Julius Kühn Institute
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Guideline for the testing of plant protection equipment

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Measurement of the drift potential of nozzles in a wind tunnel

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Introduction

The purpose of this guideline is to measure the drift potential of nozzles for crop protection in field crops. The methodology on how tests in a wind tunnel are carried out and the evaluation of these tests.

The results for flat fan and symmetrical double flat fan nozzles can be used to evaluate the drift reduction of field sprayers equipped with these nozzles may be used for entry in the section "List of loss reducing devices - drift reduction" of the descriptive list according to JKI Guideline 2-2.1.

1. Definition

The drift potential is the proportion of the applied amount of active ingredient that is released from the spray jet during the application process as a result of the airstream and does not directly reach the target area. When exposed to wind, the drift can be carried over and beyond the area to be treated.

2. Wind tunnel

The tests are carried out in a wind tunnel of closed construction. The measuring section of the wind tunnel should be at least 1 m high and 2 m wide. Outside the boundary layers on the walls of the wind tunnel, uniform flow conditions prevail in the entire measuring section; without installations (spray booms, valves and nozzles), temporal and local deviations of the flow velocity shall not exceed 2 % of the mean value.

3. Test arrangement

The nozzle to be tested is arranged in the test section in such a way that the application is downwards and the main axis of the spray jet cross-section is aligned transversely to the direction of flow (Appendix 1 a). An imaginary plane running parallel to the bottom of the measuring section at a height of 20 cm forms the virtual target area of the application. The applicant specifies the distance of the nozzle to the virtual target surface.

The measurement of the drift potential is carried out in a vertical measuring plane, which is formed by several collectors (polyethylene tubes with 2 mm diameter) arranged one above the other and stretched horizontally across the entire width of the measuring section transverse to the flow. The maximum vertical distance between the collectors is 100 mm. The lowest collector is at the height of the virtual target surface, the uppermost collector at the maximum in height with the nozzle.

The distance between the main axis of the spray jet cross-section on the virtual target surface and the measuring plane is (2 ± 0,02) m. In the case of double flat jet nozzles, this distance refers to the main axis of the spray jet with the smallest distance to the measuring plane (Appendix 1 b and c).

4. Test execution

For the tests 3 nozzles of one type each are to be used, whose volume flow at 3 bar deviates by a maximum of 2.5 % from the table value. For each of these nozzles a test is carried out with the respective setting to be tested.

If the results are used for the evaluation of the drift reduction according to guideline 2-2.1, the drift potential of the nozzle TeeJet TP11003-SS at 3.0 bar spray pressure and 50 cm target distance must be determined as the reference basis for each test series.
During the tests, the flow velocity is (2 ± 0.1) m/s, the air temperature (20 ± 1) °C and the relative humidity (80 ± 5) %.
Water with a water-soluble fluorescent detection substance is applied. The concentration should be such that the spray liquid deposited on the collectors can be quantified with a maximum error of 0.05 µl using the method described below. Preferably, the detection substance pyranine 120% (Simon & Werner) with a concentration of 0.1 g/l should be used.
The spraying time should be chosen in such a way that saturation of the collectors is avoided. It is usually (5 ... 10) s. The volume applied during this time must be determined with a maximum error of 1 %.
After application, wait until the spray liquid on the collectors has dried completely.
Afterwards, the entire detection substance must be extracted from the collectors in a defined manner with distilled water. At least one sample of the spray liquid must be taken daily and used to prepare a calibration solution for the subsequent evaluation by defined dilution.

