Normative and operative issue on the use of ULV

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Summary
Droplet size sprayed by different models of foggers and knapsack mistblowers, adjusted to apply different volume rates, was measured using a laser diffraction instrument (Malvern Spraytec). Thanks to a dedicated software, for each equipment and setting tested, the instrument provided the droplets parameters used to characterize the sprayed droplets size (VMD or D50, D1, D90 and V100). Droplets sprayed by knapsack mistblowers resulted slightly coarser, with VMD ranging from 77 to 90. Concerning foggers tested (one cold fogger and one thermal fogger) results pointed out that ultra fine droplets were sprayed, featured by VMD values ranging between 37 and 78 μm according to the size of the dosing nozzles. The draft of test protocol for the inspection of foggers in use was prepared on the basis of elements available in EN ISO Standard and in analogue documents already prepared and used in some EU countries. The draft test protocol seems to be applied without problems for the inspection of this type of PAE in use.

1. Introduction

Ultra Low Volume (ULV) Pesticide Application Equipment (PAE - hot fogger, cold fogger, knapsack mistblower fitted with ULV kit) are sprayers which produce very small droplets (50-60 μm) and allow to apply pesticides with very low volume application rate. At present, for these type of PAE no EN/ISO Standard methods and requirements for both brand new and in use machines are available. In Italy the national law which implements the EU Directive 128/2009 on sustainable use of pesticides (D.lgs 150/2012 and the relative National Action Plan) requires the mandatory inspection also for the ULV sprayers in use. At the same time in some Italian Regions restrictions about the minimum size of droplets emitted by the sprayers have been introduced, aimed at containing spray drift and its environmental and bystander risk. If this latter aspect should not be a problem for the foggers, as they are usually operated indoor (e.g. in glasshouses and storerooms), it could pose limitations for use of knapsack mistblowers in open fields. As there is not a bibliography on the subject, this work was aimed at assessing the droplets size generated by four models of commercial knapsack mistblowers and two models of commercial foggers. Moreover, a specific draft test protocol for the inspection of foggers in use was prepared.

2. Materials and methods

Droplets size

Tests were carried out in the Crop Protection Technology Laboratory at DiSAFA – University of Torino (Italy), using a Malvern Spraytec laser diffraction instrument to measure the size of droplets, expressed in terms of VMD (D50), D10, D90, and V100 (percentage of volume of drops having a diameter smaller than 100 μm - Van de Zande, 2008), generated by 2 different foggers (thermal and cold) and 3 knapsack mistblowers (Table 2.1). Droplets size measurements were carried out positioning the outer edge of the spout of each sprayer tested at a distance of 500 mm from the laser beam and aligning the

centre of the spout with the laser beam axis. Tests were conducted spraying deionised water (at 20°C temperature) in conditions of air temperature of 21-25°C and relative humidity of 85-90%

Table 2.1: Different models of ULV sprayer tested.

Sprayer	Air speed (m/s)[1]	Nominal flow rate (L/min)
A –Thermal fogger dosing nozzle 1	--	0.24
A - Thermal fogger dosing nozzle 2	--	0.54
B - Cold fogger dosing nozzle 1	--	0.15
B - Cold fogger dosing nozzle 2	--	0.33
C - Knapsack mistblower 1	10.3 – 6700 rpm	0.70
D - Knapsack mistblower 2	5.9 – 7300 rpm	0.75
E - Knapsack mistblower nozzle 1	6.8 – 6000 rpm	1.10
E - Knapsack mistblower nozzle 2	6.8 – 6000 rpm	1.40

Draft protocol for functional inspection of fogger

The draft of test protocol for the functional inspection of foggers in use was prepared on the basis of elements available in EN ISO 16122-1 and EN ISO 16122-4 and in documents already prepared and used in some EU countries like Belgium and the Netherlands.

3. Results and Discussion

Droplets size

VMD of droplets emitted by the tested foggers always resulted below 80 µm. Finer droplets sizes were registered when the reduced liquid flow rates were employed; in these cases also the V100 value resulted very high (90%) (Table 3.1). Knapsack mistblowers generally sprayed droplets slightly coarser (featured by VMD ranging between 77 and 90 µm). Droplets size in this pneumatic equipment was affected not only by the liquid flow rate but also aby the air velocity. In this case, the percentage of droplets with diameter below 100 µm resulted lower with respect to the ones found using the foggers.

Table 3.1: Results obtained.

