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Pesticide efficacy of local save materials: Mineral oils and surfactant against broccoli pests

El-Sisi, A.G.[1]; Hayam, M. Saad[2] and Abdel-Aziz, M.F.[2]

[1]Central Agricultural Pesticides Laboratory, Agricultural Research Centre, Dokki, Giza.
[2]Cotton Leafworm Research Department, Plant Protection Research Institute, Agricultural Research Centre, Dokki, Giza.

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Abstract:

Broccoli is a cruciferous vegetable that is a nutritional powerhouse and it infested by different insect pests. Pesticidal efficiency of some local materials: mineral oils (CAPL-1, CAPL-2) and surfactant (Sisi-6) were determined against both whitefly, *Bemisia tabaci* (Gennadius) (Hemiptera :Aleyrodidae) (adult and nymphs) and cotton leafworm, *Spodoptera littoralis* (Boisduval) (Lepidoptera: Noctuidae) (larvae). Obtained results indicated that all tested materials showed succeded effect against to both two stages of whitefly at all tested concentrations 1.0,1.5 and 2.0% (V./V.) since they gave initial effect ≥ and equal 70% reduction and mean residual effect ≥ and equal 40% reduction of live individual / leaf, therefore 1% concentration is perferred for controling this pest for economic consideration. On the other hand, results of toxicity against second instar larvae of cotton leafworm as expressed by LC_{50}'s and toxicity indexes indicated that all tested materials showed toxicity effect, onar gave the highest toxic effect followed by surfactant Sisi-6 and mineral oils CAPL-1 and CAPL-2, also results indicated that tested materials showed latent toxic effect against larvae , pupae and moth emergency since they reduced percent moth emergency therefore they cause of broken of life-cycle of insect, onar showed the highest effect followed by surfactant Sisi-6 and mineral oils CAPL-1 and CAPL-2.

Introduction

Broccoli is considered among the most valuable vegetable crops, due to its composition of phytochemical compounds, with potential effects on preventing several cancer types and other illnesses (Brown *et al.*, 2002).

It is undesirable of using chemical pesticides for controlling pests infested broccoli crop since it is considered among food vegetable crops which remain for a short period in the field, therefore, some local, safe and cheep materials could be use as alternatives for conventional pesticides.

The white fly, *Bemisia tabaci* (Gennadius) (Hemiptera : Aleyrodidae) is considered the main insect pests infesting broccoli and cause great losses

not only in quantity but also in quality of the broccoli yield (Hashem *et al*., 2009). This pest has become resistant to the conventional insecticides on different crops (Palumbo *et al*., 2001). Cotton leaf worm. *Spodoptera littoralis* (Boisduval) (Lepidoptera: Noctuidae) is one of the most destructive agricultural pests in subtropical and tropical regions. The pest causes a variety of damage as a leaf feeder and a cutworm on seedlings. It can attack numerous economically important crops throughout the year (EPPO, 1997). In Egypt the Egyptian cotton leaf worm, *S. littoralis* is one of the most destructive phytophagous insect pests, not only to cotton, but also to other field crops and vegetables including broccoli (Kandil *et al*., 2003). Recently research has been made for new and nontraditional control agents effective against this pest since resistance has been recorded for most conventional insecticides (Rashwan *et al*., 1992). Published studies indicated that mineral oils, surfactants and plant oils proved pesticidal efficiency against different pests infested broccoli (El-Hariry and El-Sisi (1991); Rizk *et al*. (1999) and Mousa and El-Sisi (2001) and Badr *et al*. (1995).

The present study aims to determine the pesticidal efficiency of some mineral oils (CAPL-1), (CAPL-2) and surfactant (Sisi-6)against both whitefly, *B. tabaci* and cotton leafworm, *S. littoralis* infested broccoli crop.

