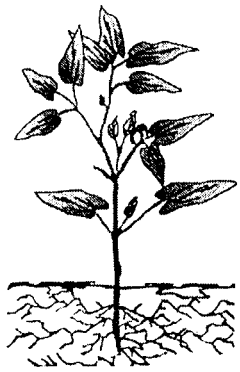

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SPRAY MODIFIERS FOR OPTIMUM PESTICIDAL ACTIVITY OF THE FATTY ACID-BASED AND AZADIRACHTIN COMPOUNDS

[17]

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ABSTRACT

The paraffinic fraction and nonionic surfactant increased the efficiency of the potassium salts of fatty acids concentrate (M-pede 49% EC) insecticide/miticide against aphids (*Aphis fabae*), red mite (*Tetranychus urticae*) and whitefly (*Bemisia tabaci*) by 7.36, 12.67 and 10.97 folds respectively. The obtained results also indicate that the addition of a mixture of 4% paraffin and 3% surfactant to neem oil EC (Triology 90% EC), gave the highest values of relative toxicity, whereas it showed 9.55, 1.82 and 38.29 folds against aphids, red mite and white fly, respectively. It should therefore be possible to optimize and maximize the pesticidal activity of fatty acid-based and neem oil products by using appropriate paraffinic fraction and/or nonionic surfactants to be applied as ready-to-use formulations.

INTRODUCTION

It is now recognized that by choosing an appropriate safe formulation to match the application procedure, increasing efficiency of the present agrochemicals is possible. Thereby, reducing the mass of application of active ingredients, is necessary to control pests. The use of certain adjuvants is an example of how this approach is being applied. These materials include; surfactants, petroleum fractions, esterified seed oils, penetrant aids and protective colloids. They have been used to: (1) modify the surface layers of plants, (2) improve quality or performance characteristics, (3) soften pest cuticle waxes, (4) enhance penetration into target pests and (5) increase residual activity **(Moustafa and El Attal, 1985, Moustafa *et al* 1990 and Ford and Loveridge, 1995).**

Tests have been conducted to assess the efficiency of special paraffinic petroleum fraction and surface-active agent as adjuvants, to increase the pesticidal activity of fatty acid-based and azadirachtin products against aphids, mites and whitefly.

MATERIALS AND METHODS

I. Adjuvants

I.1 Nonionic surfactant: Polyethylene glycol condensate with the properties; pH (5% solution) 5-6 and Hydrophile-Lipophile Balance (HLB) 10.5, produced by Alnour Chemical Services Org., Cairo, Egypt

I.2 Refined paraffinic petroleum fraction: It was supplied by Cooperative Organization of Petroleum, Cairo, Egypt. Its properties and structural composition were determined according to ASTM methods **(Anonymous, 1980)**. Percentage carbon atoms in paraffinic structure (% Cp) was calculated by determining the refractive intercept (RI) and kinamatic viscosity gravity constant adopting method of **Smith (1953)**.

As shown in **Table (1)**, the mineral fraction used was highly purified to avoid plant injury and

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Table 1. Physical and chemical properties of the candidate fraction

Property	Test method	Value
Kinamatic viscosity, centistocks	ASTM 445	10.30
Unsulfonated residue % (UR %)	ASTM 483	96
Distillation at 760 mm Hg. °C	ASTM 447	
50 %		345
10-90 %		**60**
Neutralization number, acidity	ASTM 974	0.05
% Cp	RI-KVGC	70
Pour point, °F	ASTM 97	> 20
Specific gravity at 60 °F	ASTM 1217	0.854

unfavorable responses. This was achieved by limiting both acidity (0.05) and sulfonatable compounds (UR 96%) to ensure plant safety. Moreover, it had high paraffinicity (% Cp 70).

While adjuvants are commonly applied as tank mix, present investigation aimed to include candidate adjuvants in the finished product to obtain ready-to-use formulations.

II. Pesticides

II.1 Potassium salts of unsaturated and saturated aliphatic carboxylic acids 49% w.w EC (M-Pede 49% EC), were provided by Mycogen Corporation, San Diago, CA., USA. Their properties are : pH 10.75, specific gravity at 25 °C 0.93, viscosity 13.8 cps and flash point > 150°C.

M-pede was improved by the addition of 4% paraffinic fraction and 3% polyethylene glycol condensate to obtain ready-to-use formulation.

II.2 Neem oil 90 % EC (Triology 90% EC): containing azadirachtin as the active ingredient which fits well with IPM programs. Triology 90% EC was provided by GINTRA, Cairo, Egypt.

Two improved formulations were prepared by the inclusion of 3% polyethylene glycol condensate surfactant and another formulation by the addition of both 3% surfactant plus 4% paraffinic fraction.

III. Testing and evaluation

III.1 Insecticidal efficiency: Colonies of *Aphis fabae* and *Bemisia tabaci* were reared on faba bean and cotton seedlings in the laboratory at 25 °C and 80% RH. The adults of both insects were exposed to six concentrations of candidate formulations before and after improvements by dipping technique according to **Khalafalla *et al* (2007)**. Each concentration was replicated three times and each replicate contained ten aphids or ten white fly. The average percentage of mortality was calculated after 24 hours. The mortality percentages were corrected according to Abott's formula **(Abott 1925)**.

