

## **The comparison of the nozzle inspection methods in field crop sprayers: Nozzle flow vs. spray transverse distribution – methodology and some results**

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### **Introduction**

Polish national procedure for the inspection of field crop sprayers in use allows two methods of evaluation of the nozzles working during the inspection of the field crop sprayers. Only three countries (Poland, Portugal and Sweden) use both methods (measurement of nozzle flow and transverse distribution) [Wehmann 2012]. Measuring only nozzle flow is carried out in four countries, and in the majority of countries only measurements of the transverse distribution of the spray are carried out, with the coefficient of variation CV% as a measure of accuracy.

The comparison of the nozzle inspection methods have not been carried out in a direct way. Therefore, it is not known which of these methods is more rigorous, and if both methods could achieve the same results. In order to compare the stringency and time-consuming of both inspection methods, the methodology of comparative tests have been elaborated.

### **Materials and methods**

The elaborated methodology [Godyń 2013] describes how to compare and criteria for the evaluation of methods of inspection nozzles in field crop sprayers.

In all studies, three types of Lechler nozzles were used (utilized before for less than one hour) flat fan standard (LU 120-03) at 3 bar, flat fan air-injector (ID 120-03) and Twin flat spray air-injector compact nozzles (IDKT 120-03) at 4.5 bar. During the tests the electronic spray patternator SPRAYER TEST 1000 (PESSL Instruments, Austria) have been used. The trials on the groove patternator (STABEN - "mechanical") are planned to be done soon. The nozzle flow have been measured by SCHACHTNER (set of 20 scaled burets of nominal capacity 2000 ml and accuracy 20 ml) and ball flow-meter LURMARK.

For each of the method the time of removing and assembling nozzles or changing positions of nozzle bodies was measured and assumed as a common time for further calculations. For each of the evaluated method the time of each action was measured and the results of the study during the test were noted (CV%, mean nozzle flow rate, the number of the burets with 15% deviation from the mean and each nozzle flow rate). The gathered data allows the calculation of average time of the inspection of one nozzle depending on the type of the nozzle and the method used as well as binary and linear assessment of the test result.

The binary assessment expressed if the sprayer/nozzle inspection would be passed or not. The linear assessment expressed a percentage of fulfill the inspection criteria (eg. CV% or the maximum deviation from the nominal value of nozzle flow rate).

Example: For limit value of CV% or flow rate deviation = 10% (linear assessment = 100%):  
if measured CV% / deviation = 5% - the binary assessment is 1 (passed), the linear assessment is 50%

if measured CV% / deviation = 15% – the binary assessment is 0 (not passed / failed), linear assessment is 150%.

The comparison of the means for the linear assessments obtained for each nozzle type or inspection method answers whether the compared methods are equally “rigorous”.

The repeatability of measurements was evaluated using the coefficient of variation for repetitions.

## Results

The measurements of the transverse distribution uniformity were done by means of the electronic patternator SPRAYER TEST 1000 for the field crop sprayer Krukowiak with the 12 m long boom. The most uneven transverse distribution of the spray was measured for standard nozzles LU-120-03 (mean binary assessment = 0, all repetition failed; mean linear assessment = 104.55%) and the most equal for the air-injector ID-120-03 nozzles (binary = 1; linear = 64.08%). The CV% value for the first repetition of the IDKT nozzles (10.74%) clearly differed from three others (< 8.8%), therefore binary assessment achieved 0.75 (one failed) and linear one = 92.00%. A possible reason for a such difference was elimination of the spraying on to the spray line by one of the nozzles, noticed after the first measurement.

The average time of a single measurement (one position of a scanner) for standard nozzles was 36.5 seconds in comparison to 32.6 seconds for the air-injector nozzles. The mean test time of a single nozzle depended on the flow rate of the nozzle and the flow was pressure dependent. In this study, the 3.0 bar pressure was used for the standard and 4.5 bar for the air-injector nozzles (acc. to the Regulation of Ministry of Agriculture concerning sprayers inspection).

Average time of the assembling one nozzle was 29.06, 12.53 for disassembling and 1.53 seconds for rotating a nozzle body. The results of measurements will be used to simulate full inspection time for the method with all nozzles removed from the boom and/or for booms longer than 12 m or equipped with more than one set of the nozzles.

## Conclusions

When the study will be finished it will be possible to answer which inspection method is more time-consuming or more restrictive. Preliminary analysis of the data obtained for a single measurement method shows the significance of a nozzle type in the final assessment of the evaluated method. The other data show differences in accuracy, time consuming and costs of different methods.

## References

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