

## Requirements for plot trial equipment and how to control

Reinhard Friessleben

Bayer AG, Research & Development, Crop Science  
Application Technology  
40789 Monheim, Germany

### Abstracts

Plot trial technology is an important element to guaranty high quality and reproducible trial results – this is relevant for all phases of the development of a Plant Protection Product. Beside proper calibration and homogenous distribution safety aspects play an important role. Calibration and homogenous distributions needs to be controlled before applying each individual trial. In a defined sequence preferable before the season starts these controls should be done and documented by an authorized quality assurance system.

Quality parameter should be:

- Distribution pattern controlled via patternator or alternatively individual nozzle flow rate
- Control of pressure gauges
- Control of leakage

Bayer is using the Herbst Sprayer test 1000.

### Key words

Plot trial equipment; test requirements; calibration; sprayer inspection

### Introduction and requirements for plot trial equipment

Small Plot research should be conducted on uniform experimental areas that minimize differences from soil and other not trial relevant parameters. Small plot research enhances the ability to detect true and repeatable differences among the experimental treatments. Another important requirement is that many treatments in a small area of land minimize land resource and chemical amount requirements.

Plot trial technologies have to follow the same principal application requirements like equipment used by farmers. In particular spray volume, droplet sizes, direction of the spray have to be as close as possible to farmers practice. One of the challenges is the simulation of higher speeds. However if spray volume and droplet sizes are tested in a relevant range, application speed should not be such a relevant factor for plot trial methodology. Nozzle manufacturers are offering various options to represent different spray volumes and droplet sizes as well usable for plot sprayer.

Plot trial methodology in research and development of Plant Protection Products (PPP) is based on long years' experience, Standard Operating Procedures (SOP's) and specific designed field trial equipment. For these application equipment used during the development of plant protection products following basic requirements needs to be analyzed and as precise as possible to be defined such as:

- Ability to apply small plots – plot size to be depending on crop, trial questions,
- Precision in distribution and calibration of PPP
- Reproducibility of spray operations
- Standardization
- comparability with farmers practice
- Documentation

Technical details need to be taken into consideration to fulfil plot trial officers specific requirements such as:

- high safety standards
- Technical rest liquid
- Cleaning processes
- Transportation limitations

Normally, small sprayers spray booms (spray booms sprayers developed for small plots) are used in many different trial types. By this, spray booms sprayers or atomizers are meant which are carried, pushed or pulled by the field trial officer, such as single nozzle apparatuses, spray booms which are carried or mounted on a frame and others.

The apparatuses can be motor-driven or operated using compressed-air. Additionally equipment can be equipped with a fan in particular for the application in high growing crops.

### **How to calibrate and control field trial equipment**

One of the most essential steps regarding the conduct of field studies is the calculation of the product quantity which is to be applied on the trial area and the calculation of the quantity of spray liquid. This includes calculating the net and gross plot area, the starting and the rest liquid.

Here, calculation depends on both the application method (such as spraying, dressing etc.) and the reference (such as surface, band, individual plant etc.). Moreover, as far as these methods of application are concerned there are different references for each of them on which calculations are based. The respective reference is indicated in the study protocol.

The calibration/control of both small apparatuses and equipment which is used in the practice (farm-scale equipment) may be divided into the following steps comprising different tasks as far as a spray boom will be concerned:

- Measuring flow rate of the individual nozzles
- Measuring nozzle distance
- Measuring application speed

For the recording of calibration and calculation data specific documentation tools are available and will be consequently used by the field trial officers.

### **General check and calibration of equipment prior to the beginning of the season**

Calibrations prior to the beginning of the season have to be carried out by a patternator test or at least the determination of the single nozzle flow rate for each equipment combination/water rate (nozzle type). They are not necessary; if the alteration of the water rate is only due to a change in pressure (only one pressure has to be set for annual checking).

This implies that for the pressure setting which was not inspected, the nozzle flow rate has to be measured twice right before the application.

Prior to the annual start of the field part of a trial, the application equipment has to be maintained and checked. This inspection may be carried out either by the field trial officer himself or by an internal/external quality assurance system. If necessary, essential parts of the application apparatus, such as

- manometer
- pressure supply
- nozzles

have to be replaced. If this is finalized the inspection has to be repeated. All operations which were carried out have to be documented.

### **Sprayer inspection procedures at Bayer AG – Crop Science with focus on equipment used for arable crops/vegetables and other horizontal spray boom application procedures**

Booms will be inspected in an annual cycle using the Sprayer Test 1000 manufactured by Ernst Herbst Prüftechnik e.K. (picture 1). This is a mobile Electronic Sprayer Test Equipment for testing the distribution of agricultural field sprayer. This inspection will be recorded electronically. The connection between the testing device and the computer is radio controlled - wireless. The dimensions of the test device could be confirmed as practically usable even for a relative small spray boom length of maximum 3 m. These parameters are: groove width = 100 mm; groove depth = 100mm; 1500 table length. The existing software for sprayer inspection will be used – only adaptations for specific printout of the test protocol had been programmed. The complete spray width will be measured and recorded (picture 2). The positioning of the spray boom is horizontally adjusted and the spray boom distance to the grooves reflects the recommended distance during usage in the field. The test unit will normally be operated autonomously from the standard liquid bottles. Instead of these bottles a constant water supply is used, controlled by a pressure regulator and by a certified pressure gauge. It's important to control these booms at standard operating pressures. Due to the specific pipe dimensions pressure losses are relevant for plot trial spray booms. This procedure implies that booms and adjacent combined equipment components like pressurized bottles, connection pipes, trolleys, backpacks and others will be controlled separately. Technical deficiencies at the spray boom which might have an impact on horizontal distribution pattern and safety parameters are in the focus of these inspections such as:

