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SPRAYING QUALITY ASSESSMENT OF SPRAYERS DEVOTED TO MOSQUITO CONTROL

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Abstract

Mosquito control operators in France are mainly public and have at their disposal a wide range of spraying techniques to control mosquitoes. Due to the lack of commercial solutions, and in order to meet technical objectives and comply with regulations, they look to continuously improve their spraying application techniques.

In the framework of the European Life+ project LIFE08 ENV/F/000488, the aim of this paper is to describe a new approach in order to evaluate sprayer's performance comparing Droplet distribution on the ground for larvicides and in the air for spatial adulticiding.

Key words: Mosquito control, spraying, spatial distribution, biological efficacy

1. Introduction

Mosquito control in France is achieved through the spraying of insecticide in natural areas including water surfaces a wide range of sprayers with a combination of terrestrial and aerial applications. Classical evaluation of the application is mainly related to biological efficacy in terms of mosquito (larvae or adults) mortality [1]. The IMCM Life + project encompasses the evaluation of the spraying quality of terrestrial sprayers for both larvicide and adulticide applications by testing sprayer performance in terms of droplet sizes and deposits. A two step methodology was developed by Irstea (ex_Cemagref) in order to get accurate data from different spraying techniques to be compared with biological efficacy.

2. Material and Methods

Four different sprayers (Table 1) were tested through droplet size measurements and ground or atmospheric deposits for pure water and ad hoc biocide (i.e. BTi incl. in Aquabac XT® or VectoBac 12 AS® specialties for larvicide and Aqua K Othrin EW® for adulticide). Droplet sizes were measured by using a Malvern Spraytec device by using light diffraction measurements.

TABLE 1: List of sprayers tested

Sprayer	Product used	Settings	Forward Speed	Theoretical Spray Range	Test bench
Argo/ATV	Vectobac 12AS®	Teejet TT 02	8 km/h	4 m / side	50 m
Martignani 300 l/h	Aquabac XT ®	Peripheral diffusers	9 km/h	30 m	80 m
Martignani 200 l/h	Aquabac XT ®				
Martignani 45 l/h	Aqua K – Othrin EW®	Central diffuser		50 m	88 m
London Fogger			40 m		
STHIL 420 "atomiser"		Calib. Pellet 0.5 and 0.8	3 km/h	10 m	22 m



2.1. Grading analysis of droplet sizes tested with water and with insecticide mixtures

This analysis was carried out with a laser granulometer (Malvern Spraytec®). It allows the measurement of the droplet distribution (droplet's size and mean volumetric diameters) for each modality in Table 1.

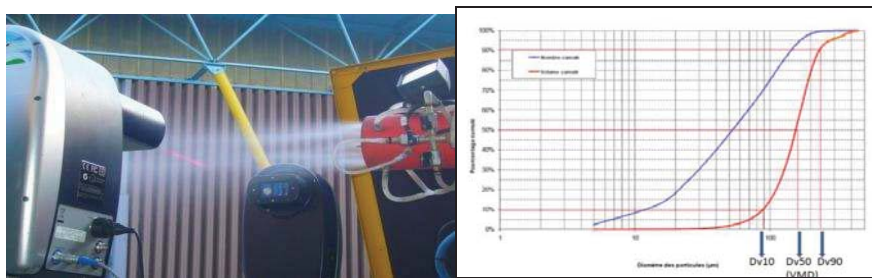


FIGURE 1: Granulometry laser using diffraction

Each measurement was repeated at least 3 times in the same conditions (fluid, flow rate, position). Results were expressed in terms of droplet size distribution with all necessary distribution characterization (Dv10, Dv50, DV90, Span, etc) (Fig 1). Literature on such an experimental particle seizer indicates easy setting up as well as reliable reproducibility of results [1].