III.2 Acaricidal efficiency: It was assessed against adults of lab-red mite *Tetranychus urticae* reared on castor-oil leaves. Discs of castor-oil were dipped in each concentration for 20 seconds. The discs were placed on wet cotton in Petri dishes and left to dry. Ten adults were placed on each disc, and each concentration was replicated three times **(Moustafa *et al* 2002)**. The percentage of mortality was calculated after 24 hours. The corrected percent mortalities were statistically computed according to **Finney (1971)**.

RESULTS AND DISCUSSION

Data in **Tables (2, 3 and 4)** indicate that the paraffinic fraction and poly ethylene glycol condensate adjuvants, increased the toxicity of the fatty acid-based and azadirachtin compounds against *Aphis fabae, Tetranychus urticae* and *Bemisia tabaci*. The relative toxicity (R.T.) was calculated from LC_{50} values by assigning and arbitrary value of 1.0 for the least effective compound. Based on the LC_{50} values (**Table 2**), the results indicate the inclusion of both the paraffine fraction and polyethylene glycol in the formulations exhibited

Table 2. Toxicity of the candidate pesticides and their combinations with paraffinic fraction and polyethylene glycol condensate against the adults of *Aphis fabae*

Compound	LC_{50} (FL 95%) (ppm)	Slope	R.T.*
Fatty acid-based EC (M-pede 49% EC)	1436.32(1154.0-1769.79)	1.18 ± 0.11	1.00
+ 4% paraffin & 3% surfactant	195.14 (138.78-255.80)	0.96 ± 0.11	7.36
Azadirachtin EC (Triology 90% EC)	1336.00 (1050.04-1678.17)	1.11 ± 0.10	1.08
+ 3% surfactant	298.56 (214.49-390.51)	1.08 ± 0.12	6.89
+ 3% surfactant & 4% paraffin	139.87 (107.39-172.30)	1.23 ± 0.12	10.27

* R.T. = Relative Toxicity

Table 3. Toxicity of the candidate pesticides and their combinations with paraffinic fraction and polyethylene glycol condensate against the adults of *Tetranychus urticae*

Compound	LC_{50} (FL 95%) (ppm)	Slope	R.T.*
Fatty acid-based EC (M-pede 49% EC)	6106.33 (4497.50-9547.91)	0.98 ± 0.14	1.00
+ 4% paraffin & 3% surfactant	482.07 (364.96-618.05)	1.06 ± 0.14	12.67
Azadirachtin EC (Triology 90% EC)	1045.76 (840.74-1275.45)	1.27 ± 0.12	5.84
+ 3% surfactant	852.09 (705.12-1014.81)	1.58 ± 0.15	7.17
+ 4% paraffin & 3% surfactant	576.88 (479.85-687.52)	1.48 ± 0.15	10.59

Table 4. Toxicity of the candidate pesticides and their combinations with paraffinic fraction and polyethylene glycol condensate against the adults of *Bemisia tabaci*

Compound	LC_{50} (FL 95%) (ppm)	Slope	R.T.*
Fatty acid-based EC (M-pede 49% EC)	1799.72 (1421.16-2221.07)	12.27 ± 0.15	2.36
+ 4% paraffin & 3% surfactant	164.00 (120.70-208.69)	1.16 ± 0.15	25.91
Azadirachtin EC (Triology 90% EC)	4248.89 (3311.12-5417.08)	1.11 ± 0.19	1.00
+ 3% surfactant	244.62 (181.67-309.53)	1.23 ± 0.12	17.37
+ 4% paraffin & 3% surfactant	110.98 (87.71-137.61)	1.55 ± 0.16	38.29

* R.T. = Relative Toxicity

the highest levels of relative toxicity followed by azidirachtin mixed with 3% surfactant and azidirachtin and fatty acid-based compounds without any addition against aphids.

Addition of both the surfactant and paraffin fraction in the concentrates of the two candidate compounds showed the most toxic effect against *Tetranychus urticae*, followed by azadirachtin alone. The potassium salts of the fatty acids were the least effective in this respect. The relative toxicity values were 12.67, 10.59, 7.17, 5.84 and 1.00 fold respectively **(Table 3)**.

The influence of polyethylene glycol condensate at the rate of 3% alone and in combination with 4% paraffinic fraction on response of *Bemisia tabaci* is illustrated in **Table (3)**. Azadirachtin EC used in admixture with a blend of paraffin and surfactant had the least LC_{50} (110.98 ppm) and R.T. value (38.29 folds). The same trend was observed with the fatty acid-based compound when mixing its emulsifiable concentrate with blend of paraffin and surfactant, where the LC_{50} and relative toxicity were 164.0 ppm and 25.91 folds respectively. Lower toxicities were obtained with the two experimental toxicants without any addition.

