Test procedure for drift reducing equipment

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Summary

Drift is one of the main paths of plant protection products to non-target organisms. In Germany great efforts are made to reduce drift. Therefore sprayers are tested concerning their drift reducing ability in relation to the German basic drift values which have been determined on the basis of more than 180 drift trials with conventional sprayers. A classification system with classes of at least 50 %, 75 % and 90 % drift reduction has been introduced. Sprayers which meet the requirements of the German guideline are listed in the list of drift reducing sprayers. Nearly all of the sprayers are equipped with air injection nozzles to produce larger droplets. In orchards and hops further measures like shields on fan outlets, green detectors or tunnels are necessary to achieve the respective drift classes. Newer trials show that a drift reduction of 99 % in orchards is possible.

Introduction

Effects of plant protection products on non-target organisms are of great importance in the authorisation procedure. They are assessed on the basis of exposition data (Ganzelmeier, 2000). Drift is one of the main paths of plant protection products to non-target organisms. Therefore it is essential to improve sprayers so that drift can be reduced.
In field tests and wind tunnel tests the drift potential of sprayers and nozzles are measured. The results are compared with basic drift values which have been established in drift trial programs using conventional spray techniques (Ganzelmeier et al. 1995 and Rautmann et al. 2001).

Testing of Sprayers in Germany

In a voluntary test procedure manufactures have the opportunity to get the JKI-approval sticker. These sprayers or sprayer parts like nozzles are tested on a farm for at least one season and on JKI test stands. Manufacturers can apply for registration of their sprayer as a drift reducing sprayers if it has the JKI-approval sticker and if it has proven its drift reducing property. As a rule, an adequate amount of drift trials must be performed. The trials must be performed in accordance with guideline VII 2-1.1 „measuring direct drift when applying liquid plant protection products outdoors". Wind speed must be at least 2 m/s. The ground sediment must be measured in distances of 5 m, 10 m, 20 m, 30 m and 50 m.

Execution and assessment of trials

The assessment is made using one of the following alternative procedures.

1. Comparison with the basic drift values. At least 3 drift trials are to be performed with the equipment to be tested. For each distance, at least 30 measured values are necessary. From them the median values are to be calculated. From the median values of each distance a regression line in accordance with the method of minimal quadratic deviations is calculated. The classes of drift reduction are calculated from the median values, resulting from the tests done for the evaluation of the basic drift values.
2. Classification of the tested equipment is in the class which regression line is not exceeded within the total measured distance range by the regression line of the equipment to be examined.
3. Comparison with an already registered reference equipment. At least 3 drift trials are to be performed with the equipment to be tested as well as with the reference equipment. For each distance, at least 30 measured values are necessary in total per equipment. From the median values of each distance a regression line in accordance with the method of minimal quadratic deviations is calculated for the equipment to be tested as well as for the reference equipment.
4. Classification of the tested equipment is in the class in which the reference equipment is registered, if the regression line of the reference equipment is not exceeded within the total measured distance range by the regression line of the equipment to be examined.

5. If possible and asked for by the applicant for nozzles for field crops, through a comparison measurement with a reference nozzle. As a reference nozzle, a nozzle is to be taken which is already registered as a decisive part for the drift reduction of a field sprayer. The test is done in the wind tunnel in accordance with guideline VII 12.2.1 (currently in preparation). Classification is performed with the help of the «Drift-Potential-Index» (DIX) in the same class if the DIX is not higher than the DIX of the reference nozzle.

The plant protection equipment is registered in the list of loss reducing equipment if the examination has proved that the equipment possesses the drift reducing properties.

Drift reduction classes

According to the basic drift values there are different drift values for the drift reduction classes in various crops and growth stages (Tab. 1). For sprayers in other crops, those values are used that belong to the basic drift values used in the authorization procedure.

Tab. 1. Ground sediments in % of the application rate calculated on the basis of the median values

Dist.	Field crops			Fruit crops, early stages			Fruit crops, late stages			Grapes			Hops		
[m]															
	50%	75%	90%	50%	75%	90%	50%	75%	90%	50%	75%	90%	50%	75%	90%
1	0,48	0,24	0,10												
3				9,48	4,74	1,90	3,478	1,739	0,696	2,63	1,31	0,53	4,97	2,49	0,99
5	0,10	0,05	0,02	5,85	2,92	1,17	1,863	0,931	0,373	1,16	0,58	0,23	2,95	1,48	0,59
10	0,05	0,03	0,01	3,03	1,52	0,61	0,798	0,399	0,160	0,38	0,19	0,08	1,46	0,73	0,29
15	0,04	0,02	0,01	1,51	0,76	0,30	0,423	0,212	0,085	0,20	0,10	0,04	0,54	0,27	0,11
20	0,03	0,01	0,01	0,68	0,34	0,14	0,237	0,119	0,047	0,13	0,06	0,03	0,25	0,13	0,05
30	0,02	0,01	0,00	0,22	0,11	0,04	0,105	0,053	0,021	0,07	0,03	0,01	0,08	0,04	0,02
40	0,01	0,01	0,00	0,10	0,05	0,02	0,059	0,029	0,012	0,04	0,02	0,01	0,04	0,02	0,01
50	0,01	0,01	0,00	0,05	0,03	0,01	0,038	0,019	0,008	0,03	0,01	0,01	0,02	0,01	0,00

