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THE INFLUENCE OF DRIFT REDUCTION AGENTS AND WIND SPEED ON SPRAY DRIFT IN WIND TUNNEL

Steponavičius D., Lekavičienė K., Andriušis A., Zaleckas E., Zinkevičius R., Jomantas T., Vytautas Magnus University, Agriculture Academy (Lithuania), **Ignatavičius J.** JSC "Nando Labs" (Lithuania)

INTRODUCTION

The wind is one of the most important environmental factors that cause the drift of sprayed plant protection products. Spraying many plant protection products are not recommended at wind speeds higher than 4 m s^{-1} (Tepper, 2017). Blowing side wind or frequent gusts of wind be able to blow poisonous droplets quite far away (30 meters or more). Due to wind-induced dispersion of the spray liquid, higher costs are incurred, pollute the environment, and may cause adverse effects on human health (Pradhan and Mailapalli, 2020). To reduce the negative influence, preparations with anti-drift properties are increasingly being investigated (Landim et al., 2019). Therefore, the aim of the study – to analyze the efficiency of the newly developed drift reduction agents (DRA) at different wind speeds.

MATERIALS AND METHODS

Trials of drift reduction solutions were carried out in open circuit type wind tunnel which was developed to study the drift from the sprayer nozzle under controlled and repeatable environmental and spraying conditions (Fig. 1). The wind tunnel cross section increased from 0.9×0.9 m at the entrance to 1×1 m at the exit with a slope of 0.5°. The chambers were 5 m long in total. An air-injector nozzle was used during trials. The spray liquid was supplied with a Pentair Hypro Shurflo Standard Table Spray 220 VAC. The spray pressure was 4.0 bars.

The trials were performed with water (control) and two solutions (DRA-1 and DRA-2) in which the main part of the active substance of 0.1% concentration was calcium dodecylbenzenesulfonate (CDS) (50%) and butanol (18%). In both solutions, one of the active ingredients was polyether-modified trisiloxane (PMT), which belongs to organic silicon surfactants. Polyether-modified trisiloxane concentration was 0.06% in solution DRA-1 and 0.10% in solution DRA-2. Polyether-modified trisiloxane reduce the surface tension of solutions and can also wetting the surface of hydrophobic plants. Water and two solutions (DRA-1 and DRA-2) were sprayed at two different wind speeds (8 m s^{-1} and 10 m s^{-1}). A total of 30 L of each solution was sprayed. Tests were repeated three times.

A probability level of 0.05 was used as the criterion for tests of significance throughout the data analysis.