The role of paraffinic fraction in increasing the toxicity the fatty acid- based insecticide/miticide against the three candidate pests is shown in **Table (4)**. The toxicity of M-pede was increased by 7.36, 12.67 and 10.97 folds against *Aphis fabae, Tetranychus urticae* and *Bemisia tabaci* respectively **(Table 5)**. The role of mineral oil EC in augmenting the effectiveness of insecticide formulations could be attributed by the function of oil as an antifeedant and/or as a penetrant aid **(Moustafa and El Attal, 1985)**. Ethylated esterified seed oils are now used to improve the efficacy of herbicide treatment by softening leaf wax and enhancing penetration **(Killick and Schulties 1998)**. **Ford and Loveridge (1995)** reported that the oil adjuvants can produce increased insecticidal efficacy.

Data in **Table (6)** proved the same trend with the potassium salts of the fatty acid compound, whereas paraffinc fraction and surfactant blend significantly enhancing the toxicity of azadirachtin EC compound against the three experimental pests. As a general trend, data indicate that mixing this blend in azadirachtin EC gave the highest values of relative toxicity; 9.55, 1.82 and 38.20 against *Aphis fabae, Tetranychus urticae* and *Bemisia tabaci* respectively.

The results suggest that the addition of certain adjuvants to a proprietary emulsifiable concentrate formulation, can lead to the reduction in the amounts of active ingredient necessary to achieve treatments of equivalent toxicity.

Table 5. The role of 4% paraffinic petroleum fraction on the efficiency of potassium salts of fatty acids (M-pede 49% EC) against *Aphis fabae*, *Tetranychus urticae* and *Bemisia tabaci*

Test insect	Compound	LC_{50} ppm	R.T.*
Aphis fabae	M-pede	1436.32	1.00
	M-pede + paraffin	195.14	7.36
Tetranychus urticae	M-pede	6106.33	1.00
	M-pede + paraffin	482.07	12.67
Bemisia tabaci	M-pede	1799.72	1.00
	M-pede + paraffin	164.00	10.97

Table 6. The role of 4%paraffin fraction and 3% polyethylene glycol condensate on the efficiency azidrachtin EC (Triology 90% EC) against *Aphis fabae, Tetranychus urticae* and *Bemisia tabaci*

Test insect	Compound	LC_{50} ppm	R.T.*
Aphis fabae	Azidrachtin EC	1336.00	1.00
	Azadirachtin + surfactant	298.56	4.47
	Azadirachtin + surfactant + paraffin	139.87	9.55
Tetranychus uericae	Azidrachtin EC	1045.76	1.00
	Azadirachtin + surfactant	852.09	1.23
	Azadirachtin + surfactant + paraffin	576.09	1.82
Bemisia tabaci	Azidrachtin EC	4248.89	1.00
	Azadirachtin + surfactant	244.62	17.37
	Azadirachtin + surfactant + paraffin	110.98	38.29

* R.T. = Relative Toxicity

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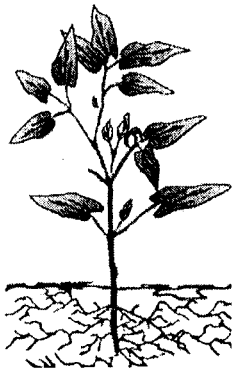

حوليـــات العلـــوم الزراعية
جامعة عين شمس ، القاهرة
مجلد(٥٤)، عدد (١)، ٢١١-٢١٦، ٢٠٠٩

تحسين مستحضرات المبيدات المشتقة من الأحماض الدهنية والنباتية (أزيدراختن) للحصول علي أقصى كفاءة إبادية

[١٧]

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الموجـــــز

تمت دراسة إمكانيـــة تحـــسين وزيـــادة كفـــاءة مستحضرات المبيدات التى أساسها أحمـــاض دهنيـــة ومركبات النيم (أزيدراختن) بواسطة قطفة برافينية عالية النقاوة ومادة بولى إيثيلين جليكول المـــستحلبة. أظهرت النتائج أن إضافة القطفة البارافينية بنسبة ٤٪ والمادة المستحلبة بنـــسبة ٣٪ لمستحـــضر الحمـــض الدهنى (إم- بيد ٤٩٪ EC) ، أعطـــت زيـــادة فـــي الكفاءة ضد كل من المن والعنكبوت الأحمر والذبابـــة البيضاء بمعدل ٧،٣٦ , ١٢،٦٧ , ١٠،٩٧ ضـــعف علي التوالى . تم الحصول على نفس الإتجاه فى حالة مستحضر النيم (تريولوجى ٩٠ ٪ EC) حيث زادت الـــسمية النـــسبية بمعـــدل ٩,٥٥ , ١,٨٢ , ٣٨,٢٩ ضعف، لكل من من الفول والعنكبوت الأحمر والذبابة البيضاء على التوالى .

وبنـــاء علـــي هـــذه النتـــائج يتـــضح أن هنـــاك إمكانية لتحسين وزيـــادة كفـــاءة المبيـــدات المـــشتقة من الأحماض الدهنيـــة ومركبـــات النيم ، بإضـــافة قطفات برافينية مناسبة ومواد مستحلبة غيـــر أيونيـــة حتى يمكن تجهيزها كمستحضرات للإستخدام الحقلى مباشرة.

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