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<tr>
<td>Average</td>
<td></td>
<td>42.3</td>
<td>6.6</td>
<td>11.7</td>
</tr>
</tbody>
</table>

3 Results

The areas cultivated on the studied farms were between 40 and 470 ha. Data were collected over a 3-year period for 2,192 plant protection treatments by 34 operators on 24 farms. Since some of the plant protection products contained more than one active substance, a total of 2,711 active substance applications were taken into account.

3.1 Work rate and working hours

The evaluation showed a size-related increase in the daily work rate per operator from approx. 20 ha/day on smaller and medium-sized farms to about 40 ha/day on larger farms. Over the period of the survey, the work rate remained relatively constant within each of the size classes.

The number of daily working hours with plant protection products rose from 4.8 h/day on the smaller farms to 6.8 h/day on the larger ones; however, the frequency of plant protection treatments (days per year) was unrelated to farm size. The data show that plant protection operators came into contact with the products on average between 10 and 15 days per year (Tab. 1). The highest value measured in one case was 27 days per year.

3.2 Application frequencies and intervals for various active substances

Table 1 covers work with all plant protection products. However, the frequency of contact for any one operator is very much lower when considered in relation to individual active substances, as can be seen from Figure 1.

Taken overall, the enquiry data show that in 830 cases a given active substance was applied on only one day per year (Fig. 1). In over 99% of all cases, a given active substance was applied on five days per year at most. Only in a minority (less than 1%) of all cases did applications take place on more than 5 days per year, due to repeated treatments of very large fields (e.g. 2 x 5 days per year).

In terms of a percentage distribution about 31% of all active substance handlings occur on a single day per year. In about 69% of all cases, a given active substance handling implies repeated contact (two or more days per year) with ca. 27% of all cases on successive days and ca. 42% with spray intervals i.e. with a break of handling for at least one day following the day of handling (Fig. 2).

Repeated treatments are carried out either on successive days (Tab. 2) or with spraying intervals (Fig. 3). As a rule, repeated applications are carried out on successive days in cases where the field is too large to be completely treated on a single day. It was
found that a maximum of 5 applications are carried out in succession. 18% of all applications were completed after 2 successive days.

Repeated applications carried out not on successive days but at intervals account for 27% of all applications. In these cases the intervals between working days were recorded (Fig. 2). The intervals between treatments varied mostly from 8 to 21 days.

3.3 Seasonal distribution

The seasonal distribution of plant protection measures is shown in Figure 4. It is clearly evident that applications are not spread out evenly throughout the year but are mainly concentrated on the months from March to June. Fewer plant protection treatments are performed in the other months.

3.4 Technical equipment on farms

On 22 of the 24 farms, cabin tractors were used for plant protection operations, and 19 of these were additionally fitted with air filters. The two tractors without cabin were used on farms with less than 100 ha. There were no appreciable differences in the width of the booms used for plant protection operations (on average between 16 and 19 m). There were, however, considerable differences in the sizes of the spray tanks. The spraying equipment on farms with less than 100 ha had tanks with an average spray liquid volume of about 1400 litres, whilst average tank sizes of about 2100 were found on farms with over 200 ha.

4 Discussion

The results of this investigation give an overall view of the application of plant protection products on representative farms in West Germany. Production intensity on these farms is above the average for the country as a whole. The investigation recorded the duration, frequency and seasonal distribution of plant protection operations in the 1996 to 1998 seasons on 24 farms in Hessen and Rhineland-Palatinate producing market crops.
The study provides evidence that the number of days on which individual operators handle plant protection products is limited, amounting to an average of approximately 10 to 15 days (with a maximum of 27 days).

The average daily work period for the handling of plant protection products also lies within a relatively narrow range of 4.8 to 6.8 hours.

On farms of up to 200 ha, the average work rate was around 20 ha/day. On farms of over 200 ha, the daily work rates were about 40 ha. The higher work rate obtained on these farms was due to the machinery used (e.g. higher spray tank capacity) and to longer working hours.

Of the approximately 470,000 farms in Germany in 1998, 96% were smaller than 100 ha (ANON., 1998b). Operators on these farms can be expected to achieve a work rate of about 20 ha/day. This corresponds to the daily work rate assumed in the German operator protection concept (LUNDEHN et al. 1992) for field crops, thus confirming that the value currently used in the German model is acceptable for the great majority of operators.

On farms of > 200 ha, the work rate was noticeably exceeded (about 40 ha/day), though a risk assessment based on the German model would have to allow for other parameters, e.g. closed cabins, which are not provided for in the German model. For this purpose reduction factors of 0.22–0.36 are given in the North American PHED model (ANON., 1998a). It may thus be assumed that operator exposure even on larger farms is not underestimated by the BBA model.

Further investigations are being conducted to analyse the situation on large farms with field areas of over 1000 ha and more, and also with regard to private contractor firms applying plant protection products over several tens of thousands of hectares per year (BBA, publication in preparation). These investigations focus on the situation of plant protection operations in field crops. Studies of this kind for are not yet available for high crops in Germany. These form part of another ongoing project concerned with gathering EU-wide application data (project sponsored by the European Crop Protection Association (ECPA): Survey on work rates and frequency of handling active substances for major crop types [field crops, grapes, orchard crops] in representative countries of Northern and Southern Europe).

As far as single active substances are concerned, operator exposure is confined to a very few days per year. In 55% of all investigated cases, the operator comes in contact with an active substance only once a year. Repeated application on successive days take place mostly on 2 days. Where spraying intervals are included, applications are usually repeated after 8 to 21 days. Although the maximum contact frequency was 11 contacts per year, cases with between 6 and 11 contacts per year accounted for less than 1% of the total.

The results obtained here should not be left out of account for the overall risk assessment.

The data compiled here can also be of use for more recent approaches to risk assessment, such as “probabilistic modelling”, which requires a large body of individual data. Among experts, “probabilistic modelling” is now commonly considered as a promising addition to the currently used deterministic approach to operator risk assessment.

5 References


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Kontaktschrift: Dr. Martin Schäfer, Industrieverband Agrar e.V., Karlstrasse 21, D-60329 Frankfurt am Main