

Petroleum Oils as A Component of Integrated Pest Management of Phytophagous Mites

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ABSTRACT. The aim of the present study is to evaluate the effect of certain petroleum oil formulations on some phytophagous mites, *i.e.* *Eutetranychus orientalis* Klein and *Tetranychus urticae* Koch. Moreover, effect of these formulations on predacious mite *Amblyseius gossipi* El-Badry was also evaluated to predict suitability of petroleum oil formulations to be as a component of integrated mite control.

Results indicated that albulium 80% EC, KZ 95% EC, shokrona super 95% EC, and shokrona 95% EC were more toxic to adult females of *E. orientalis* than that of *T. urticae* and significantly reduced their fecundity. The response of eggs to the mineral oils varied according to their age. The predacious mite *A. gossipi* shows more resistance to petroleum oil than phytophagous ones. Under field conditions shokrona and shokrona super exhibit satisfactory effectiveness against phytophagous mites on fruit trees and a little adverse effect on predacious mite was recorded comparing with synthetic acaricides.

Fruit trees are highly infested with phytophagous mites, scale insects and mealybugs. Mineral oils are usually used to control these insect pests Rawhy (1960), Abdel-Salam (1965) and Ezzat and Rawhy (1966). The chemical control program for the phytophagous mites is being conducted by various synthetic acaricides. Unfortunately, the overuse and misuse of synthetic acaricides, lead to delterious

effects on the environment and beneficial species, as well as resistance problems to the recommended acaricides become more obvious. Therefore, the present work was directed to evaluate the effect of some petroleum oil formulations on some fruit tree pests especially phytophagous mites as well as scale insects and mealybugs to minimize environmental contamination with pesticides and to save expenses.

Materials and Methods

1. Formulating of some local petroleum oil formulations:

Local petroleum oil fraction was formulated as emulsifiable oils (EO) at Central Agricultural Pesticides Laboratory (CAPL), Giza, Egypt. Osman (1989) using local emulsifying agents. These formulations are shokrona 95% EO, and shokrona super 95% EO, KZ 95% EC is an emulsified oil provided by Kafr El-Zayad for pesticides and chemicals, Egypt. Moreover, albulium is an imported sprayable petroleum oil. Tedifol and Komite are also tested as synthetic acaricides under field conditions.

2. Biological Effectiveness:

2.1. Under Laboratory Conditions:

2.1.1. *Adulticidal Effectiveness*: Ten adult females of the same age of susceptible strains of either phytophagous mites *E. orientalis* and *T. urticae* or predacious mite. *A. gossipi*, were transferred onto separated discs of sweet potato and dipped for 5 seconds into different oil concentrations, while control ones were dipped into water. These discs were transferred onto wet cotton pads into petri dishes and kept under controlled laboratory conditions ($25 \pm 2^\circ\text{C}$ and 65 RH). Mortality percentages were computed after 24 hours.

2.1.2. *Ovicidal Activity*: Ten adult females of above mentioned species were transferred onto separated sweet potato discs to lay eggs. Females were removed after 1,2 and 3 days respectively to get eggs with different ages. The discs were dipped into different oil concentration for 5 seconds and kept under controlled laboratory conditions till hatching, then hatchability percentage were counted.

2.1.3. *Effect on Fecundity*: Newly emerged adult females of phytophagous mites were transferred onto separated leaf discs and dipped for 5 seconds into median lethal concentrations of tested formulations (LC_{50}), then the adult females were singly transferred onto new untreated discs, egg numbers deposited from these females were used as fecundity index.

2.2. Under Field Conditions:

A heavily infested apple orchard was selected for this investigation. The experiment was designed as randomized complete blocks and each treatment was replicated four times. Two oil formulations (shokrona and shokrona super) and two acaricides (Tedifol and Komite) were sprayed to evaluate them under field conditions. Samples of 80 apple leaves were collected from each treatment after 28 days from spray application. The number of moving stages of either phytophagous or predacious mites on the leave samples were counted and tabulated.

3. Statistical Analysis:

Median Lethal Concentrations (LC_{50s}) and slop values of each treatment were calculated according to Finney (1952). Reduction percentage in the population under field conditions were estimated according to Henderson and Nilton (1955).

4. Evaluating Physico-Chemical Properties of Sprayable Oil:

Distillation characteristics, unsulphonated residues percentages (USR vol %), API gravity and pour point were evaluating according to ASTM methods.