Sprayer	D10 (µm)	VMD (µm)	D90 (µm)	V100 (%)
A - Hot fogger dosing nozzle 1	17	37	87	90
A - Hot fogger dosing nozzle 2	26	64	166	72
B - Cold fogger dosing nozzle 1	29	56	99	90
B - Cold fogger dosing nozzle 2	32	78	153	64
C - Knapsack mistblower	37	90	169	58
D - Knapsack mistblower	29	77	186	68
E - Knapsack mistblower nozzle 1	35	81	172	65
E - Knapsack mistblower nozzle 2	37	85	178	67

Comparing the droplet size spectra obtained for the tested sprayers with that of the reference nozzle (ISO flat fan 03 operated at 3 bar pressure, VMD = 240 µm) indicated by the British Crop Protection Council (BCPC) it is possible to classify the droplets generated by foggers and knapsack mistblowers as very fine (VF) and fine (F) respectively. In Figure 3.1 examples of droplets spectra obtained using a thermal fogger and a mistblower are reported.

[1] data (measured 3 metres from the point of delivery) take from ENAMA Certificate

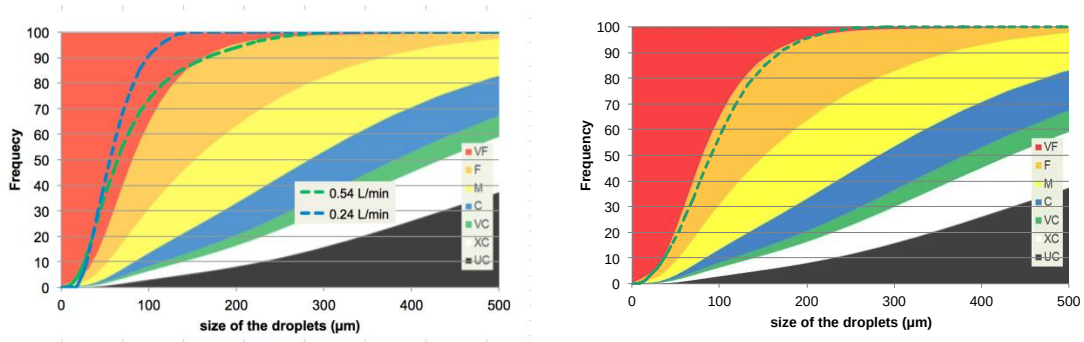

Fig.3.1: Examples of droplets spectra of hot fogger (sx) and knapsack mistblower 1 (dx).

Draft protocol for functional inspection of fogger

Pre-inspection

Follow EN ISO 16122-1 requirements (when applicable).

Safety of the machine

All guards (covers, locking, etc.) belonging to the machine are present, do not show excessive wear and function properly. The exhaust pipe is sufficiently shielded or fitted with warning labels to avoid injury by heatin. The fuel tank (if present) shall be in good condition, shows no leakage and equipped with a matching cap and functioning breather. The gasoline pipe (in present), including filters, check valve, diaphragm, dispensing needle shall be in a good condition and does not show any leakage. Fuel tank (in present) shall be well fixed. The exhaust pipe (if present) shall be in good condition.

The mechanical condition of electrical power (if present) shall be in good conditio, considering moisture, dirt and corrosion. The protection, clearing and earth conductors shall be not interrupted. Tools, controls, contactors, switches and warning signs/labels shall be in good condition. The connecting lines or mobile lines shalll be not damaged or improperly repaired. All the associated installation and plugs shall be in good condition. The electrical system has not undergone any modifications, in particular in the safety features, which affect the safety. The condition and status compressor (if present), drive, tank, hoses and pipes, shall be in good condition.

Test method: visual check

Requirements of the machine

Concerning leaks and dripping, spray mix agitation, spray liquid tank, measuring, controls and regulation systems, lines and filtering system, nozzles output follow the indication of EN ISO 16122-4 (when applicable).

Other specific requirements

The ignition and functioning burner shall function properly (thermal fogger).

Functioning compressor shall function properly (cold fogger).

During a trial run of the machine is visually checked whether the formed droplet spectrum is uniform and sufficiently fine.

Test method: function test

4. Conclusion

Droplets size measurements carried out on ULV sprayers confirmed their very fine level of pulverisation. On one hand this is a positive aspect as, operating at a defined spray volume, fine droplets enable to increase target coverage and this is very important for contact PPP. However, very fine droplets are more susceptible to evaporation and drift, so attention shall be paid in order to prevent this phenomena especially when operating with environmental temperatures over 30°C and in windy areas. If fogger use is recommended only indoor, as

there is no way to significantly increase the droplets size, for knapsack sprayers that are often operated outdoor it is necessary to reduce the engine rotation speed at the minimum level indicated by the manufacturer and to increase the liquid flow rate in order to get coarser droplets. Some experimental data registered at DiSAFA during ENAMA certification tests of new knapsack mistblowers pointed out that reducing the engine and therefore the fan rotation speed by 20% it is possible to increase the average droplets size up to 60%. Concerning the draft test protocol for foggers in use, it will be re-examined by the competent SPISE Technical Working Group to publish and disseminate it as SPISE Advice (as it already happened for boom sprayer and orchard sprayer adjustment and for the inspection of train sprayers). This with the aim to use this document as basis for a future International Standard.

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