- Leakages at membranes , valves and tubes and pipes
- Existence and functionality of filters
- Nozzle filters with different size and mesh number
- Nozzle filters with different functionalities (e.g. ball strain filters)
- Positioning of nozzles in particular after maintenance activities. It's recommended signaling a number at each nozzle to guaranty constant positioning
- Replace worn nozzles
- Utilize uniform nozzles at each spray boom (, distance, manufacturer, material, calibre, spray angle)
- Deformation of spray boom
- Distance to the target area

Other general requirements for plot trial spray booms

- Liquid supply should be in the centre of the spray boom
- Preferred working width 2 – 3m
- Preferred nozzle distance 50cm; 25cm possible
- Compact injector nozzles (e.g. AirMix; AI XR; IDK) will be more used as a standard in field trial operations
- The usage of specific asymmetric end nozzles needs to be finally checked, tested and approved

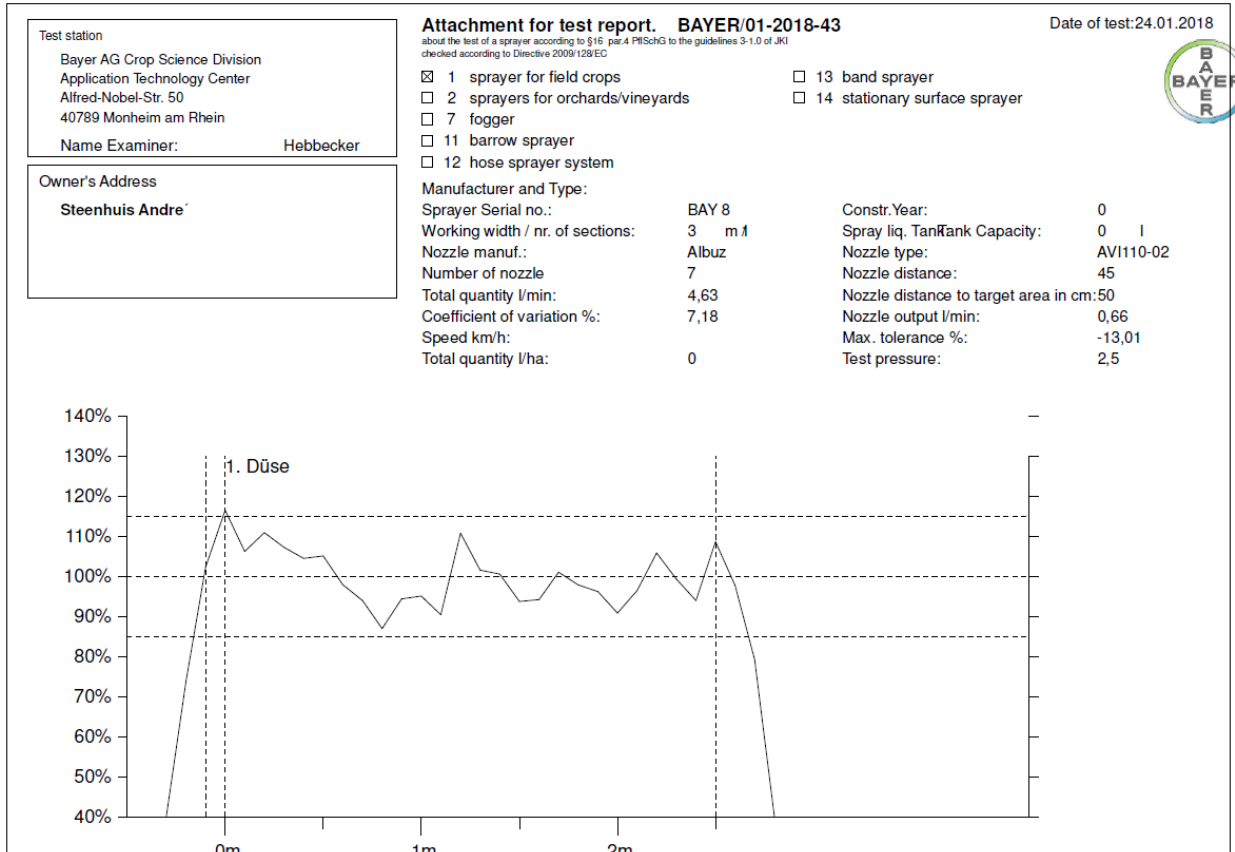
### **Conclusion**

Plot trial technology for the application of Plant Protection products is important to guarantee high quality and reproducible test results. The regular inspection of these equipment is in the company

interest and should follow standardized procedures. Inspection of spray equipment needs to be documented. Beside safety aspects, leakage, calibration and homogeneity of spray liquid distribution should be in the focus of these tests. The Bayer AG had long years' experience using JKI certified patternator and in the documentation of test results.



Picture 1: plot spray boom patternator test system used at Bayer AG



Picture 2: example of a test report of a 3 m boom