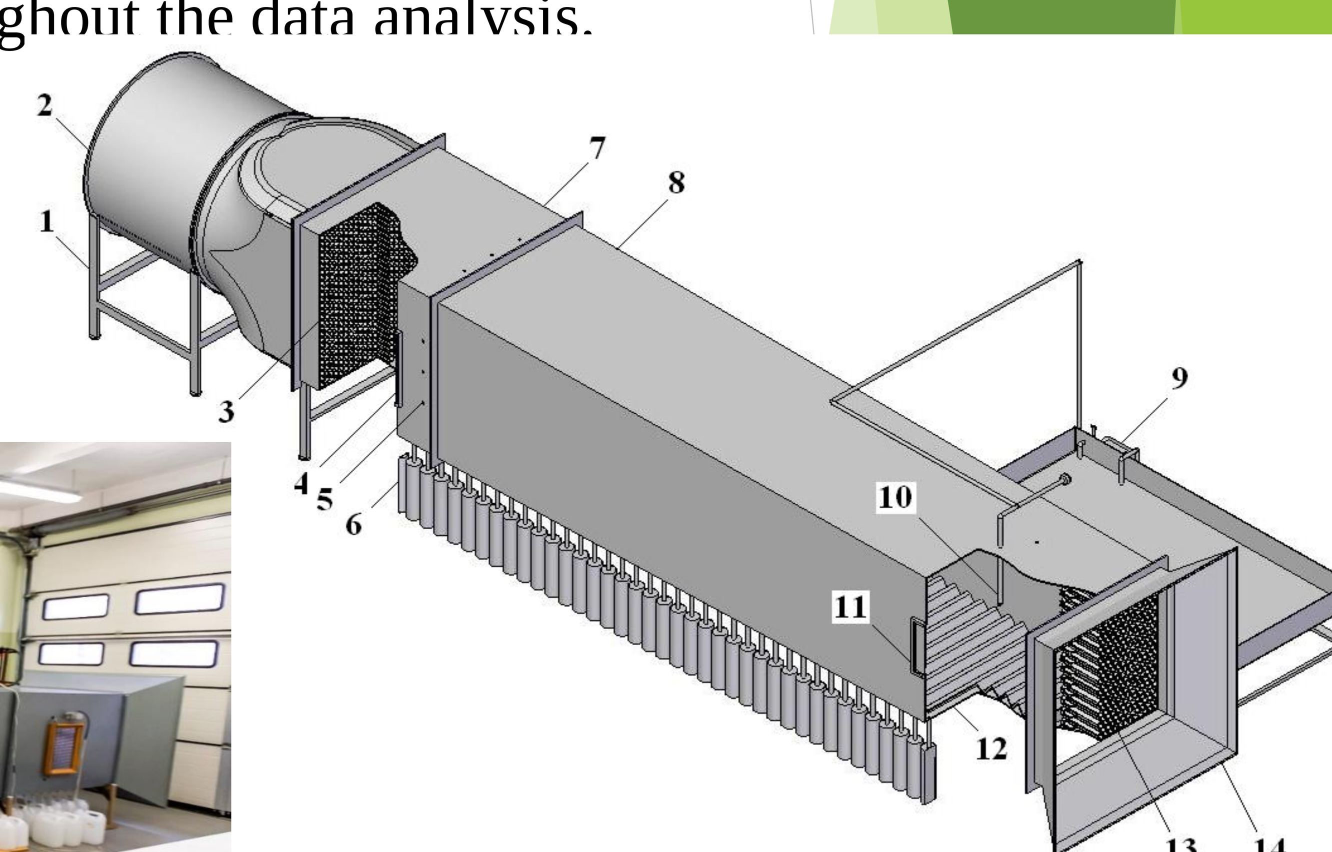

Fig. 1. Test bench (wind tunnel) for spray drift investigation (Bauša et al., 2018): 1, frame; 2, suction fan with electric motor; 3, 13, air flow straighteners; 4, 11, window; 5, air velocity measurement place; 6, flask; 7, connection chamber; 8, investigation chamber; 9, spray supply equipment; 10, nozzle; 12, corrugated tin; 14, air intake section.

RESULTS

Studies have shown that droplets drift depends on the wind speed and the type of drift reduction agents (Fig. 2 and 3). When the water droplets sprayed with the nozzle are affected by 8 m s^{-1} side air flow, their drift reached 21.7 ± 0.7%. By increasing the air flow speed to 10 m s^{-1}, the drift of water droplets carried downwind increased by 20% (up to 27.2 ± 0.4%). Summarizing the research, it can be stated that when the wind speed was 8 m s^{-1}, experimental DRA-2 solution drifted about 46% less than water and about 17% than other DRA-1. When the wind speed reached 10 m s^{-1}, experimental DRA-2 solution drifted about 30% less than water and similar with other DRA (i. e. DRA-1). The reason for this is a solution of a substance DRA's restricting the small droplets that are the most exposed to the wind.

