Recovery and stability of fluorescent tracer Acid Yellow 250

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Fluorescent tracers are often used for spray drift and deposition measurements because of their high sensitivity, allowing to measure very low spray deposits. A negative characteristic of these tracers is degradation by sunlight and storage. Recovery rates of the tracer Acid Yellow 250 were measured after exposure to sunlight, application to filter cloth collectors and after storage. After 30 minutes of sunlight exposure the recovery rate was 91%. The filter cloth collectors showed a very high recovery rate of 99.8%. After six weeks of storage in a dark and cooled storage the recovery rate was 90%. These results are very similar compared to the well-known tracer Brilliant Sulpho Flavine.

Keywords: fluorescent tracers, Acid Yellow 250, degradation, recovery, spray drift, spray deposition.

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Contents

1 Introduction

In experiments concerning spray drift and spray deposition a fluorescent tracer is very suitable to use. A major advantage of fluorescent tracers is their high sensitivity, which means that spray deposits can be measured very accurately at low concentrations. Besides, the costs of analysis are low compared to those for deposits of active ingredients of plant protection products (PPP). However, a clear disadvantage of fluorescent tracers is their relative limited stability when exposed to direct sunlight as often is the case in field experiments on spray distribution and spray drift. Earlier research showed that the tracer Brilliant Sulpho Flavine (BSF, CI 56205) is one of the more stable tracers (Cai & Stark, 1997; Pergher 2001) which makes BSF a useful tracer in experiments involved with spraying. However, because of large variations in BSF quality (Stallinga *et al.*, 2012) and limited availability, tracer Acid Yellow 250 (AY250; cas number 93859-32-6) is used instead for spray deposition and drift trials by Wageningen Plant Research. This tracer has very similar properties as BSF, but there is no data available on degradation by sunlight, collector recovery rate and the effect of storage. To verify recovery and stability an experiment was performed based on the requirements of ISO 22866 (ISO 22866, 2015). The setup and results are presented in this note.

2 Materials and Methods

The experiments were performed using filter cloth collectors (Technofil TF-290; 50 x 10 cm) and a solution of demineralized water and AY250 (0.05 g/l).

To determine the breakdown effect by sunlight, filter cloths were attached on Styrofoam plates and spiked with 5 ml of the AY250 solution. The collectors were exposed to sunlight for a duration of 15, 30 and 60 minutes. The experiment was performed in sunny conditions on 24 June 2024. Five filter cloths for each exposure time were used. A set of reference collectors was not exposed (0 minutes). Solar intensity during the period of exposure was 824 W m^{-2}, measured by a weather station. The collectors were rinsed immediately after the exposure time with 1 L of demineralised water. A spectrophotometer (Perkin Elmer FL 8500; wavelength: excitation 450 nm, emission 500 nm) was used to measure the fluorescence value of each sample. For background detection untreated collectors and the fluorescence of the demineralised water were analysed as well. The measured fluorescence value of each sample was calculated to recovery volume (µL) with the following formula.

$$V_{sample} = \frac{(F_{sample} - F_{demi} - F_{blank}) \cdot f_{cal} \cdot V_{dilution}}{\rho_{solution}}$$

V_{sample}	recovery volume [µL]
F_{sample}	fluorescence value of the sample
F_{demi}	background fluorescence value of the demi water
F_{blank}	background fluorescence value of a blank sample
f_{cal}	calibration value from fluorescence value to µg/L
$V_{dilution}$	dilution volume [L]
$\rho_{solution}$	concentration of the solution [g/L]

Collector recovery rate of the filter cloth collectors was determined by applying 5 ml of the same AY250 solution directly in 1 L of demineralised water and 5 ml of liquid on filter cloth collectors in ten repetitions. After the liquid dried, the filter cloth collectors were washed in 1 L demineralised water and analysed with the spectrophotometer. By comparing the fluorescence value of the directly applied solution and the solution applied on the filter cloth collectors, the recovery rate was calculated.

The effect of storage was determined by applying 5 ml of the AY250 solution on filter cloths, put them in plastic bags and store them in a dark, cooled storage with a temperature of 5 °C. The filter cloths were analysed directly (0) and after 3, 6 and 9 weeks. Five collectors were analysed for each storage time.

3 Results

The results of the tracer degradation by exposure to sunlight, collector recovery rate and degradation by storage are shown in the next paragraphs.

3.1 Degradation by exposure to sunlight

The recovery rate of AY250, compared to the recovery volume at time 0, after different sunlight exposure times (minutes) is presented in Figure 1.