Results and Discussion

1. Biological Effectiveness:

1.1. Under Laboratory Conditions:

1.1.1. *Adulticidal Action:* Data in Table (1) clearly shows that albulium was the

Table 1. Effects of four petroleum oil formulations on the susceptibility of two phytophagous and one predacious mites

Formulation	<i>E. orientalis</i>		<i>T. urticae</i>		<i>A. gossipi</i>	
	LC ₅₀	Slope	LC ₅₀	Slope	LC ₅₀	Slope
Albulium 80%	14	0.99	48	1.40	89	1.35
KZ	62	1.20	90	2.90	102	1.85
Shokrona	89	1.80	95	2.51	153	1.74
Shokrona Super	92	1.92	151	2.23	182	1.96

most effective compound on adult stages of *E. orientalis* and *T. urticae*. According to the effectiveness against phytophagous mites, the four tested petroleum oil formulations could be arranged in the following descending order; albulium, KZ, shokrona super and finally shokrona. The LC_{50} values on *E. orientalis* were 14,62, 89 and 92 ppm respectively, while those on *T. urticae* were 48,90,95 and 151 ppm respectively. It could be postulated that the tested petroleum oil formulations are more toxic to *E. orientalis* than *T. urticae*. These results are in agreement with El-Attal *et al.* (1983). The same table also shows that the adult females of predacious mite. *A. possipi* are less susceptible than phytophagous mites. LC_{50} values of albulium, KZ, shokrona super and shokrona are 89,102,153 and 182 ppm, respectively.

1.1.2. Ovicidal Activity:

1.1.2.1. *Against E. orientalis*: Data in Table (2) shows that, albulium was the most toxic oil formulations against 1,2 and 3 days old eggs of *E. orientalis*. The LC_{50} values of albulium, KZ, shokrona super and shokrona were, 6, 35, 68 and 75 ppm on one-day old eggs; 9, 52, 78 and 81 ppm on two-days old eggs and finally, 13, 60, 83 and 89 ppm on three-days old eggs for albulium, KZ, shokrona super and shokrona, respectively. Therefore, it could be mentioned that one-day old eggs are more susceptible to petroleum oil formulations than other ages.

Table 2. Effects of four petroleum oil formulations on the susceptibility of three egg ages of *E. orientalis*

Formulation	Egg Age (days)					
	1		2		3	
	LC_{50}	Slope	LC_{50}	Slope	LC_{50}	Slope
Albulium	6	1.78	9	1.08	13	1.98
KZ	35	1.90	52	1.28	60	1.19
Shokrona	68	2.15	78	2.16	83	2.18
Shokrona Super	75	1.33	81	1.14	89	1.65

1.1.2.2. *Against T. urticae*: The tested petroleum oil formulations could be arranged in the following descending order according to their ovidial activity; shokrona, shokrona super, KZ and finally albulium (Table 3). LC_{50} values of the tested formulations are; 106,92,38 and 35 ppm against one-day old eggs; 141,105,49 and 45 ppm against two-days old eggs and 148,141,89 and 53 ppm against three-days old eggs, respectively. Generally, results of ovicidal activity of the tested petroleum oil formulations are in agreement with Riehl and Rodriguez (1965), Carlos and Cardona (1981) and El-Attal *et al.* (1983).

Table 3. Effects of four petroleum oil formulations on the susceptibility of three egg ages of *T. urticae*

Formulation	Egg Age (days)					
	1		2		3	
	LC_{50}	Slope	LC_{50}	Slope	LC_{50}	Slope
Albulium 80%	35	2.70	46	2.66	53	2.50
KZ	38	1.35	49	2.20	89	2.15
Shokrona	92	2.07	105	2.12	141	2.82
Shokrona Super	106	2.31	141	2.25	158	2.64

1.1.2.3. *Against A. gossipi*: Data in Table (4) indicate that shokrona gave the least toxic effect against one-day old eggs of predacious mite *A. gossipi* followed by shokrona super, KZ and albulium. LC_{50} values were, 171, 143, 92 and 84 ppm, respectively.

1.1.3. *Effect on Females Fecundity*: Data in Table (5) reveal that the adult female fecundity of *E. orientalis* and *T. urticae* was greatly reduced after treated the newly emerged adult females with LC_{50} of the four petroleum oil formulations. The average numbers of deposited eggs per female of *E. orientalis* were reduced to 64,56,42 and 36% as a result of treating with albulium, KZ, shokrona super and shokrona, respectively. Furthermore, the above mentioned formulations exhibit 76,64,54 and 42% reduction of *T. urticae* female fecundity.

