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ROLE OF SOME RELATIVELY NOVEL ALTERNATIVES IN INCREASING INSECTICIDES TOXICITY AGAINST SOME SUCKING PESTS

Nassef, A. M.
Plant Protection Institute A.R.C., Egypt

ABSTRACT

Laboratory experiments were carried out to evaluate the bioactivity of certain traditional insecticides (i.e. profenofos, chlorpyrifos-methyl, monocrotophos and carbosulfan) against certain sucking pests. The tested alternative were also evaluated when combined in mixtures with conventional insecticides at 1: 10 ratio based on the LC_{50}'s and LC_{90}'s value Profenofos showed the highest toxicity against adults of whitefly, *B. tabaci* (Genn.) and two-spotted spider mite, *T. urticae* (Koch.) (LC_{50}'s 52 & 8 ppm and LC_{90} 150 & 25 respectively), wherever carbosulfan showed the highest toxicity against aphids (LC_{50} 75 ppm and LC_{90} 160 ppm).

Chloropyrifos-methyl showed moderate toxicity against aphids and mites wherever monocrotofos showed the least. For the joint action pesticides/alternatives at 1: 10 , the tested mineral oil Kz, and vegetative oil (black cumin) improved the toxicity of all tested pesticides against aphids and mites. It was obvious that non of the tested alternatives (i.e. mineral oil Kz, natural oil black cumin or liquid detergents) showed synergistic action to profenofos, monocrotophos, and carbosulfan against adults of *Bemisia tabaci* (Genn.), meanwhile, chlorpyrifos-methyl mixtures with Kz oil and vegetative oil black cumin induced a high increase in toxicity 87.6% and 86.5%, also the mixtures of chlorpyrifos-methyl with nastabon increase the toxicity with 28% and 7.96% for LC_{50} and LC_{90} values, respectively.

INTRODUCTION

Sucking pests e.g. whitefly, *Bemisia tabaci* (Genn.), green peach aphids, *Myzus persicae* (Sulz.), and two spotted spider mites, *Tetranychus urticae* (Koch) are deleterious one stacking many crops and vegetables.

The economic importance of these pests is attributed to their high reproductive potential and transmite plant pathogenic viruses (Harris and Maramorsch, 1977). Also extracting large quantities of phloem sap which can resulting in greater than 5% yield reduction (Loiyd, 1922).

Chemical control measures are usually effective, potentially cover the control of most pests and diseases and may be used effectively under a wide variety of condition.

On the other hand the wide use of insecticides currently registered for control resulted many problem such as chemical resistance and hazards to mammals (Prabhaker *et al.*, 1985).

The honeydew excreted by these homopteran insects serves as a medium for sooty mold fungi (Perkins, 1983 and 1987). For all that, the aim of the present study is to find out relatively novel alternatives reduce dosage of insecticides through mixing process, relatively, low cost material compared to most insecticides and low human health hazards.

MATERIALS AND METHODS

I. Pesticides tested and their alternatives:

a.Pesticides:

- Selecron (profenofos) 72% EC.
  0-4-bromo-2-chlorophenyl o-ethyl s-propyl phosphorothioate.
- Reldan (chloropyrifos-methyl) 50% EC.
  o,o-dimethyl o-3, 5,6-trichloro-2-pyridyl phosphorothioate.
- Novacron (monocrotofos) 40% SCW.
  dimethyl (E)-1 methyl-2-(methyl carbamayl) vinyl phosphate.
- Marshal (carbosulfan) 25 WP.
  2,3 dihydro-2, 2-dimethyl benzofuran-7 yl (dibutylaminothio) methyl carbamate.

b. Mineral oil:

Kz oil 95% EC provided by Kafr El-Zayat Comp. of pesticides, Egypt.

c. Vegetative oil:

A natural oil was isolated form seed of black cumin, *Nigella sativum*.

d. Liquid detergent:

Nastabon and Oki.

II. Test arthropods:

a. Whitefly, *Bemisia tabaci* (Genn.)

Laboratory strain reared as described by Azab *et al.*, 1971 with minor modification.

The toxicity of the tested pesticides and pesticides/alternatives was investigated. Serial concentration of toxicants were prepared using water. Triton X100 was added when testing the natural oil as an emulsifier. The bioassay technique described by El-Helaly *et al.* (1976) was adopted with some modification.

Data obtained were corrected by using Abbott's formula (1925) percentages of increase in toxicity were calculated according to (Sun 1950).

b. Aphids, *Myzus persicae* (Sulz.):

The green peach aphid, *Myzus persicae* (Sulz.) (Homoptera: Aphididae) was reared in the laboratory according to the method adopted by Norman and Suotton (1967).