Materials and Methods

1. Mineral oils:

CAPL-1: It is a sulphonated solar cut of petroleum oil, prepared as emulsifiable concentrate 96.6%. It is registered at no. 501 for controlling scale insects infested citrus horticulture, produced by Central Agricultural Pesticide Laboratory.

CAPL-2: It is a lubrication cut of petroleum oil, prepared as emulsifiable concentrate 96.6%. It is registered at no. 502 for controlling scale insects infested citrus crops. Produced by Central Agricultural Pesticide Laboratory.

2. Surfactant:

Sisi-6: It is anionic surfactant, prepared by Dr. El-Sisi, A. G. by neutralization of sulphonic acid with suitable alkaline. The product contained 10% potassium sulphonate.

3. Determination pesticidal efficiency against whitefly, *Bemisia tabaci*:

Experiment was conducted in broccoli field infested with whitefly at Giza. Spraying with previous materials at concentrations 1.0, 1.5 and 2% (V./V.) was done on Desember 22, 2015 using a hand sprayer provided with one nozzle. Pesticidal efficiency was determined according to Ministry of Agriculture Protocoles but at small scale. Infestation rate were determined before and after 1, 3, 5 and 7days of spraying by direct inspection for adult and by collecting 10 leaves from each treatment and inspecting them under binocular, then the mean number of nymphs' stage of whitefly / leaf was calculated. Percentage reductions were calculated according to equation of Henedrson and Tilton (1955).

Phytotoxicitys: It was determined by recording any flaming, curl and color change occurred in leaves of treated plants up to 7 days after treatment.

4. Toxicity of the tested materials against larval stage of cotton leafworm, *Spodoptera littoralis*:

Leaf-dip technique method was used to determine the toxicity of the studied materials against 2nd instar larvae by dipping leaves in different concentrations of each material then hanged to complete dry then introduced to 30 larvae 2nd instar larvae of each treatment, 3 replicates for each concentration. Dead and alive larvae was counted, then mortality percentage was recorded and corrected percent mortalities were calculated according to

Abbot formula (1925), LC-P lines were drawn up and LC_{50}'s, LC_{90}'s and slopes were calculated. Toxicity indexes were calculated according to Sun (1950) equation.

5. Pesticidal efficiency of the tested materials against cotton leafworm, *Spodoptera littoralis*:

To investigate the initial and latent effect of the tested materials, ten leaves of broccoli of each treatment were taken after spraying when plant become dry, then transferred to the laboratory and introduced to 2nd instar larvae of cotton leafwom under constant conditions of 25 ± 1°C and 70% ± 5% R.H., three replicates for each treatment each have 20 larvae. For studying the latent effect, other samples were taken each 2 days from treated plants continuously and introduced to the rest alive larvae until pupation stage. Mortality counts was recorded after 3, 5, 7 and 10 days of exposure, then mortality percentages were calculated, developmental effect against both pupae and moth emergency were studied by recording total numbers of formed pupae and moth emergency for each treatment then calculating their percentages by the method described by El-Sisi and Farrag (1989).

Pupation% = (No. of formed pupae / initial number of 2nd instar larvae) * 100

moth emergency% = (No. of formed moth / initial number of 2nd instar larvae) * 100

Results and Discussion

1.Pesticidal efficiency against whitefly, *Bemisia tabaci*:

According to the Ministry of Agriculture recommendations for using natural products and safe materials in controlling pests, succeeded materials should give initial effect not less than 40% reduction. According to these recommendations, results in Table (1) about the effect against numphs and Table (2) about the effect against adults of whitefly indicated that all tested materials at all tested concentrations gave high initial and residual effect agree with Ministry of Agriculture (1993) recommendations, also the effect increase as concentrations increased, but for economic considerations the lowest concentrations (1.0 %) is preferred. The obtained results are complied with El-Hariry and El-Sisi (1991), Rizk *et al*. (1999) and Mousa and El-Sisi (2001) findings of testing of those materials against sucking pierce pests. Results of field inspection of treated broccoli indicated that no any phytotoxic on broccoli was observed up to 7days of treatment.

