

## Effect of Adding Mineral Oil to the Effectiveness of Permethrin Emulsion Spray Droplets on *Plutella xylostella* Larvae

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### ABSTRAK

Keberkesanan titis semburan emulsi permethrin dicampur dengan (10% v/v) dan tanpa minyak mineral telah dinilai dalam makmal dengan bioassai menggunakan larva *Plutella xylostella*. Nozel mikro telah digunakan untuk mendapatkan saiz titis semburan berukuran 52-274  $\mu\text{m}$  median diameter isipadu (VMD). Instar larva kedua telah diletakkan di atas cakera daun yang telah dirawat dan catatan rebahan dan kematian larva dibuat selepas 1 jam dan 24 jam berturutan. Bila titis semburan bertambah kecil, dos juga menurun tanpa kehilangan keberkesanan permethrin ke atas larva. Ini menunjukkan titis semburan yang kecil adalah lebih cekap jika dibandingkan dengan titis semburan kasar. Semburan menggunakan saiz titis semburan di antara 70  $\mu\text{m}$  hingga 100  $\mu\text{m}$  tidak menghasilkan peningkatan keberkesanan permethrin dari campuran titis semburan emulsi dengan minyak mineral apabila dibandingkan dengan titis semburan emulsi sahaja. Walau bagaimanapun pada saiz titis semburan yang melebihi 125  $\mu\text{m}$ , keberkesanan campuran titis semburan emulsi permethrin dengan minyak mineral didapati menurun.

### ABSTRACT

The effectiveness of permethrin emulsion spray droplets with (10% v/v) and without mineral oil was evaluated in the laboratory by bioassay using larvae of *Plutella xylostella*. A microtip nozzle was used to produce spray droplets ranging from 52 - 274  $\mu\text{m}$  in volume median diameter. The 2nd instar larvae were placed on treated leaf discs, and knockdown and mortality were recorded after 1 h and 24 h respectively. In both treatments, as droplet size decreased the dose also decreased without losing the effectiveness of permethrin indicating that small droplets were more efficient than large droplets. When sprayed using droplet size between 70  $\mu\text{m}$  to 100  $\mu\text{m}$ , there was no increase in the effectiveness of permethrin from emulsion spray droplets plus mineral oil compared to emulsion spray droplets alone. However, for droplet sizes greater than 125  $\mu\text{m}$ , the effectiveness was reduced.

**Keywords:** permethrin, mineral oil, spray droplets, *Plutella xylostella*

### INTRODUCTION

In pesticide spraying, the evaporation of water-based spray droplets is one of the major routes of pesticide loss. This could be severe especially in the tropics where the weather is hot. Thus, oil is sometimes added to reduce evaporation and to increase the life span of water-based formulation spray droplets before the target is reached (Wodagenah and Matthews, 1981). However, little is known about the biological effect on the leaf surfaces when oil is added to the spray droplets. The combined use of mineral oil and synthetic pyrethroid insecticide have been shown to reduce the incidence of virus transmitted by

aphid on potatoes (Gibson and Rice, 1986; Gibson and Cayley, 1987). In those studies, the movement of the insect on the treated area was very limited. The present study evaluates the extent to which the addition of mineral oil affects the efficacy of permethrin spray droplets against the mobile larvae of the diamondback moth, *Plutella xylostella* L.

### MATERIALS AND METHODS

The diamondback moth was cultured on brussels sprout leaves in the laboratory at  $20 \pm 2^\circ\text{C}$  and  $70 \pm 10\%$  RH. The emulsifiable concentrate (EC) formulation of permethrin (Ambush 25

EC - ICI Plant Protection Division, Jealott's Hill, Berks) was diluted with water. One dilution contained 10g of active ingredient (a.i.)/litre, while the other dilution contained 10g a.i./litre and 10% (w/v) mineral oil (Ulvapron - British Petroleum Oil Ltd, Victoria Street, London). To both dilutions, 0.75% (w/v) of fluorescent tracer, Uvitex Stardust (Ciba-Geigy) was added. The spray mixture was freshly prepared and used within 24 hours. A microtip nozzle (Coggins and Baker, 1983) was used to produce spray droplets between 52 - 274  $\mu\text{m}$  in volume median diameter.

### Bioassay

The bioassay procedure adopted was according to Omar and Matthews (1987). Leaf discs (5  $\text{cm}^2$ ) of brussels sprout plants were sprayed at various droplets density under the UV light. They were then grouped into their respective class of droplet density (no. of droplets/ $\text{cm}^2 \pm 15\%$  S.E.). Samples of droplets were collected on magnesium oxide-treated slides before and immediately after treatment for measurement of droplet size. The undersurface of leaf discs were coated with petroleum jelly to discourage larvae from crawling underneath them. The leaf discs were then placed in petri dishes lined with moist filter papers. Control discs were sprayed with water containing 0.75% (w/v) fluorescent tracer for EC treatment and water containing 10% (v/v) of mineral oil and 0.75% (w/v) fluorescent tracer for EC plus mineral oil treatment. Three 2nd instar larvae were placed on each disc. A minimum of seven discs were used for each class of droplet density and at least four droplet densities (representing doses) were used to obtain a dose response curve. All tests were carried out at  $20 \pm 2^\circ \text{C}$  and  $70 \pm 10\%$  RH.