The rapid-dip test (FAO Methods No. 17 1980) was applied to evaluate the toxicity of the tested compounds against opterous adults of aphids. Mortality percentages were calculated and corrected according to Abbott's formula (1925) for pesticides/alternatives mixtures, increase in toxicity was calculated.

c. Mites *Tetranychus urticae* (Koch.):

Original strain of *T. urticae* was provided and identified by Acrology Dept. Plant Protection, Institute, Sakha Agriculture Research Station.

The leaf-disc dip methods (Siegler, 1947) was used to evaluate the efficiency of pesticides or pesticides/alternatives mixtures at 1: 10 ratio against *Tetranychus urticae* by means of bionocular, mortality counts were recorded and corrected by Abbott's formula 1925. Increase in toxicity was calculated by the equation of Sun (1950).

RESULTS AND DISCUSSION

I. Insecticidal activity against aphids:

Results presented in Table (1), showed that carbosulfan had the highest toxicity followed by profenofos LC_{50}'s, 75 and 88 ppm and LC_{90}'s 160 and 220 ppm respectively. Monocrotophos showed week toxicity (460 and 960 ppm), wherever, chlorpyrifos-methyl showed moderate toxicity. This is logical because carbosulfan acts as an aphicide. (Halawa *et al.,* 1992; Nassef, 1998) reported that furathiocarb showed the highest toxicity followed by pirimiphos methyl (LC_{50}'s 32, 150 ppm, respectively). The results were agreed with our results.

Table (1): The effect of some insecticides and its mixture with some oils and detergents to aphid *Myzus persiscae* (Sulz.).

Pesticides and it mixtures	LC_{50}	LC_{90}	*% increase in toxicities at LC_{50}	*% increase in toxicities at LC_{90}
Profenofos	88	220	-	-
+ (1) Kz oil	9	13	89.7	94.09
+ (2) Black cumin oil	7	13	92.0	94.09
+ (3) Nastabon	32	60	63.6	72.73
+ (4) Oki	20	48	77.3	78.18
Chlorpyrifos-methyl	220	600	-	-
+ (1) Kz oil	100	380	54.5	36.67
+ (2) Black cumin oil	108	290	50.9	51.67
+ (3) Nastabon	480	920	-118.2	-53.33
+ (4) Oki	1000	3800	-354.5	-533.33
Monocrotophos	460	900	-	-
+ (1) Kz oil	220	400	52.17	55.56
+ (2) Black cumin oil	160	500	65.22	44.44
+ (3) Nastabon	400	1000	13.04	-11.11
+ (4) Oki	1300	4000	-182.6	-344.4
Carbosulfan	75	160	-	-
+ (1) Kz oil	20	42.5	73.33	73.44
+ (2) Black cumin oil	23	76	69.33	52.50
+ (3) Nastabon	170	500	-126.67	-212.50
+ (4) Oki	95	260	-26.67	-62.50

*** % Increasing toxicity =**

$$\frac{LC_{50} \text{ or } LC_{90} \text{ of insecticides alone} - LC_{50} \text{ or } LC_{90} \text{ of insecticides in mixtured}}{LC_{50} \text{ or } LC_{90} \text{ of insecticides alone}} \times 100$$

For the joint action of pesticides/alternatives combination (1: 10) results are recorded in Table (1) evident that the tested mineral oil (Kz oil) and the vegetative oil (Black cumin) improved the toxicity of all tested pesticides, the effect was more pronounced with profenofos % increase in toxicity 89.7 and 94.09, 92.0 and 94.09 at LC_{50}'s and LC_{90}'s respectively. Such results might be of great importance in IPM programmes where it is desirable to control simultaneously more than one pest (i.e. aphid and mites for instance). Improving the toxicity of insecticides against aphid by mixing with mineral oils were reported by many authors (Omar *et al.,* 1987; Mourad *et al.,* 1994; Hydar *et al.,* 1996 and Nassef, 1998). The two detergents Oki and Nastabon showed antagonistic action when added to chlorpyrifos-methyl, monocrotophos and carbosulfan. On the other hand, profenofos mixed with Nastabon and Oki at 1: 10 ratio, induced toxicity to aphids more than to that produced by carbosulfan, the recommended aphicide that most toxic compound (LC_{50}'s 32 and 75, respectively).

II. Insecticidal activity against adults of whitefly, *Bemisia tabaci* (Genn.):

Results of toxicity of pesticides against adults of *B. tabaci* (Genn.) are recorded in Table (2), based on $L.C_{50}$ values, it was cleared that, Profenofos had the highest toxicity followed by Monocrotophos and Carbosulfan with LC_{50}'s 52, 110, 110, ppm, respectively. Chlorpyrifos-methyl showed moderate toxicity with LC_{50} 250 ppm. The results partly agreed with those of Ayoub (1994) who found that pirimiphos-methyl and IGR, diafenthiuron had relatively high values of LC_{50}'s (21.5 and 26.25 ppm, respectively).