2.2. Spatial distribution on the ground for larvicide

Ground deposits of larvicide were estimated with the use of BSF tracer (1 g/l: Brilliant Sulfoflavine) dosage in Petri dishes placed every meter on distances varying from 20 m to 80 m depending on the sprayer. Due to short spray range in the case of Argo/ATV (1 table1) 3 lines of 17 boxes were placed at 0.5m in accordance with ISO/CD 24253 [4]).

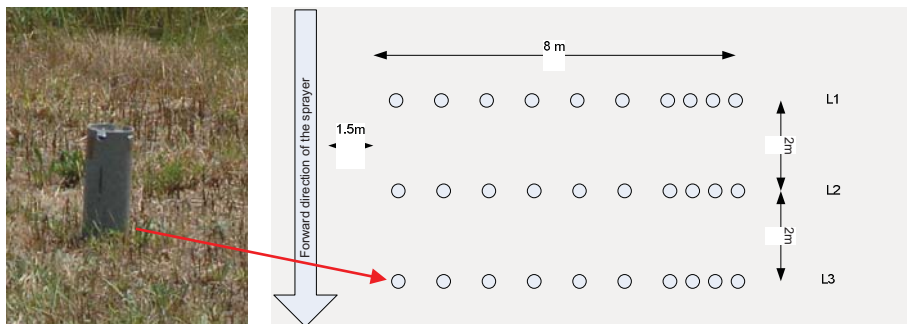


FIGURE 3: Collecting grid for the ARGO/ATV system

2.3. Spatial distribution in the air for adulticide

Atmospheric concentration of Deltamethrin + BSF (1 g/l) was estimated by using 4 series of PVC wires (2 mm diameter) placed at 0.55 – 1 - 1.5 and 1.95 m above ground level and fixed on metallic frames placed every 3 or 4 m up to 100 m downwind (Fig 4). Deposits were normalized in $\text{ng}\cdot\text{cm}^{-2}$ for 1 $\text{g}\cdot\text{ha}^{-1}$ of active substance.

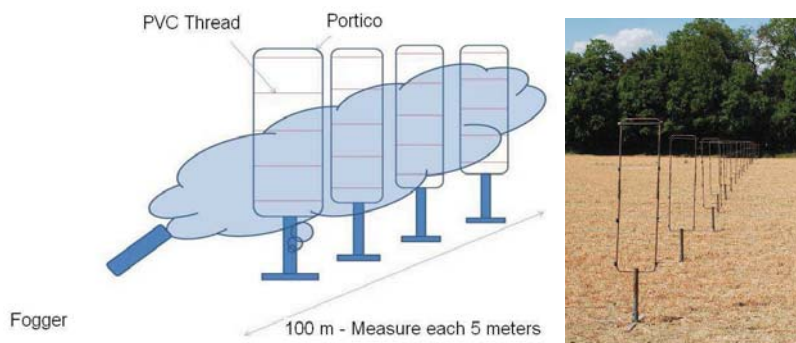


FIGURE 4: Specific vertical supports to evaluate air adulticide treatment

2.4. Weather conditions

Weather conditions were recorded by using a RM Young 3D Ultrasonic weather station. Table 2 recapitulates this information for the tests. It should be noted that in all cases (larvicide or adulticide), spraying applications were carried out under the wind as the collecting grid was adapted depending on the weather conditions.

TABLE 2: Weather conditions

sprayer	Temp °C	Relative Humidity %	Wind burst km/h	orientation
ARGO	17.1	40	19/26	SO
Canon Martignani Aquabac XT 300	17,7	45	17/26	SO
Canon Martignani Aquabac XT 200	16,7	40	19/30	S
Canon Martignani VectoBac 12AS 300	18	72	22/31	SE
Canon ULV	17	45	20/28	SO
	17	45	9/17	NE
knacksack mist blower STHIL	21	14	16/31	NE

2.5. Measurement method of deposit

After spraying phase and a lag time of 20 min, Petri dishes were individually collected. Dye contents was measured through spectrofluorometry (Perkin Elmer 45 LS) with the help of a calibration curve. Results are directly expressed in terms of field dosage for the different sampling positions

For larvicide application, the dosage corresponds to the amount measured in one dish (58 cm^2) and considered as representative of the local deposits. The recovery rate corresponds to the integral of the values under the distribution curve. For adulticide applications, the calculated amount is expressed in $\mu\text{g}/\text{cm}^2$ of collector; the surface of collection corresponds to a half perimeter (0,1 cm) * length of the wire (37 cm).