### Assessment of treatment effect

Knockdown (lack of co-ordination, twitching and convulsion) and mortality (no movement when probed with a fine camel hair brush) of the larvae were recorded after 1 hour and 24 hours respectively. Data were analysed by probit analysis (Finney, 1971) and the median quantity for 50% knockdown ( $\text{KQ}_{50}$ ) and mortality ( $\text{LQ}_{50}$ ) were obtained. If mortality occurred in control, treatment mortality was corrected using Abbott's

formula. Droplet size was measured using the Optomax computer based image analyser.

## RESULTS AND DISCUSSION

As the spray droplet size of the EC formulation and EC formulation plus oil decreased, the  $\text{KQ}_{50}$  and  $\text{LQ}_{50}$  also decreased indicating the utilization of permethrin deposit for knockdown and mortality from small droplets was more efficient than large droplets (Figure 1 and 2). A similar result was obtained using different formulations and insecticides (Munthali and Wyatt, 1986; Omar and Matthews, 1987). Small droplets distribute toxicant more efficiently than large droplets, hence increasing the probability of the mobile larvae coming into contact with the toxicant. Thus, dosage could be reduced without decreasing the larval responses by using small droplets.

When sprayed at a droplet size between 70  $\mu\text{m}$  and 100  $\mu\text{m}$  in diameter, adding mineral oil to the EC formulation did not improve the knockdown and mortality effectiveness of permethrin (Figure 1 and 2). Earlier work also showed no increase in toxicity when spraying was done under low volume conditions, using a mixture of petroleum oil and fenpropathrin for control of adult *Bemisia tabaci* (Ishaaya *et al.*, 1986). With larger droplet sizes ( $>125 \mu\text{m}$ ), the  $\text{LQ}_{50}$  and  $\text{KQ}_{50}$  values of EC formulation plus mineral oil with droplet sizes tested were greater (Table 1) when compared to the  $\text{LQ}_{50}$  values of the EC alone, indicating the reduction of permethrin efficacy. The reduction of the effectiveness of permethrin with the addition of mineral oil could be due to the permethrin penetrating the leaf interior. Oil has been documented to enhance the penetration of the pesticide into plants (Worthing and Walker, 1986). The permethrin, having a major contact mode of action, depends on contact with the larva for the transfer of toxicant to produce the response. Since oil enhanced the penetration of permethrin into the plant, the toxicant on the surface was less than when EC alone was used.

The present study shows that when a mixture of mineral oil and permethrin is sprayed with droplets greater than 125  $\mu\text{m}$  in diameter, the effectiveness of permethrin is reduced. For field control, it appears that a higher dosage of permethrin would be needed if the EC formulation is mixed with oil and sprayed with larger

