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Droplet size of pneumatic spraying nozzles used for the control of coffee pests

By OLINTO LASMAR, MARCELO DA COSTA FERREIRA,
SERGIO TADEU DECARO JUNIOR and JOSÉ RICARDO LORENÇON

São Paulo State University, Faculty of Agriculture and Veterinary Sciences
Dept. Phytosanitary, Access road Prof. Paulo Donato Castellane, 14884-900 Jaboticabal, SP – Brazil
Corresponding Author Email: lasmar84@yahoo.com.br

Abstract

The spray nozzles are responsible for the formation of droplet and each nozzle presents its own characteristics related to the specific droplet spectrum for certain targets. In coffee crops, the target control of some insects is done primarily through foliar spray at high volumes; however, the application in ultra-low volume (ULV) emerges as a promising alternative for use in the Integrated Pest Management, mainly by decreasing volumes of water applied and increase operational performance. The aim of this study was to evaluate the diameter of the droplets formed from a pneumatic nozzle of a ULV sprayer developing, in order to control *Leucoptera coffeella* by applying insecticide spraying liquids with different concentrations of mineral oil. The experiment was conducted in April 2012 in the town of Altinópolis, SP and the plots were constituted of coffee plants variety Catuaí IAC - 99, approximately 12 years old and an average height of 2.50 m. Treatments were applied in a volume of approximately 70 L ha^{-1} through a pneumatic sprayer (in developing) using an insecticide (profenofos + lufenuron) at a dosage of 800 mL pc ha^{-1} with different concentrations of mineral oil (5, 10, 15 and 20%). The spectrum of the droplet diameter was determined by the droplet collection according to the method of a glass slide coated with magnesium oxide, which were fixed in the middle third of the plants in a randomized block design with four replications. After sprayings, the slides were taken to the laboratory of the Nucleus for Research and Development to Application Technology - NEDTA, Dept. Phytosanitary - UNESP, Campus Jaboticabal-SP, Brazil and evaluated on an optical microscope equipped with a micrometer scale. Data were analyzed using polynomial regression. All four oily spraying liquids showed low values of VMD with 33.78, 50.22, 56.85 and 46.66 μm, respectively (Fig. 1). These values are far below the DMV expected (± 100 μm), causing the droplet to have not enough energy to be deposited on the surface of the coffee leaves, contributing negatively to the quality of the application and consequently the effectiveness of insect control target. Furthermore, we have an environmental issue, since one is dealing with very small droplet and that, if not used with proper technical knowledge, can cause serious contamination problems, especially for pollinator insects. Therefore, new adjustments must be made in sprayer for new determinations of droplet diameter so that information can contribute in the development of the pneumatic sprayer in coffee crop.

Key words: Droplet spectrum, ultra-low volume, *Coffea arabica*

Introduction

The spray nozzles are responsible for the formation of droplets and each nozzle presents its own characteristics related to the specific droplet spectrum for certain targets. In coffee crops, the control of some target insects is done primarily through foliar spray at high volumes; however, the application in ultra-low volume (ULV) emerges as a promising alternative for use in Integrated Pest Management, mainly by decreasing volumes of water applied and increase operational performance.

The spectrum of droplets produced by an equipment depends on the type of spray nozzle, orifice size and working pressure, and chemical-physical characteristics of the spraying liquid (Paulsrud & Montgomery, 2005).

Among the innovations incorporated recently into agricultural spraying systems for perennial crops in Brazil, we can mention spraying at ultra low volume (ULV), which uses concentrated pesticides formulated in oils, sprayed with very fine droplets (less than 100 micron VMD) with volumes from 20 to 40 L per hectare, which should be made with adjuvants capable of reducing the evaporation of the drops (CBB, 2011).

There are ULV sprayers that use of the pneumatic nozzles types (energy gas nozzles) to produce a droplet spectrum suitable according to the target and currently, its use is more frequent in urban area sprays to control insect vectors of disease, although their use in the agricultural is also known. In this context, the aim of this study was to evaluate the diameter of the droplets formed from a pneumatic nozzle of a ULV sprayer developing, in order to control *Leucoptera coffeella* by applying insecticide spraying liquids with different concentrations of mineral oil.

Materials and Methods

The experiment was conducted in April 2012 in the town of Altinópolis, SP and the plots were constituted of coffee plants variety of Catuaí IAC-99, approximately 12 years old and average height of 2.50 m. Treatments were applied in a volume of approximately 70 L ha^{-1} through a pneumatic sprayer in developing (Smart 400 UBV) with 12 flat spray nozzles (Fig. 1A and 1B), and using an insecticide (profenofos + lufenuron) at dosage of 800 ml pc ha^{-1} with different concentrations of mineral oil (5, 10, 15 and 20%). The working pressure of the sprayer was approximately 0.6 kgf. cm^{-2} in the air compressor.

The spectrum of the droplet diameter was determined by the droplet collection according to the method of a glass slide coated with magnesium oxide, which were fixed in the middle third of the plants in a randomized block design with four replications (Fig. 1C).

Fig. 1. ULV Sprayer (A), pneumatic flat spray nozzle (B) and the glass slide coated with magnesium oxide (C).

After spraying, the slides were taken to the laboratory of the Nucleus for Research and Development to Application Technology - NEDTA, Dept. Phytosanitary - UNESP, Campus Jaboticabal-SP, Brazil and evaluated on an optical microscope equipped with a micrometre scale. Data were analyzed using polynomial regression.