2. Results & conclusion

2.3. Droplets granulometry

A single measurement of droplet size with pure water does not give reliable information of sprayability of a real mixture. In general, $Dv50$ is lower when mixtures are used. Droplet sizes measurement let appear significant differences between water and mixtures (Fig 6) for

all kind of sprayers and particularly for Fogger, ARGO and knacksack mist blower for which the reduction reaches 50% (Fig 7).

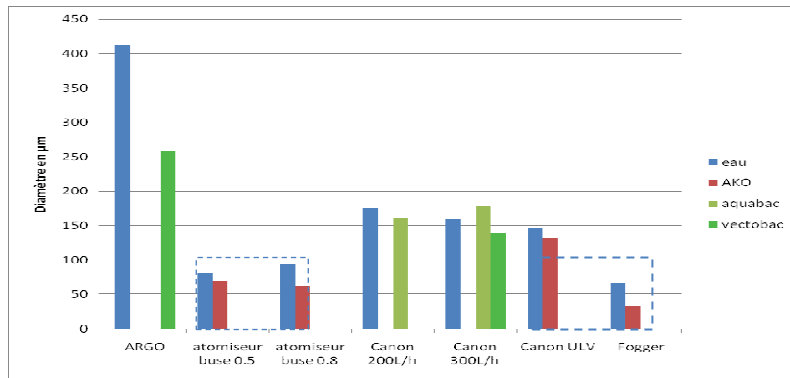


FIGURE 6: comparison of DV50 droplet sizes for each apparatus for water and product used.

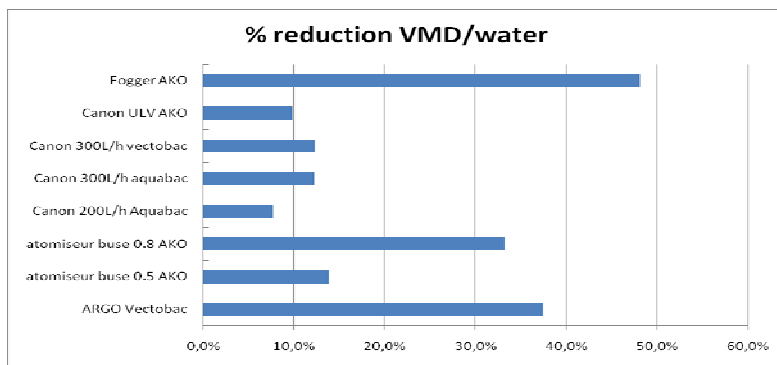


FIGURE 7: Percentage of reduction Product/water

In general droplet sizes are coherent regarding the use of those sprayers with larger droplets in the case of the larvicide application compared to adulticide (These measurements are confirmed by a percentage of the size of droplets lower than 100 µm, strongly required in the case of the adulticide application [3]. One also can notice the notable shift in Granulometry when products are used which induce smaller droplets.

Measurements of granulometry with the product made possible the characterization of each apparatus and to check the relevance of the design with respect to the type of application.

2.4. Spatial distribution of ground deposits for larvicide

in the case of larvicide application, Martignani Phantom and ARGO system were tested.

