Institut für Agrarökologie

Laboratory-scale test system to derive relative foliar wash-off factors (WOF) for plant protection products

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INTRODUCTION

Background

- **Foliar Wash-off Workshop** (ECPA): "Development of a Harmonized Study Protocol". Bracknell, UK, 05.11.2015
- Current lack of experimental methods to determine foliar wash-off of pesticides
- Current standard experimental design for WOF determination:
  - Spray-treated planted pots
  - Placement under rain chamber
  - Realistic application and exposure of intact plants
  - **Drawbacks:**
    - **Variability of leaf distribution has a strong impact on individual leaf's spray and rain interception**
    - **Only large plants with sufficient leaf areas are usable**

Purpose of the study

- Development of a laboratory-scale test system (see Fig. 1) to estimate foliar **wash-off factors in relation to a tracer**
- Simple yet adaptable **screening test design**
- Adapted for ranges of crops, PPP/formulation and rain duration/intensity

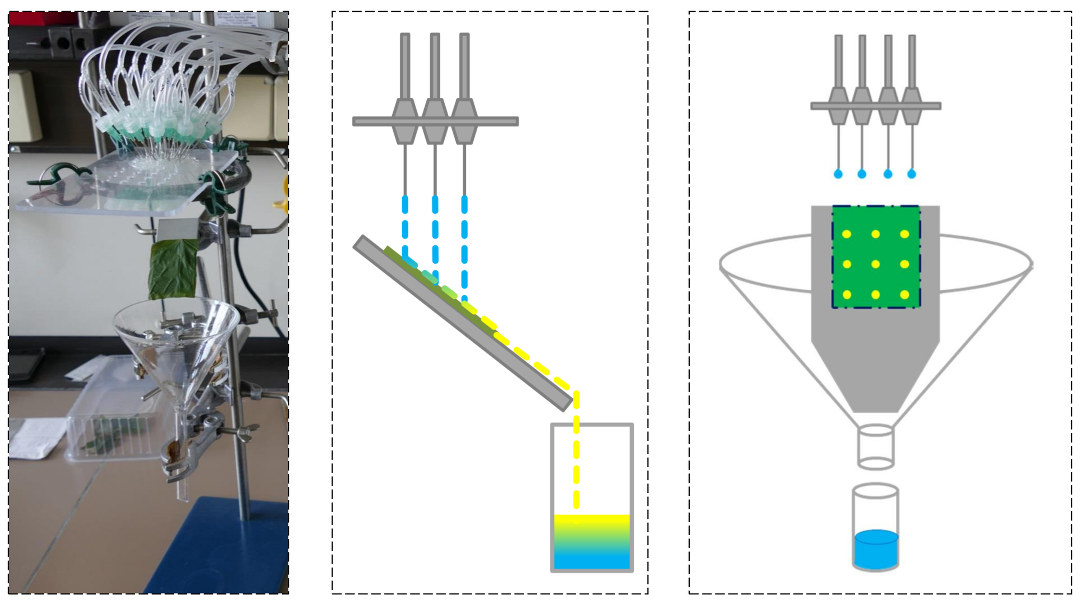

Figure 1: Tier 1 development and schematic of the test system

MATERIAL AND METHODS

Area of investigation

- Crop types
  - **Grape vine**
  - Bean
- Foliar wash-off tracer
  - Bromide (ion exchange chromatography)
  - **Pyranine (fluorescence)**
- Test compound
  - Cyflufenamid (Fungicide, EC formulation)

Figure 2: Detail on leave application

Characteristics of the test system

- Single leaf section application (see Fig. 3)
- Flat irrigated area (**metal** / glass plate, see Fig. 4,5) with fixed angle (45°)
- Micro-irrigation (see Fig. 6)
- Direct collection and evaluation of wash-off solution

Figure 3: Treated leaves during drying period

Leaf preparation and application

- Cultivation in soil under greenhouse conditions
- Harvest of homogeneous leaves shortly prior to application
- Full or section of leaves 4×5 cm² (see Fig. 32
- Homogenous application with 100×1µL drops (see Fig. 2)
- **24h storage** in the dark

Artificial rain and fraction protocol

- **Bi-distilled water**
- Rain flow: 0.5 mL/min
- Standard cumulative fractions after
  - 10, 20, 30, 40, 60 & 80 s (about 1.0 mL/s)