Table 4. Effects of four petroleum oil formulations on the susceptibility of one-day old eggs of *A. gossipi*

Formulation	LC ₅₀	Slope
Albulium	85	1.53
KZ	92	1.92
Shokrona	143	1.93
Shokrona Super	171	1.88

Table 5. Effects of four petroleum oil formulations on fecundity of females of two phytophagous mites

Formulation	No. of deposited eggs/female of					
	<i>E. orientalis</i>			<i>T. urticae</i>		
	treat.	untreat.	% red.	treat.	untreat.	% red.
Albulium	18	50	64	22	91	76
KZ	22	50	56	33	91	64
Shokrona	29	50	42	42	91	54
Shokrona Super	32	50	36	53	91	42

1.2. Under Field Conditions:

Data in Table (6) shows that after 28 days from spray application, apple trees infestation with phytophagous mites mainly *E. orientalis* and *T. urticae* was reduced up to 87,82,87 and 82%; while predacious mite *A. gossipi* was less affected and reduced up to 28,25,23 and 31% as a result of treating with shokrona super, shokrona, tedifol and Komite, respectively. These results are in agreement with the findings of Aly *et al.* (1984), Helmy *et al.* (1984) and El Halwany *et al.* (1987).

Table 6. Effects of two petroleum oil formulations and two synthetic acaricides on a phytophagous and a predacious mites on apple trees after 28 days from spraying

Treatment	% Reduction									
	<i>T. urtica</i>					<i>A. gossipi</i>				
	1	2	3	4	*	1	2	3	4	*
Shokrona Super	95	85	83	83	87	31	33	26	23	28
Shokrona	84	82	82	80	82	25	25	31	20	25
Tedifol	90	89	86	81	87	26	24	23	19	23
Komite	82	81	82	81	82	42	38	32	20	33

* Average % reduction.

1,2,3,4 = No. of weeks

Regarding these results it could be recommended petroleum oil formulations as alternative of synthetic acaricides, due to their efficacy, little effect on the beneficial species and natural enemies as well as no resistance problem and no phytotoxic effect have been observed.

2. Suitability of the Present Egyptian Base-Oil for Formulating Emulsifiable Oil

A number of inspections have been carried out at EXON Research and Engineering Company, USA (1990). The present base-oil is not a narrow range horticultural spray oil (Table 7). In fact, some 40% of the volume (800 °F+) is capable of causing injury to plants. Fortunately, some 30% of the volume (0-30%) is essentially a diluent which lowers the dosage level of the too heavy molecules. The chromatogram (Fig. 1) illustrates that the present Egyptian base-oil is a blend of two other materials. In summary, the present base oil is not specifically designed for agriculture. It appears to be a blend of mineral seal oil (500-600 °F) and a heavier automotive lube base stock.

Table 7. Inspection of Egyptian Base-Oil

1-Simulated Distillation Analysis at 100 mmHg			
Vol. % off	Time (min.)	NBP °C	NBP °F
00.5 (IBP)	02.96	227.0	440.6
05.0	05.39	262.2	503.9
10.0	06.39	276.7	530.1
20.0	07.90	298.6	569.4
30.0	09.33	319.4	606.9
40.0	12.70	367.0	692.0
50.0	15.91	411.0	771.7
60.0	17.78	436.6	817.9
70.0	19.18	455.8	852.5
80.0	20.73	476.7	890.1
90.0	23.10	507.8	946.0
95.0	25.83	542.7	1008.9
99.5 (FBP)	32.44	627.4	1161.3
2-USR %	92.0		
3-API Gravity at 60 °F	33.5		
4-Specific gravity	00.8577		
5-Pour point	20.0		