Table (1): Pesticidal efficiency of the tested materials against nymphs of whitefly, *Bemisia tabaci* infested broccoli crop.

Treatments	Conc. (%)	Pre. Treatment count No. / leaf	Initial effect after 24hrs		Residual effect				
					No. / leaf after			Mean	%R
			*No. / leaf	%R	3days	5days	7days		
CAPL-1	1.0	178	28.3	78.93	23.4	30.4	33.6	29.13	77.2
	1.5	181.6	20.4	85.113	24.5	27.2	17.3	23	82.36
	2.0	197.2	20.1	86.492	20.5	12.7	37.3	23.5	83.4
CAPL-2	1.0	206.8	31.7	79.68	29.5	27.5	39.7	32.23	78.29
	1.5	170.1	19.3	84.96	16.3	19.5	21.1	18.96	84.47
	2.0	196.5	12.4	91.637	11	10	19.6	13.53	90.4
Sisi-6	1.0	186.9	17.8	87.379	35.2	63.2	24.1	40.83	69.58
	1.5	192.9	6.8	95.32	21	44.5	11.2	25.56	81.54
	2.0	202.3	3.1	97.96	35.4	15	13.6	21.33	85.319
Control		222.5	167.9	_	162.7	171.9	144.8	159.8	_

**No. / leaf = Mean No. of nymphs / broccoli leaf.*

Table (2): Pesticidal efficiency of the tested materials against adults of whitefly, *Bemisia tabaci* infested broccoli crop.

Treatments	Conc. (%)	Pre. Treatment count No. / leaf	Initial effect after 24hrs		Residual effect				
					No. / leaf after			Mean	%R
			*No. /leaf	%R	3days	5days	7days		
CAPL-1	1.0	10.9	19	72.19	1.3	1.5	2.7	1.8	73.18
	1.5	11.8	11	85.13	0.9	0.7	1.5	1.03	85.82
	2.0	12.1	9	88.14	0.7	0.8	0.9	0.8	89.26
CAPL-2	1.0	12	15	80.06	1	1.6	1.9	1.5	79.70
	1.5	11.9	12	83.91	0.9	1.1	1.6	1.2	83.62
	2.0	13.2	8	90.33	0.5	0.9	1.1	0.83	89.79
Sisi-6	1.0	12.6	15	81.01	1.1	1.5	3.6	2.06	73.45
	1.5	13.1	12	85.38	0.8	1.2	2.1	1.36	83.14
	2.0	12.2	8	89.54	0.6	0.8	1.2	0.86	88.55
Control		12.6	79	_	6.8	7.9	86	7.76	_

**No. / leaf = Mean No. of adults / broccoli leaf.*

2. Pesticidal efficiency against cotton leafworm, *Spodoptera littoralis*:

2.1.Toxicity of the tested materials against the second instar larvae of cotton leafworm, *Spodoptera littoralis*:

Results in Table (3) and Figure (1) indicated that all tested materials showed different toxicity effects against 2nd instar larvae. According to LC_{50}'s values also toxicity index surfactant Sisi-6 showed the highest toxic effect followed by mineral oils CAPL-1 and CAPL-2.

2.2. Insecticidal efficiency against larval stage of cotton leafworm, *Spodoptera littoralis*:

The results shown in Table (4) about the toxicity and latent effect against 2nd instar larvae of cotton leafworm indicated that:

2.2.1. The toxicity increased as both concentration and period of feeding with treated leave increased.

2.2.2. Sisi-6 showed the highest latent toxicity after 10 days against 2nd instar larvae followed by CAPL-1 and CAPL-2

2.2.3. The developmental effect against pupae and moth emergency indicated that treatment with Sisi-6 the highest decreased in pupae and moth emergency then cause broken the insect life cycle compared with untreated (control) followed by CAPL-1 and CAPL-2.