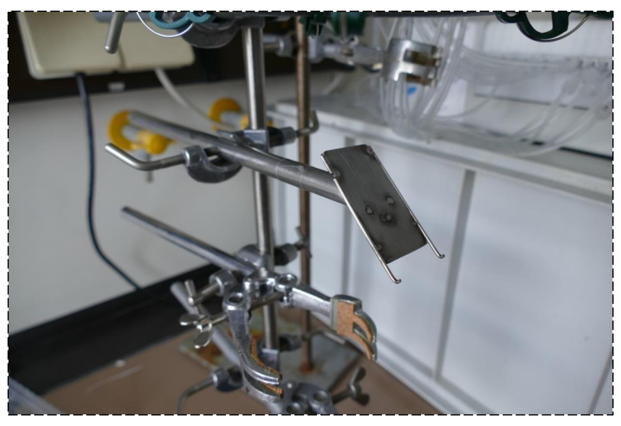

Figure 4: Detail on the plate holder

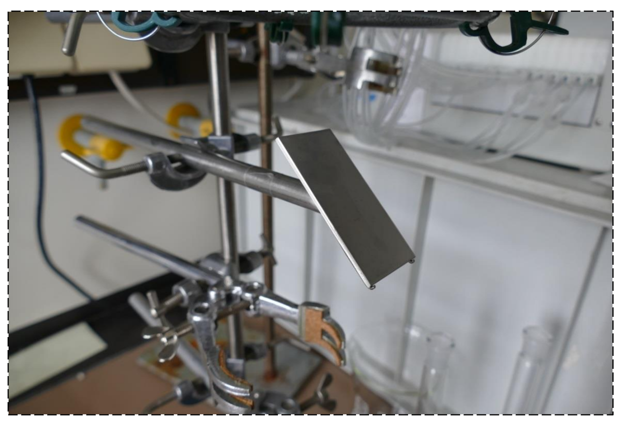

Figure 5: Detail on the leave plate

Figure 6: Detail on the irrigation outlet

RESULTS AND DISCUSSION

Validity of the test system

- Tracer recovery after different storage conditions (see Fig. 9)
  - **Refrigerator**: 80%$_{appl}$
  - Room temperature: 60%$_{appl}$
  - **Storage under cold condition** is more adapted
- Tracer recovery without leave (see Fig. 7)
  - **100%$_{appl}$ both tracer**
  - No parallel losses on the test system
- Tracer recovery with plant (Grape vine):
  - **Pyranine: ~80 %appl**
  - Bromid:~20%appl (not adapted)
- Additional **non-influential** parameters:
  - Drop density < 1 drop / cm²
  - Irrigation temperature
  - Plate holder temperature (when stored under cold conditions)

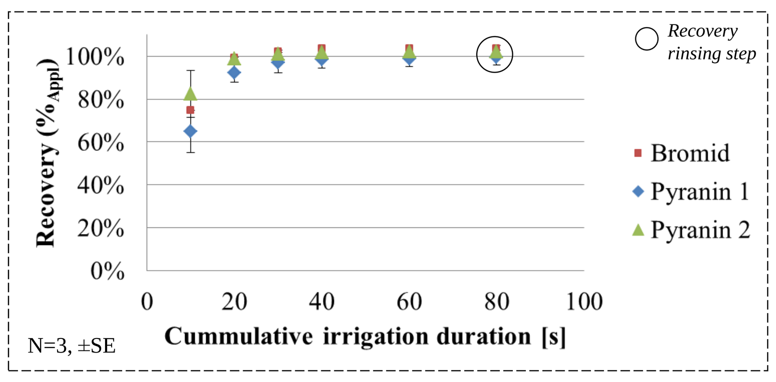

Figure 7: Recovery of bromide and pyranine from metal leaf holder

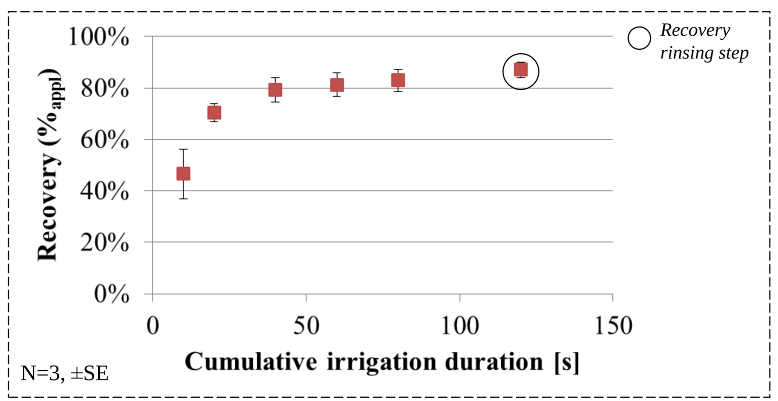

Figure 8: Recovery of pyranine from grape vine leave

First results Cyflufenamid

- Recovery comparison in the first two fractions
  - Pyranine: 56%$_{appl}$ (1st fraction) and 16%$_{appl}$ (2nd fraction)
  - Cylfufenamid: 31%$_{appl}$ (1st fraction) and 18%$_{appl}$ (2nd fraction)

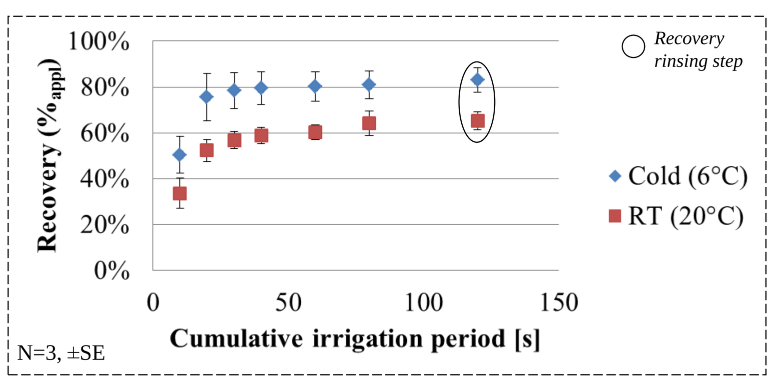

Figure 9: Influence of the storage temperature (pyranine)

CONCLUSION AND FURTHER INVESTIGATION

- ✓ Fractionation of the wash-off solution improves the understanding of the wash-off dynamics
- ✓ Even under worst case rainfall conditions, removing > 80% of applied tracer by wash-off (including recovery rinsing step), a "significant portion" of Cyflufenamid (about 50%) remained on the leaves
- ✓ Perspective:
  - Development of a rain chamber for comparison with full plants
    - Controlled rain intensity (See Fig. 11)
    - About 4 m high (See Fig. 10)
  - Participation to a inter-laboratory ring test with the rain chamber

Figure 10: Future rain chamber

Figure 11: Detail on the rain chamber nozzle