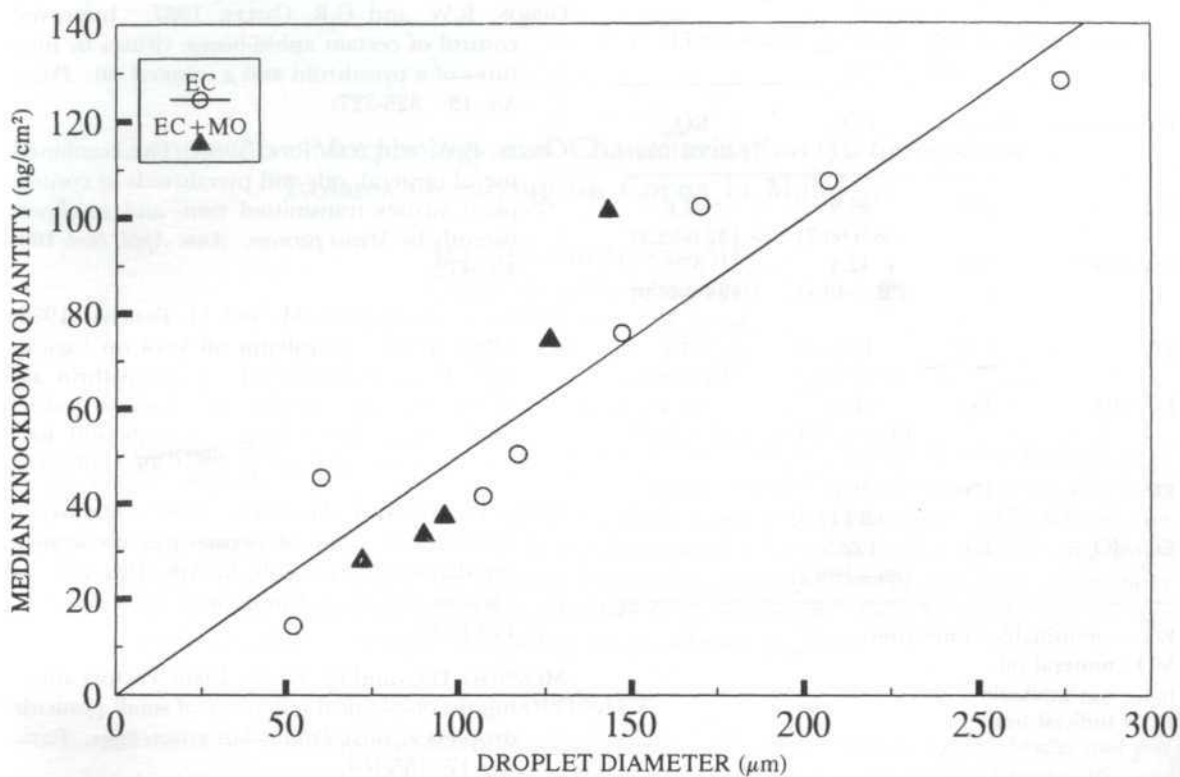


Fig. 1: Effect of adding mineral oil to EC formulation on  $KQ_{50}$  of 2nd instar *P. xylostella* larvae

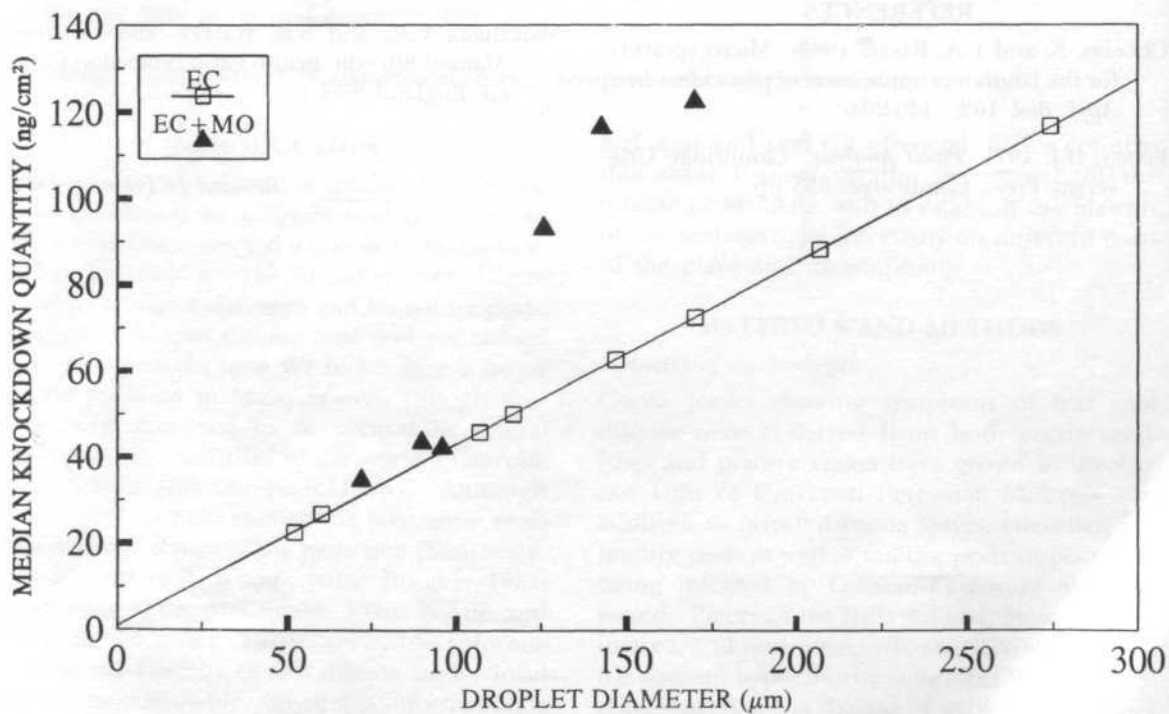


Fig. 2: Effect of adding mineral oil to EC formulation on  $LQ_{50}$  of 2nd instar *P. xylostella* larvae

TABLE 1  
Comparison of  $LQ_{50}$  and  $KQ_{50}$  values for EC  
and EC+MO

Formulation	Droplet Size ( $\mu\text{m}$ )	$LQ_{50}$ (95% f.l.)	$KQ_{50}$ (95% f.l.)
EC	107	45.9 (38.9-60.7)	41.6 (32.6-52.2)
EC+MO	96	42.4 (35.9-48.8)	37.3 (24.8-46.9)
EC	147	62.9 (49.6-89.2)	37.3 (54.5-95.8)
EC+MO	143	116.2 (94.3-136.9)	101.2 (79.1-121.7)
EC	170	72.6 (79.2-117.5)	102.1 (84.3-125.2)
EC+MO	170	122.5 (89.4-196.7)	n.a.

EC = emulsifiable concentrate

MO = mineral oil

n.a. = not available

f.l. = fudicial limit

droplets. Further research is needed to confirm the present finding.

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