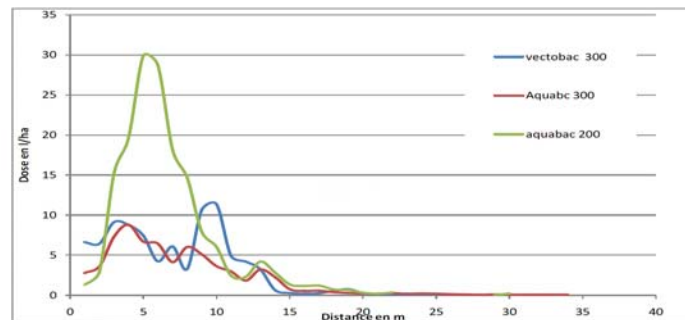


FIGURE 8: Distribution Curves of Martignani for the 3 tests

Martignani was tested with 2 kinds of flow rates (200 and 300 L/h) and with 2 different I products. VectoBac 12AS is the product usually used while Aquabac XT corresponds to a new formulation. The repetitions (Fig 8) gave relatively similar trends with a spray range of about 20 to 25 m. The maximum of deposits does not reach the target value of 12 l/ha with the AQUABAC. In comparison with measurements with 300 l/h, the amplitude of the values for VectoBac 12AS at 200 l/h (Figure 19) is much more important (the peak reaches ~ 45 L/Ha while the target dosage is 8.8 l/ha).

For the ARGO system, (Fig 9), it is to note that the collected amounts are very few. Theoretical spray range is 4 m while reduced to 2 m in practice.

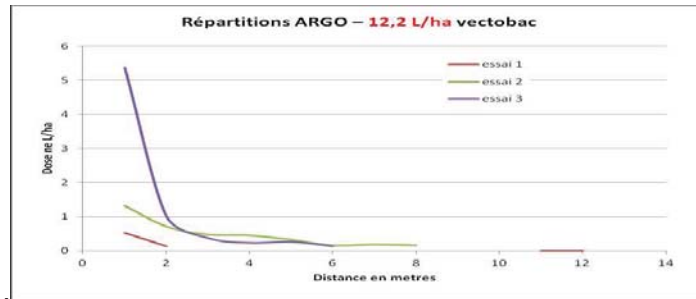


FIGURE 9: Distribution Curves of ARGO system for the 3 tests

2.5. Spatial distribution of adulticide in the air

2.5.1. Fogger

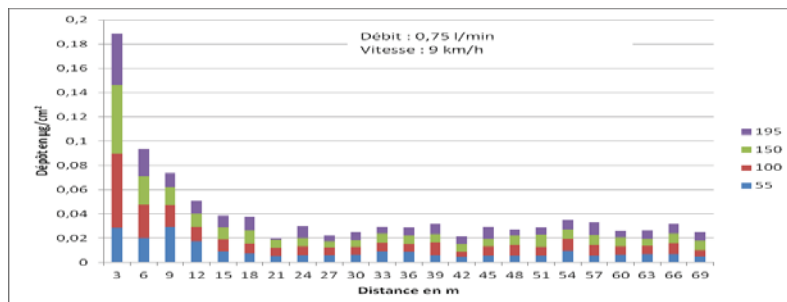


Figure 10: Deposits distribution in the air - Fogger – AQUA K-OTHRINE EW

Fig 10 shows atmospheric collection of deposits for distance up to 69 m. The concentration of products decreases slowly as the products diffusion/dilution occurs between 21 m to 69 m where dye tracer was still present. The second point is the homogeneity of deposits at the different heights along the collecting line.