Compared with those of deltamethrin or profenofos (5.2 and 7.1 ppm, respectively).

The joint action of conventional pesticides and their alternatives mixtures at 1: 10 ratio was evaluated against the adults of whitefly. It is obvious that none of the tested alternatives (i.e. mineral oil Kz, natural oil (black cumin) or liquid detergents) showed synergistic action to profenofos, monocrotophos and carbosulfan except the mineral oil Kz increase the toxicity of carbosulfan by 10% increase in toxicity. On the other hand, chloropyrifos-methyl mixtures with Kz oil and vegetative oil black cumin induced a high increase in toxicity (80-70% and 86.50%, respectively). Data showed that the use of chlorpyrifos-methyl mixtures with detergents nastabon increase the toxicity of 60^{th} LC_{50} and LC_{90} values. Ahmed and Gardiner (1987); Griunber, 1967, reported that, in some case petroleum oils increased toxicity and persistence of contact insecticides and serve as a useful addition to various insect control agents. The mechanisms of this phenomenon has not yet been established. Petroleum oil may increase the uptake of the toxicant by the insect or reduce its evaporation, dissipation or both (Ishaaya *et al.,* 1986). In some insect species, petroleum oils inhibit respiration (Grünberg 1967). Addition of petroleum oil to fenopropathrin under high volume spray conditions resulted in higher mortality of *B. tabaci* adults (Ishaaya *et al.,* 1986), Nassef, 1998 reported that furathiocarb was potentiated by the natural oil or detergents Oki and strongly by mineral oil Kz synergistic ratio (SR) 1.15, 1.22, and 3.33, respectively.

III. Pesticidal activity against mites:

The toxicity and joint action of some pesticides and the mixtures of pesticides and some alternatives were tested against *Tetranychus urticae* (Koch.). The results of toxicity tests were recorded in Table (3). It is clear that, a high toxicity was exhibited by profenofos followed by carbosulfan and chlorpyrifos-methyl (LC_{50}'s 8, 52 and 59, ppm, respectively). The same trend obtained at (LC_{90}'s 25, 120 and 220 ppm). Shoukry *et al.* (1989) found that LC_{50} of pirimifos-methyl to adult females of *T. urticae* using the same technique was 134.04 ppm. For the joint action of pesticides/alternatives 1: 10

mixtures, results revealed that the mineral oil Kz or vegetative oil remarkably potentiated the tested pesticide. The toxicity of all tested pesticides were greatly increased when mixed with Kz oil or vegetative oil (% increase: 91 & 84 and 83 & 74) and 40 & 86, respectively, at LC_{50}'s.

Table (2): The effect of some insecticide and its mixture with some oils and detergents to adults of whitefly *Bemisia tabaci* (Genn.).

Pesticides and it mixtures	LC_{50}	LC_{90}	*% increase in toxicities at	
			LC_{50}	LC_{90}
Profenofos	52	150	-	-
+ (1) Kz oil	60	750	-15.38	-400
+ (2) Black cumin oil	170	810	-226.9	-433.3
+ (3) Nastabon	350	1450	-573.0	-866.6
+ (4) Oki	250	140	-380.7	6.6
Chlorpyrifos-methyl	250	520	-	-
+ (1) Kz oil	36	100	85.6	80.75
+ (2) Black cumin oil	31	70	87.6	86.5
+ (3) Nastabon	180	780	28.0	7.69
+ (4) Oki	340	1050	-36.0	-101.9
Monocrotophos	110	360	-	-
+ (1) Kz oil	120	1000	-9.1	-177.7
+ (2) Black cumin oil	6	800	45.5	-122.2
+ (3) Nastabon	200	1300	-81.8	-261.1
+ (4) Oki	88	1000	20.0	-177.7
Carbosulfan	110	600	-	-
+ (1) Kz oil	125	540	-13.6	10
+ (2) Black cumin oil	130	4000	-18.2	-566.6
+ (3) Nastabon	1000	8000	-809.8	-123.3
+ (4) Oki	320	1200	-190.8	-100

*** % Increasing toxicity =**

$$\frac{LC_{50} \text{ or } LC_{90} \text{ of insecticides alone} - LC_{50} \text{ or } LC_{90} \text{ of insecticides in mixtured}}{LC_{50} \text{ or } LC_{90} \text{ of insecticides alone}} \times 100$$

The same trend obtained at LC_{90}'s. The mechanisms by which oils increased the toxicity and persistence of contact insecticide was discussed abovementioned. Mineral and vegetative oils were found to increase the toxicity of pesticides (Ishaaya *et al.*, 1986; Kansouh *et al.*, 1988; Mourad *et al.*, 1994; Nassef, 1998 Gamieh *et al.*, 2000 and Magouz, 2003).