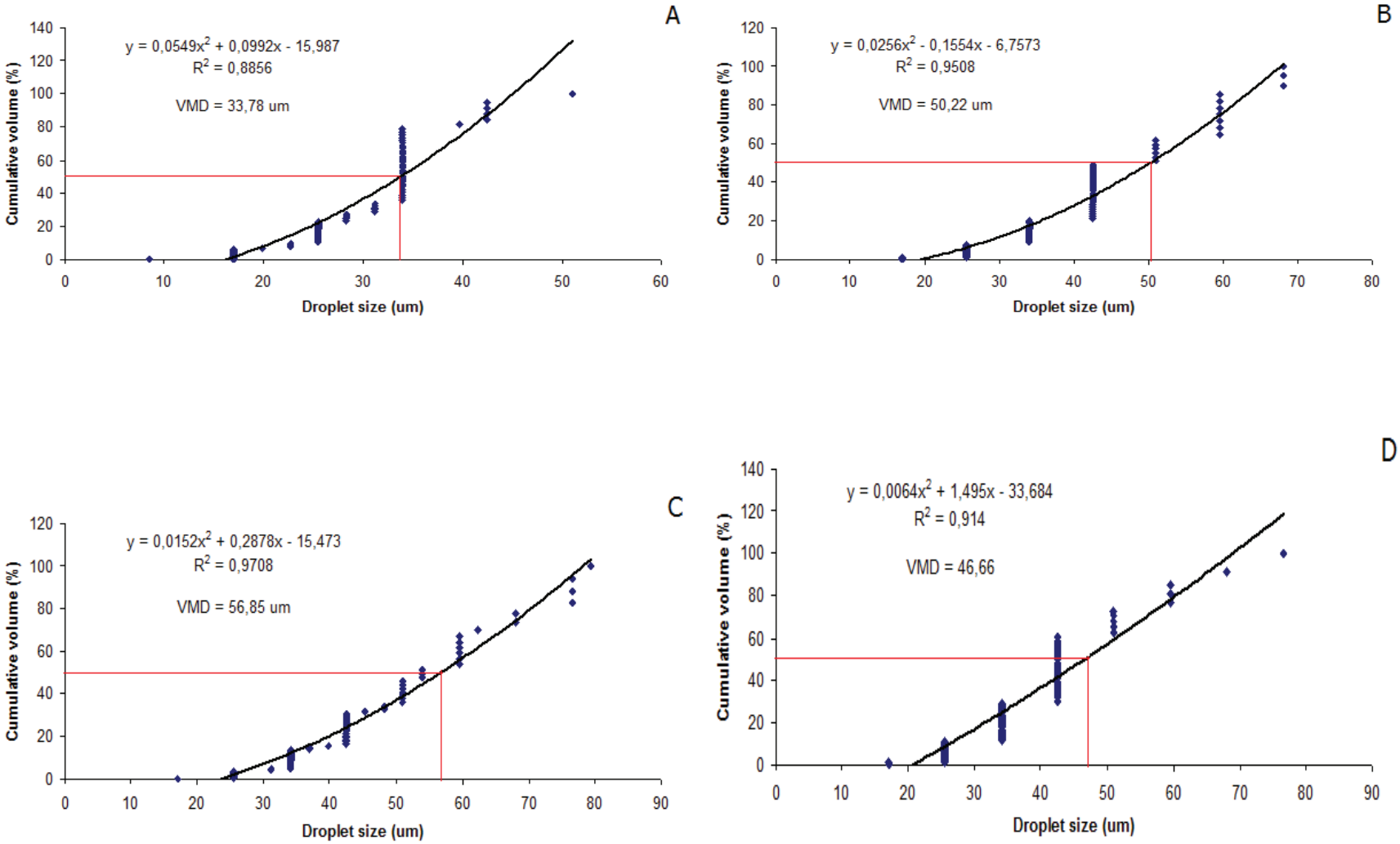

Fig. 2. Volumetric median diameter of droplet (VMD) produced by pneumatic sprayer according to the different concentrations of mineral oil in spraying liquids: 5% of oil (A), 10% oil (B), 15% oil (C) and 20% oil (D).

Results and Discussion

All four oily spraying liquids showed low values of VMD with 33.78, 50.22, 56.85 and 46.66 µm, respectively (Fig. 2, ABCD).

These values are far below the DMV expected (± 100 µm), causing the droplet to have not enough energy to deposited on the surface of the coffee leaves, contributing negatively to the quality of the application and consequently the effectiveness of insect control target.

According to Raetano *et al*. (2001), in the case of coffee crop, their format may constitute a serious obstacle to the application of pesticides that need to directly reach the target, such as fruits, leaves and branches over the internal canopy. These authors evaluated the coverage of spraying with different equipment and operating conditions in this culture and found it more difficult to reach the bottom third of the plants, providing a low control efficacy.

In sprayers for tree crops, any configuration that maintains a minimum effective distance between each nozzle and its respective target improves the uniformity of deposit and reduces drift. Furthermore, the use of ducts (towers and spears vertical or horizontal) is growing in popularity among operators, especially in relation to the search for better deposition rates, which are more accurate and lower requirements on the protection zone, contributing to improved spray quality and reduced waste (Deveau, 2009).

Furthermore, we have the environmental issue, since one is dealing with very small droplet and that if not used with proper technical knowledge can cause serious contamination problems, especially for pollinators insects.

Conclusions

All four oily spraying liquids showed low values of VMD with 33.78, 50.22, 56.85 and 46.66 µm, respectively. Therefore, new adjustments must be made in sprayer for new determinations of droplet diameter so that information can contribute in the development of the pneumatic sprayer in coffee crop.

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