Listed sprayers

All classified sprayers are listed in the list of drift reducing equipment (Rautmann, 2001). There are more than 160 entries in this list. It includes field crop sprayers and air-assisted sprayers for orchards, hops and vineyards. Some sprayers for asparagus and red/blackcurrant are also listed. Application rules on pesticide labels refer to this list and prescribe buffer zones depending on the drift reduction class (Rautmann and Streloke, 2001).

Field crop sprayers can easily be equipped with air injection nozzles to reach the requirements for the drift reduction classes (Fig. 1). Dependent on the nozzle size and the spray pressure a drift reduction of 50 % up to 90 % is possible.

Sprayers with air-assistance achieve drift reductions of 50 % in crops with a minimum height of 30 cm and 75 % in crops with a minimum height of 50 cm.

Band sprayers, which are used for weed control in sugar beets or maize, are listed in the 90 % drift reduction class

Field crop sprayer with nozzle
Lechler ID 120-05 POM / ID 120-05 C / Hardi S Injet 05
Regulation of use:
75 %: none
90 %: in first 20 m driving speed max. 5 km/h and spray pressure **2 bar**.

Field crop sprayer with nozzle
Agrotop AirMix 110-05

Regulations of use:
50 %: boom height 50 cm
75 %: spray pressure **1,5 bar** boom height 50 cm.
90 %: spray pressure **1 bar** boom height 50 cm

Field crop sprayer with nozzle
Lechler IDK 120-05 POM
Regulations of use:
50 %: spray pressure **max. 4 bar** boom height 50 cm.
75 %: spray pressure **1,5 bar** boom height 50 cm.
90 %: spray pressure **1,5 bar** boom height 50 cm driving speed 5 km/h.

Fig. 1. Some examples of air injection nozzles for field crops.

In air blast sprayers for orchards, vineyards or hops air injection nozzles lead to drift reduction, too. However further steps are necessary to reach the mentioned drift reduction classes.

In orchards the air-assistance towards the field edge must be turned-off in the first five rows. This can be achieved with a cover shield on the fan outlet or a redirection metal sheet (Rautmann, 2001). The use of these sprayers does not result in added difficulties in comparison to standard sprayers. In contrary to tunnel sprayers there is no restriction fort the use on slopes.
Some sprayers are equipped with green detectors (Fig. 2). They will shut off the nozzles when no leaves are in sight. Even with hollow cone nozzles which produce fine droplets the drift reduction is at least 50 %.

Fig. 2. Orchard sprayers with green detectors.

Another possibility to reduce drift in orchards is to spray beneath a hail net. Depending on the nozzle types, drift reduction is at least 50 % sometimes 75 %.
When orchard sprayers with small axial fans (air flow reduced to 20 000m^3/h) and air injection nozzles are used, a drift reduction of 75 % has been found. Some sprayers with a cross-flow fan have been tested and could be classified in the 75 % and 90 % drift reduction class.
To reach adequate drift reduction in vineyards, it is necessary to spray the first two rows only inwards. But not all sprayers can be adapted to achieve a drift reduction of at least 50 %. If a sprayer of the 90 % drift reduction class is necessary, tunnel sprayers are used (Fig. 3).

Fig. 3. Two-row tunnel sprayer in a vineyard.

Drift reduction in hops is quite easy. Sprayers need a shield on one side of the fan outlet and air injection nozzles to spray the outermost part of the hop garden (Fig. 4). For the inner part of the hop garden the shield must be removed. This leads to a drift reduction of 90 %. Nearly all sprayers can be adapted in this way.

Fig. 4. Sprayer in hops with air injection nozzles and with shield on the fan outlet.

Conclusions

Drift reduction is a major task in sprayer testing and developments are going on.
In all major crops a significant drift reduction is possible often with simple means. The full list of drift reducing sprayers is available on the JKI website www.jki.bund.de. Manufacturers have realized, that drift reduction is an important point to preserve the environment but also an important argument in selling sprayers.
Further tests are necessary for sprayers for vineyards to find solutions for existing sprayers to improve the possibilities for drift reductions there.
Tests with a tunnel sprayer with air injection nozzles in orchard resulted in a drift reduction of 99 %. German authorities including JKI are now working on an extension of the list of drift reducing sprayers and on new regulations of use for pesticides considering this grade of reduction.

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