3.5.2. Knacksack Mist blower (STHIL 420)

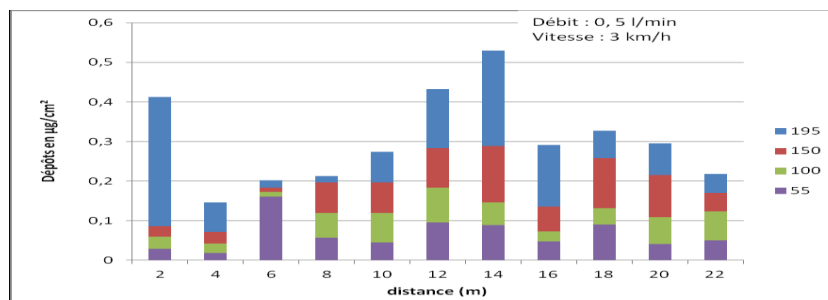


Figure 11: Deposits distribution in the air – Knacksack mist blower – AQUA K-OTHRINE EW

Compared to Fig. 10, values obtained (Fig 11) are rather variable according to the distance and the height of collectors showing a greater heterogeneity of distribution. The operator used of back and forth passes of the lance can be the cause about it. Here also the collecting distance could have been increased.

3.5.3. Martignani B748 – ULV mode (central diffuser)

The collected amounts (Fig 12) are quasi null beyond 16 m. The granulometric data indicate more important droplets sizes compared to the two other adulticides application techniques (knicksack mist blower and fogger) with respective values of Dv_{50} of 140 μm , 70 μm and 33 μm . Last, the average amount collected by wire for this spraying technique is also very low.

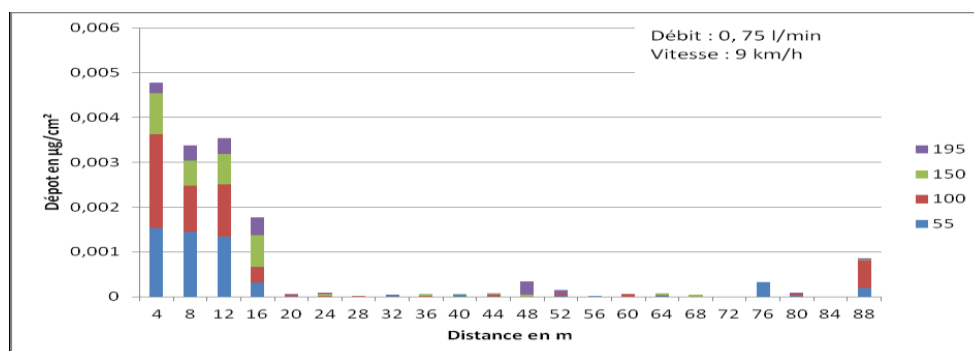


Figure 12: Deposits distribution in the air - Canon ULV AQUA K-OTHRINE EW

4. Conclusion

The characterization of mosquito control was achieved through distribution of the droplet sizes and ground or atmospheric deposits distribution. A rather good correlation is observed between the size of drops with the chemical and the type of application.

In the case of larvicide application lower spray ranges were shown compared to expectations but results were consistent with previous studies [2]. The protocol experienced for adulticide application showed that test benches could be extended as deposits up to 100 m were found for the canon mist blower – ULV mode or 70 m for the fogger. However the global amount of adulticide collected varied in great proportion depending on the sprayer. In conclusion, this preliminary study on sprayer performance will allow the implementation of Better Management Practices among mosquito control operators. A second objective will be to link physical deposits with biological efficacy.

References:

- [1]Dayal Pet al., (2004). Different parameters that affect droplet-size distribution from nasal sprays using the Malvern Spraytec. *Journal of Pharmaceutical Sciences*, Vol. 93 (7), 1725 – 1742.
- [2] JP. Douzals et al., (2010). Spraying quality assessment of a mist blower used on banana crops, Proceedings of AgEng, Clermont Ferrand, Cemagref Ed., 10p.
- [3] R.G. Knepper et al., (1991). Aerially applied, Liquid Bacillus Thuringiensis Var. *Israelensis* (H-14) for control of Spring Aedes Mosquitoes in Michigan, *J. Am. Mosq. Control. Assoc.*; (7), 307- 309.
- [4]ISO/AWI 24253-1_Matériel de protection des cultures -- Essais de mesurage du dépôt des pulvérisateurs à rampe -- Partie 1: Mesurages au champ du dépôt au sol