Results obtained were agree with Badr *et al.* (1995) findings about the latent effect of mineral oils against cotton leafworm. Generally, the mode of action could be explained as follows: the effect of mineral oils and plant oils against immature and mature stages is due to involve blocking of respiration as a result of presence of oil film (Smith and Pearce, 1948) then suffocation effect (De Ong *et al.*, 1927) also due to their antifeedant and developmental effect (Badr *et al.*, 1995). The pesticidal efficiency of any surfactant (Sisi-6) increased by its ability in decreasing the surface tension of water (El-Hariry and El-Sisi, 1991), since it might melt the epicuticle layer of pests as a result of its emulsifying effect, then cause mortality (Rizk *et al*., 1999).

It is concluded that the tested martials could be use as alternative of chemical pesticide for controlling whitefly infested broccoli crop as well as they showed toxic and latent effect against cotton leafworm. Also, they cause toxicity against larval stage and reducing moth emergency compared with untreated enough to cause broken of life cycle of this pest.

Table (3): Toxicity of the tested materials against the second instar larvae of *Spodoptera littoralis.*

Treatments	LC_{50} (%)	Toxicity Index	Slope	LC90
Sisi-6	1.282	0.0039	1.792±1.09	6.656
CAPL-1	1.443	0.0035	1.787±1.09	7.520
CAPL-2	2.495	0.002	2.167±1.16	9.738

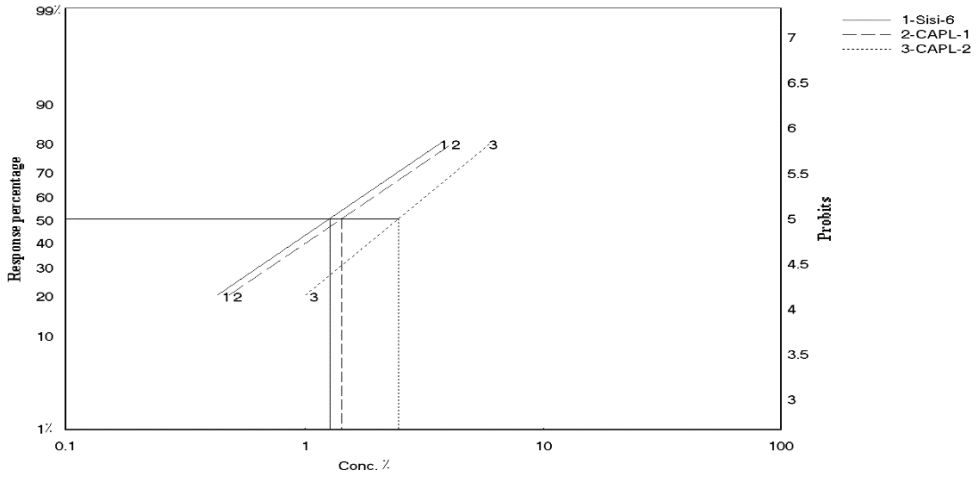

Figure (1): Toxicity of the tested materials against the second instar larvae of *Spodoptera littoralis.*

Table (4): Latent effect of tested materials against the second instar larvae of *Spodoptera littoralis.*

Treatments	Conc. (%)	% of Mortality After				% pupation	% Emergency
		3 days	5 days	7 days	10 days		
Sisi-6	1.0	21.7	30.0	43.3	60.0	40	30
	1.5	26.7	35.0	53.3	71.6	28.4	20
	2.0	28.3	36.7	63.3	78.3	21.7	15
CAPL-1	1.0	25.0	33.3	38.3	53.3	46.7	33.4
	1.5	26.7	36.7	50.0	66.6	33.4	21.7
	2.0	33.3	46.7	60.0	75.0	25	16.7
CAPL-2	1.0	15.0	18.3	18.3	28.3	71.7	55
	1.5	20.0	25.0	35.0	51.6	48.4	35
	2.0	26.7	33.3	40.0	55.0	45	28.4
Control		0.0	1.7	3.3	5.0	95	90

References

Abbot, W.S. (1925): A method for computing the effectiveness of insecticide. J. Econ. Entomol., 18:265-267.

