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: The European standards (EN 13 790) have changed. The simulated cost of a field crop sprayer inspection (1 worker) has 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, costs and time-consuming of both inspection methods, the methodology of comparative tests has been elaborated. Then some trials were carried out.

Materials and Methods: The elaborated methodology describes how to compare and what criteria to use for the evaluation of methods of inspection nozzles in field crop sprayers. In the study, three types of Lechler nozzles were used (utilized for less than one hour): flat fan standard (LU 120-03) at 3 bar, flat fan air-injector (ID 120-03) and Twin flat fan air-injector compact nozzles (IDKT 120-03) at 4.5 bar. During the tests the electronic spray patternator SPRAYER TEST 1000 (PESSL Instruments, Austria) and the groove pattetator (STABEN - "operator data readout") was used. The nozzle flow was measured by set of 20 scaled cylinders (SCHACHTNER of nominal capacity 2000 ml and accuracy 20 ml with HERBST nozzle adapters) and a ball flow-meter LURMARK.

For each of the evaluated method the time of each repeatable action was measured and the results of the measurements were noted (CV%, mean nozzle flow rate, the number of the cylinders with 10 or 15% deviation from the mean and each nozzle flow rate). The gathered data allowed the calculation of an 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 the result of the sprayer/nozzle inspection as 1 (inspection passed) and the linear assessment is 0 (inspection is not passed). The linear assessment answers whether the compared methods are equally "rigorous" or do they show the same "distance" from the limit value. The repeatability of measurements (for 4 repetitions) was evaluated by calculating the coefficients of variation.

The total cost of the sprayer inspection was calculated basing on: the time of one nozzle inspection, boom length and number of nozzles set mounted on it, workshop worker salary and the number of inspections per year done in the workshop. The proportional use of buildings with other activities was assumed to calculate costs of buildings use and equipment amortization. The time of inspection of other sprayer elements was assumed basing on other experiments (25 minutes).

Results: The results of measurements followed by binary, linear and repeatability assessments are presented in the tables 1,2 and 4. The costs of inspection depending on the method of nozzle evaluation method are contained in table 3.

Table 1. Spray transverse distribution uniformity evaluation – coefficient of variation (CV%).

Table 2. Spray transverse distribution uniformity evaluation – amount of nozzles (cylinders) containing volume outside of limit deviation from mean – binary and linear assessment and repeatability.

Table 3. The simulated cost of a field crop sprayer inspection (1 worker) depending on nozzle inspection method, boom length and number of nozzles set mounted on it, worker monthly salary and number of inspections done in a workshop per year.

Table 4. Nozzle flow evaluation – deviation from nominal value – number / percentage of nozzles with flow deviated more than 10% from the nominal value.

Conclusions:
1. The comparison of the nozzle inspection methods may be done in by the evaluation of repeatability of the measurements and the costs of the inspection.
2. The results of the flow or transverse distribution measurements may be expressed as simple binary Yes/No assessment or as a linear assessment giving the answer: which one of the methods is more rigorous or how far is the measurement result from the limit value.
3. The choice of the method of nozzle inspection may depend on the number of inspections done in the workshop.

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**Note:** The tables and figures are not fully transcribed due to the constraints of the text-based format. However, the structure and content of the tables and figures follow the methodology described in the text.