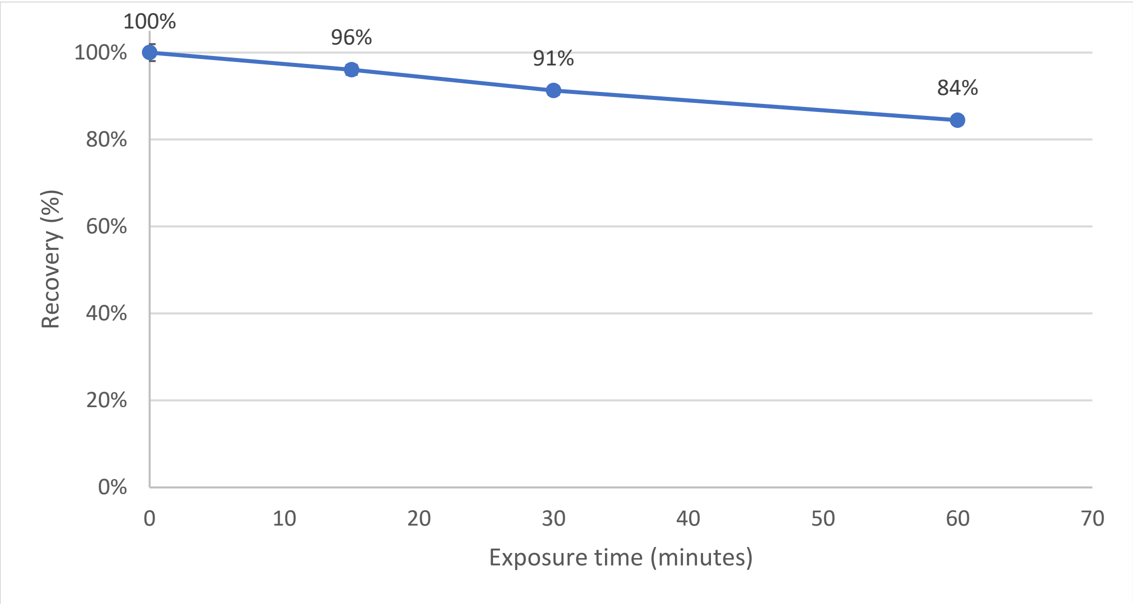

Figure 1 *Recovery of fluorescent tracer AY250, spiked on filter cloth collectors, after exposure to sunlight with standard deviation indicated.*

The results show a recovery rate of tracer AY250 of 96% (SD=1%) after 10 minutes exposure time to sunlight. After 30 minutes the recovery rate drops to 91% (SD=1%).

3.2 Recovery rate of the filter cloth collectors

Direct application of 5 mL to 1 L of demineralized water results in a measured recovery volume of 4.89 (SD=0.038) ml. Application of the AY250 solution on filter cloth collectors results in recovery volume of 4.88 (SD=0.092) ml. The combination of AY250 tracer and filter cloths show a very high recovery rate of 99.8%.

3.3 Degradation by storage

The effect of degradation by storage, compared to the recovery volume at time 0, is shown in Figure 2.

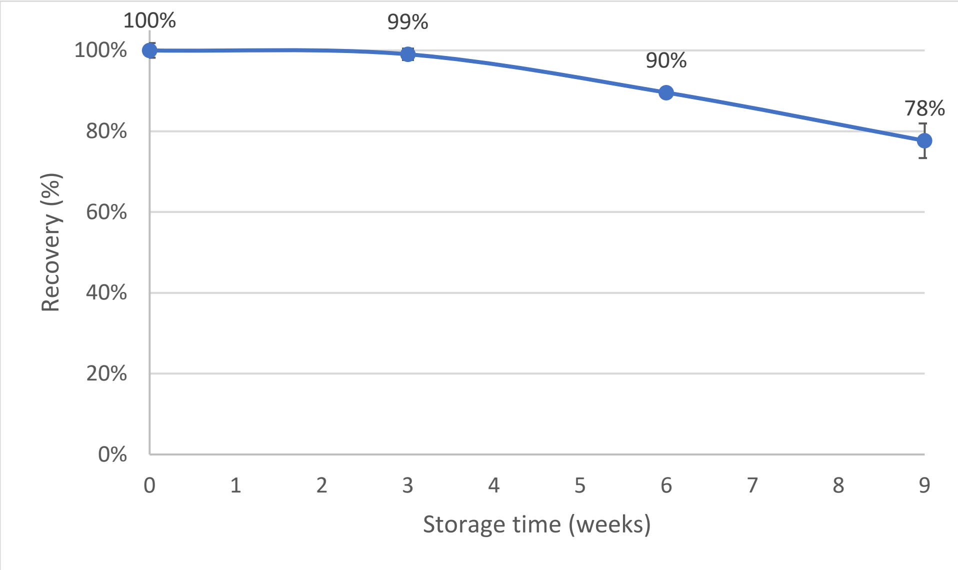

Figure 2 *Recovery of fluorescent tracer AY250 after storage with standard deviation indicated.*

After 3 weeks there is almost no effect of storage on the recovery of AY250. After six weeks 90% (SD=1%) is recovered. After six weeks degradation increased and resulted in a recovery of 78% (SD=4%) after 9 weeks.

4 Discussion and conclusions

The expected degradation by sunlight exposure is demonstrated in this experiment. With a sunlight intensity of 824 W m^{-2}, the recovery rate was 91% compared to the non-exposed collectors. Stallinga *et al*. (2012) evaluated breakdown in sunlight and degradation by storage of different batches of BSF. Average sunlight intensity was between 200 and 480 W m^{-2}. For one of the most well performing batches (2009a) the recovery rate was on average 86% after 30 minutes and 69% after 60 minutes of sunlight exposure. Compared to the AY250 experiment with a sunlight intensity which was much higher during the experiment, AY250 showed less degradation by sunlight than the tracer BSF.

Filter cloth collectors are known for their high collector recovery rate (ISO 22866, 2005). The measured collector recovery rate was very high with 99.8%, which means that almost no tracer is left behind in the filter cloth after rinsing. Both measured volumes are slightly below the expected 5 mL though, likely caused by a systematic error in the analysis procedure.

AY250 shows are relative limited amount of degradation up to 6 weeks of storage of 90% recovery rate. After 6 weeks the degradation rate increased, so the recommendation is to not exceed the 6 weeks of storage time in experiments. Up to six weeks degradation by storage is similar between BSF and AY250. The 2009a batch of BSF resulted in an average recovery rate of 91% after 6 weeks and 89% after 8 weeks of storage time (Stallinga *et al*., 2012), so after six weeks AY250 showed a stronger degradation than BSF.

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