Badr, N.A.; El-Sisi, A.G. and Abdel Meguid, M.A. (1995): Evaluation of some locally formulated petroleum oils for controlling cotton leafworm. J. Agric. Sci. Mansoura Univ., 20(5):2556-2562.

Brown, A. F.; Yousef, G. G.; and Jeffery, E. H. *et al*. (2002): Glucosinolate profiles in broccoli: Variation in levels and implications in breeding for cancer chemoprotection. Journal of the American Society for Horticultural Science, 127(5): 807–813.

De Ong E.R.; Knight, R. and Joseph, G. (1927): A preliminary study of petroleumoil as an insecticide for citrus trees. Hilgardia, 2(9):351-384.

El-Hariry, M. A. and El-Sisi, A.G. (1991): Correlation between physico-chemical properties of some local surfactants and their insecticidal activates against the faba bean aphid, *Aphis craccivora* (Koch). Egypt. J. Agric. Res., 69(1): 289-295.

El-Sisi, A. G. and Farrag, R. M. (1989): Formulation and biological effects of copper carbonate against the Egyptian cotton leafworm, *Spodoptera littoralis*. Agric. Res. Rev., 67(1): 29- 35.

EPPO (1997): *Spodoptera littoralis* and *Spodoptera litura*. In: I. M. Smith, D. G. McNamara, P. R. Scott, and M. Holderness (eds). Quarantine pests for Europe. 2nd edition. Wallingford, UK: CAB International, 518-525.

Hashem, M.S.; Abd-Elsamed, A.A. and Saleh, A.A.A. (2009): Effect of certain homopterous insects infesting broccoli plants and their associated predators' insects at Sharkia Governorate. J. Agric. Sci. Monsoura Univ., 34: 10715-10733.

Henderson, C. F. and Tilton, E. W. (1955): Tests with acaricides against the brown wheat mite. J. Econ. Entomol., 48:157-161.

Kandil, M. A.; Abdel-Aziz N.F. and Sammour E.A. (2003): Comparative toxicity of chlorofluazron and leufenuron against cotton leaf worm, Spodoptera littoralis (Boisd). Egyp. J. Agric. Res. NRC, 2 :645-661.

Ministry of Agriculture (1993): Protocol of evaluation the efficiency of pesticides in Egyptian culture. 85 pp.

Mousa, G. M. and El-Sisi, A.G. (2001): Testing of some alternatives: mineral oil, plant materials and surfactant against piercing and sucking pests infesting squash crop. Assuit Univ., 83-90.

Palumbo J.C.; Howorowitz, A.R. and Prabhaker, N. (2001): Insecticidal control and resistance management for *Bemisia tabaci*. Crop Prot., 20: 739-765.

Rashwan, M. H.; Elbaramawy, Z. A.; El-Sheikh A. E. and Radwan, H. S. A. (1992): The onest of organophosphate and carabamate resistance among 94 Nehad M. Elbarky *et al*. lower Egypt population of the cotton leafworm *Spodoptera littoralis* (Boisd). Bull. Ent. Soc. Egypt, econ. Ser., 19: 211-220.

Rizk, M.A.; El-Sisi, A.G.; Badr, N.A. and Abdel-Halim, S. (1999): Controlling of cotton sucking pests using safe materials. 2nd Int. Conf. of Pest. Control, Mansoura, 211-221.

Smith, E.H. and Pearce, G.W. (1948): The mode of action of petroleum oils as ovicides. J. Eco. Entomol., 41(2): 173-179.

Sun, Y.P. (1950): Toxicity indexes as an improved mothod of comparing the relative toxicity of insecticides. J. Eco. Entomol., 43:45-53.