In conclusion, mineral oils (especially Kz), vegetative oil (extracted from black cumin seeds) and detergents especially Nastabon are advantageous as protectants singly or combined with pesticides against some sucking pests.

Table (3): The effect of some insecticide and its mixture with some oils and detergents to mite *Tetranychus urticae* (Koch).

Pesticides and it mixtures	LC_{50}	LC_{90}	*% increase in toxicities at	
			LC_{50}	LC_{90}
Profenofos	8	25	-	-
+ (1) Kz oil	0.72	3.3	91.0	86.8
+ (2) Black cumin oil	1.25	2.5	84.4	90.0
+ (3) Nastabon	2.6	15	67.5	40.0
+ (4) Oki	19	75	-137.5	-200
Chlorpyrifos-methyl	59	220	-	-
+ (1) Kz oil	10	58	83.05	73.63
+ (2) Black cumin oil	10	100	83.05	54.5
+ (3) Nastabon	35	250	46.6	-13.6
+ (4) Oki	660	2500	-1018.6	-1036.3
Monocrotophos	260	560	-	-
+ (1) Kz oil	42	110	83.8	80.35
+ (2) Black cumin oil	66	130	74.6	76.7
+ (3) Nastabon	200	800	23.0	-42.8
+ (4) Oki	12	200	95.4	64.3
Carbosulfan	52	120	-	-
+ (1) Kz oil	31.0	180	40.4	-50
+ (2) Black cumin oil	7.0	54	86.5	55
+ (3) Nastabon	110	3000	-111.5	-2400
+ (4) Oki	2500	< 10000	-4707.6	-

*** % Increasing toxicity =**

$$\frac{LC_{50} \text{ or } LC_{90} \text{ of insecticides alone} - LC_{50} \text{ or } LC_{90} \text{ of insecticides in mixtured}}{LC_{50} \text{ or } LC_{90} \text{ of insecticides alone}} x100$$

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دور بعض البدائل الحديثة نسبيا فى زيادة سمية المبيدات المستخدمة فى مكافحة بعض الافات الثاقبة الماصة

على ممدوح ناصف
معهد بحوث وقاية النباتات ــ مركز البحوث الزراعية ــ الدقى

من خلال التجارب المعملية تم تقييم النشاط الابادى لثلاثة من المبيدات الفوسفورية التقليدية ومبيد المن الكربماتى ودراسة التأثير المشترك لبعض بدائل المبيدات من الزيوت المعدنية زيت Kz والزيت المستخلص من حبة البركة واثنان من المنظفات الصناعية السائلة مثل التستابون والـ Oki ضد بعض الافات الثاقبة الماصة وهى الذبابة البيضاء والمن والعنكبوت الاحمر العادى.

وقد أظهرت النتائج بناء على قيم الجرعات النصفية القاتلة والجرعات القاتلة لـ ٩٠% من الافراد ان اكثر المركبات سمية للذبابة البيضاء والاكاروس هو مبيد البروفينوفوس حيث بلغت التركيزات القاتلة لـ ٥٠% هى ٥٢ ، ٨٠ جزء فى المليون ، بينما بلغت التركيزات القاتلة لـ ٩٠% من الافراد ١٥٠ ، ٢٥ جزء فى المليون بينما أظهرت مبيد الكربوسلفان سمية عالية ضد المن حيث بلغت قيم الجرعات النصفية القاتلة ٧٥ جزء فى المليون والجرعات القاتلة لـ ٩٠% ١٦٠ جزء فى المليون.

ايضا اظهر مبيد الكلوربيروفوس مثيل سمية متوسطة ضد المن والعنكبوت الاحمر فى حين اظهر المونوكروتفوس سمية ضعيفة ضدها.

أما بالنسبة للتأثير المشترك للمبيدات وبدائلها عند خلطها بنسبة ١: ١٠ وجد ان الزيت المعدنى Kz والزيت النباتى black cumin أعلى سميه من كل المبيدات المختبرة ضد المن والعنكبوت فى حين لم تظهر اى تنشيط للمبيدات المختبرة ضد الذبابة البيضاء بل كان هناك تضاد فى السمية باستثناء مبيد الكلوربيرفوس مثيل الذى اظهر زيادة فى السمية ٨٧,٦ ، ٨٦,٥ عند قيم الـ LC50 ، LC90 عند خلطة بالزيت النباتى وكذلك ٨٥,٦ ، ٨٠,٧ عند خلطة بالزيت المعدنى. ايضا عند خلطة بالنستابون أدى الى زيادة فىالسمية عند قيم LC90, LC50 تقدر بـ ٢٨ ، ٧,٦ زيادة مثل هذه النتائج الواعدة تشجع على استخدام هذه الخلائط فى برامج IPM حين يراد مكافحة اكثر من آفه فى وقت واحد.