5. Evaluation

The extraction solution for each collector and the calibration solution are to be analysed fluorometrically. From the fluorometer readings, calculate the volume *Vi of* spray liquid attached to each collector.

$$V_i = V_e \frac{C_{cl} F_i}{F_c}$$

With Ve -volume of the extraction liquid
Ccl - Proportion of spray liquid in the calibration solution
Fi - *Fluorometer reading* for extraction solution from collector i
Fc - *Fluorometer reading for* calibration solution

From the resulting vertical distribution of the volume, the total volume *Vrel* and the height of the center of gravity of the distribution *h,* related to the volume extracted during the measurement, are calculated.

$$V_{rel} = \frac{\sum_{i=1}^{n} V_i \Delta x}{d\ V}$$

With Δx - distance between the collectors
V - volume applied during the measurement
n -number of collectors
d -diameter of the collectors

$$h = \frac{\sum_{i=1}^{n} x_i V_i \Delta x}{\sum_{i=1}^{n} V_i \Delta x}$$

With xi - vertical position of the collector i

These values result in the key figure of the drift potential *AP*:

$$AP = V_{rel}^{0,88} h^{0,68}$$

If the results are to be used for the evaluation of the drift reduction according to guideline 2-2.1, the drift potential index DIX shall be calculated from the drift potential *APp of the* nozzle to be tested and the drift potential *APr of* the reference nozzle:

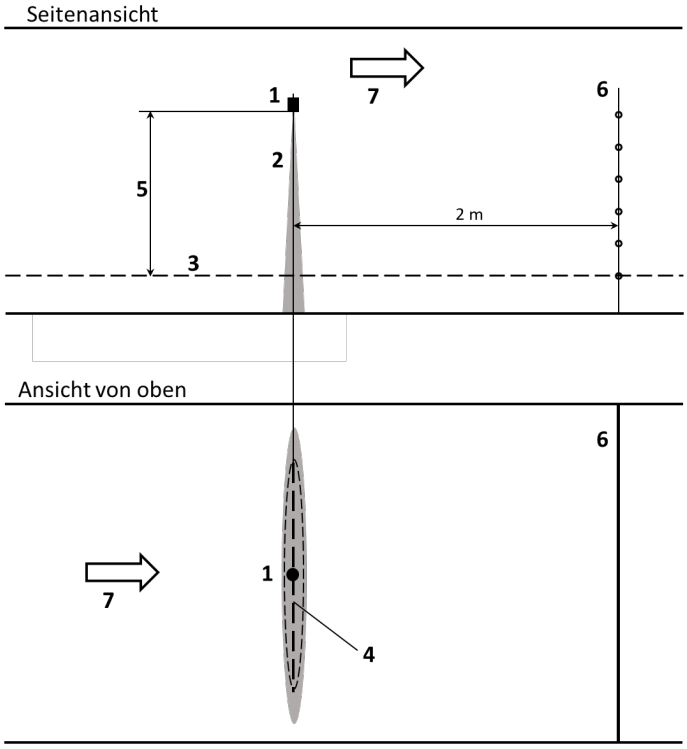
$$DIX = (AP_p / AP_r)100$$

6. **Come into effect of the guideline**
   This Guideline applies from 1st March 2021.

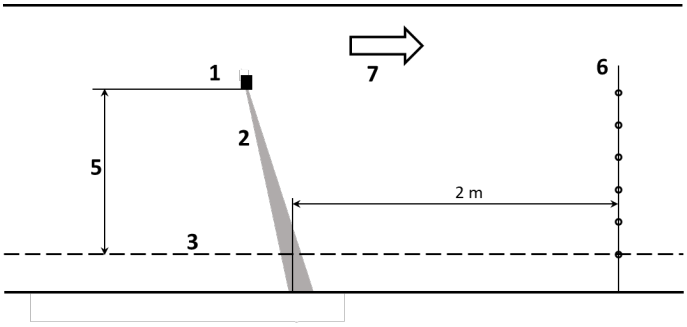
Appendix 1

a. Flat fan nozzle

1 - Nozzle
2 - Spray jet
3 - Virtual target area
4 - Main axis of the jet cross-section
5 - Target area distance
6 - Measuring plane
7 - Flow direction



b. Impact nozzle



c. Symmetrical double flat nozzle