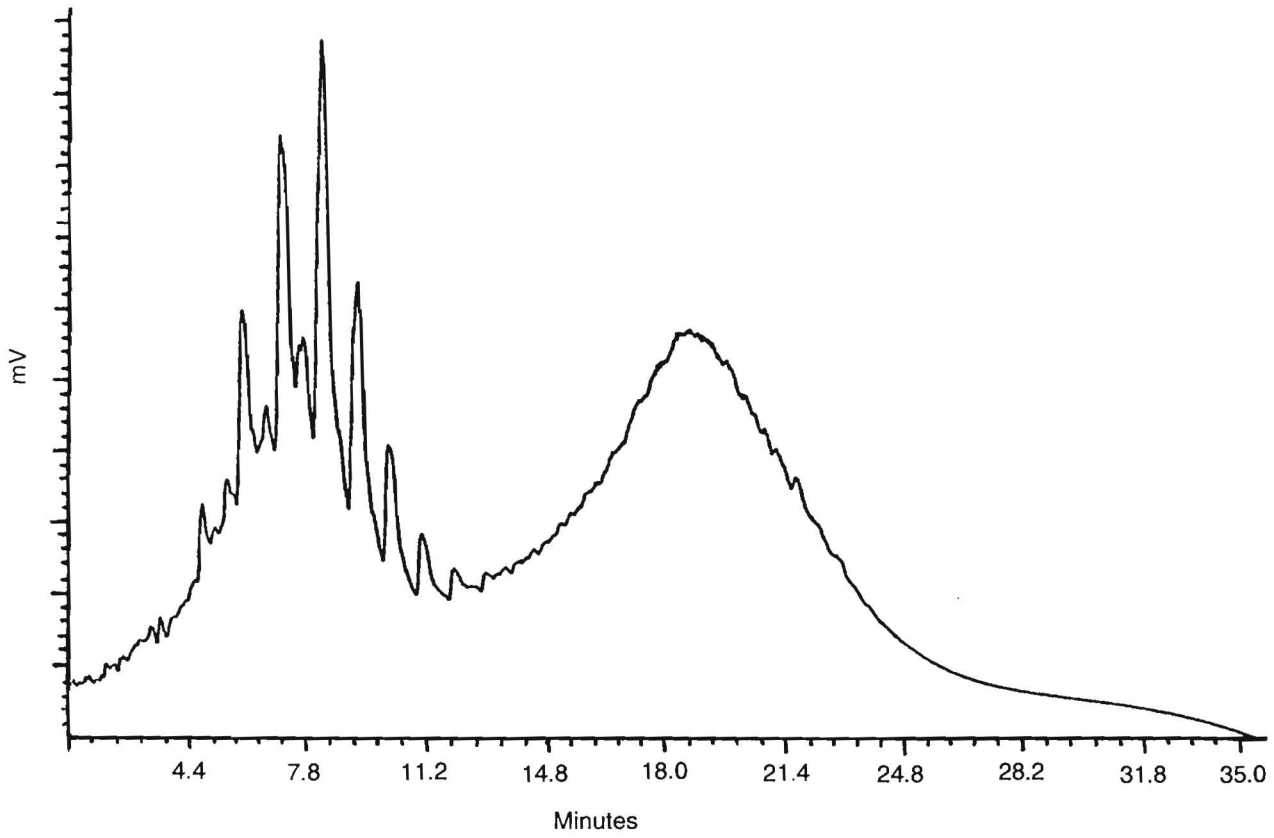


Fig. 1. Simulated Distillation Analysis at 10 mmHg.

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(Received 10/12/1994;
in revised form 02/01/1996)

الزيوت البترولية كأحد مكونات المكافحة المتكاملة للاكاروسات الضارة زراعياً

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يهدف هذا البحث لتقييم فعالية بعض مستحضرات الزيوت البترولية المجهزة محلياً والمستوردة تقيماً حيوياً على نوعين من الاكاروسات الضارة زراعياً وكذلك تقييم الاثر الجانبي الضار لهذه المستحضرات على بعض الاكاروسات التي تقوم بافتراس الاكاروسات الضارة زراعياً لتحديد مدى ملائمة هذه المستحضرات للاستخدام كأحد المكونات في المكافحة المتكاملة للاكاروسات الضارة .

وقد أوضحت النتائج المتحصل عليها أن مستحضرات الزيوت البترولية مميّزة ضد الاناث البالغة كما أنها تحد بدرجة ملحوظة من قدرتها على وضع البيض . أما فعاليتها على البيض فيتوقف على عمر البيض عند المعاملة ، حيث أن الاعمار الأولى تكون أكثر حساسية .

فيما يتعلق بتأثير مستحضرات الزيوت البترولية على الاكاروس المفترس فقد أوضحت الدراسات أن هذا الاكاروس أكثر مقاومة لفعل مستحضرات الزيوت البترولية من الكاروسات الضارة زراعياً وعليه يمكن التوصية بامكانية استخدام مستحضرات الزيوت البترولية ضمن برنامج المكافحة المتكاملة للاكاروسات الضارة زراعياً .