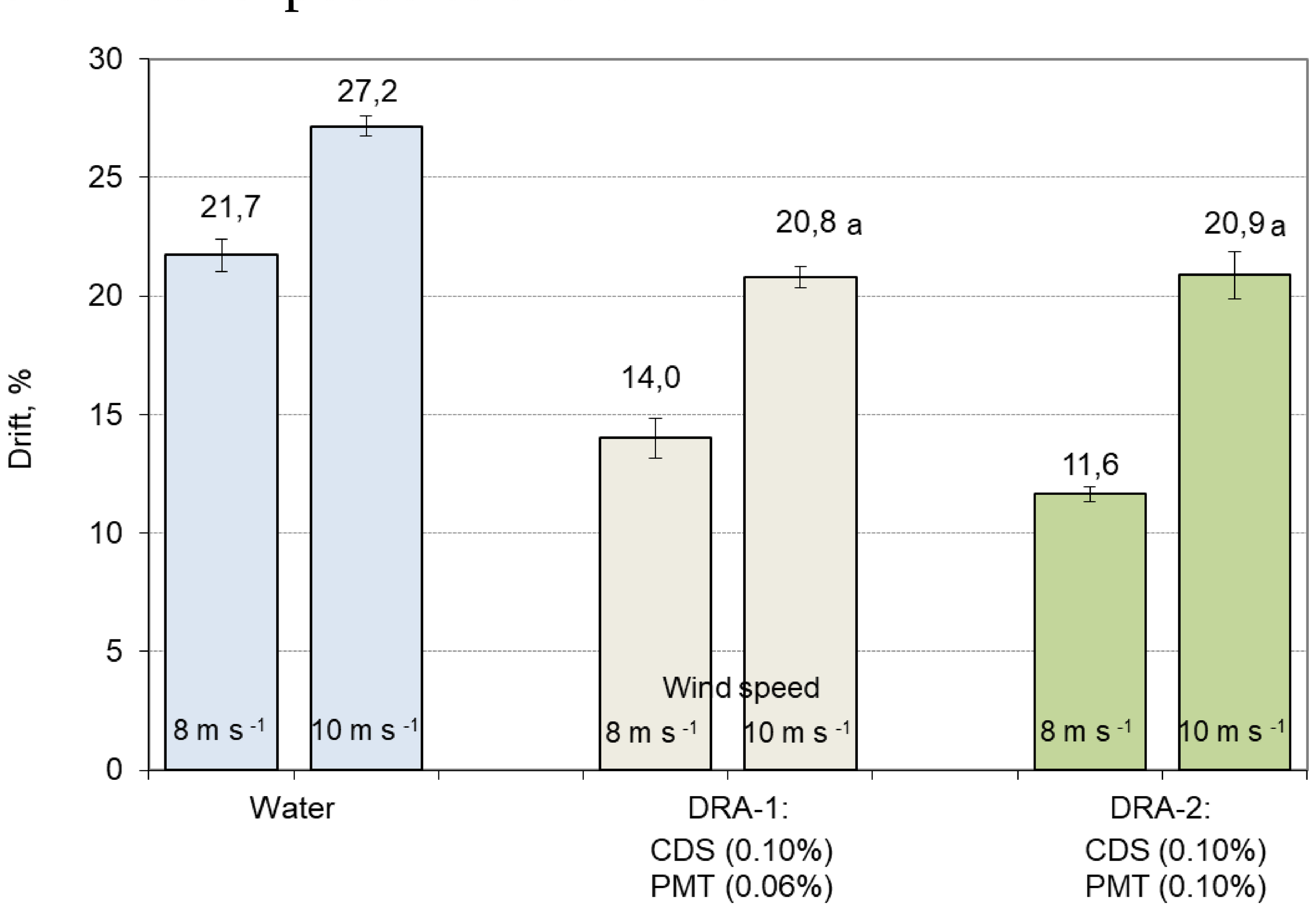

Fig. 2. Spray drift (ml) affected by side wind.

CONCLUSIONS

Studies have shown that a higher spray drift difference between different solutions at less wind speed (8 m s^{-1}) was observed compared to a wind speed of 10 m s^{-1}. At a wind speed of 8 m s^{-1} the least spray drift (11.6 ± 0.3%) was obtained using DRA-2 solution. At a wind speed of 10 m s^{-1} the spray drift of DRA-1 and DRA-2 solutions was similar and about 23% lower than that of water.

Summarizing the studies, it can be stated that the use of both experimental DRA's will have a positive impact on the environment.

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