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Toxicity of some pesticides to predatory mite, *Amblyseius finlandicus* (Oudemans) (Acari: Phytoseiidae) under laboratory conditions

Sanchit S Mandape and Abhishek Shukla

Abstract
An experiment was carried out during September to October 2014-15 and 2015-16 to investigate the effects of toxicity of different pesticides predatory mite, *A. finlandicus* under laboratory conditions. Toxicity was assessed by calculating percent mortality of eggs, nymphs and adult stages of *A. finlandicus* resulting 12 h, 24 h, 36 h, 48 h, 60 h and 72 h after treatment. The effects were classified by IOBC classification indicated that propergite 0.067 percent was slightly harmful (>30% mortality) to eggs and adults of *A. finlandicus*. Spiromesifen at the concentrations 0.0129, 0.0229 and 0.0329 percent were harmless (<30% mortality) to all stages of *A. finlandicus* however, wettable sulphur 0.05 percent was slightly harmful (>30% mortality) to all stages of *A. finlandicus*. Further, difenthiuron at 0.04, 0.05 and 0.06 and fenpyroximate at 0.04, 0.05 and 0.06 percent concentrations were harmless (<30% mortality) to eggs, nymphs and adults of the phytoseiid mite, *A. finlandicus*.

Keywords: Predatory mite, *A. finlandicus*, toxicity, pesticides

1. Introduction
Mites are among the most significant pests of agricultural and horticultural crops causing serious losses [1, 2]. In addition, there are some beneficial mites who predate upon harmful mites and small insect pests and thus help in biological control and maintaining natural balance [3]. The problem arises when such important creatures are not given due status and the indiscriminate use of insecticides further complicate it by killing them too fast than the mite pests [1, 2]. In the absence of these useful mites, whatever population of pest mite is left, it has an open field to multiply and destroy the crop almost completely. So, there is a great need to understand the effect of commonly used pesticides on the predatory mite like *Amblyseius finlandicus* (Oudemans) which is one of the most common phytoseiid predators in almost all the agro-ecosystems and play a vital role in regulating the population of phytophagous mites [4]. Therefore, the present investigation was carried out to know the effect of some of the commonly available acaricides to the predatory mite, *A. finlandicus* under polyhouse condition on frenchbean.

2. Material and Methods
The study on the toxicity of different pesticides were carried out at Acarology laboratory, Department of Agricultural Entomology, N. M. College of Agriculture, Navsari Agricultural University, Navsari during September-October 2014-15 and 2015-16. Effect of different pesticides was tested against different stages of the phytoseiid mite, *A. finlandicus*. The predatory mite, *A. finlandicus* was collected from the stock culture maintained in the laboratory on frenchbean infested with two spotted spider mite, *Tetranychus urticae* as prey. Different concentration of pesticides were prepared separately in beakers and spread on the surface of petri-dishes (10 x 1.5 cm), the surface was dried under ceiling fan. Twenty numbers of different stages *viz.*, eggs, nymph and adults of the predatory mite, *A. finlandicus* were placed /released separately on the treated surface of petri-dishes of various concentrations. They were placed on the surface of treated petri-dishes for 15 minutes and then transferred to other petri-dishes having natural food *i.e.*, *T. urticae*. The mortality of various stages of predatory mite, *A. finlandicus* was recorded after 12, 24, 36, 48, 60 and 72 hours after the treatment. Each concentration was repeated three times and each repetition includes 20 individuals of various stages of the predatory mite.

On the basis of the mortality, different pesticides were classified as: harmless (0–29% effect), slightly harmful (30–79% effect), moderately harmful (80–99% effect) and harmful (more than 99% effect) [3]. The data thus obtained were analysed by completely randomized design (CRD).

3. Results and Discussion

The toxicity of various pesticides to various stages of phytoseiid mite, *A. finlandicus* are presented and discussed as under.

3.1 Toxicity to eggs: The pooled data on the effect of pesticides on eggs revealed that, the interaction (Y x T) between year of observation (Y) and treatment (T) was found to be non-significant exhibiting similar response of the pesticides during two years. Among all the thirty one treatments, egg mortality caused after 12 hours of treatment was highest in wettable sulphur 0.06 percent (31.63%) followed by the treatment with ethion 0.06 percent (29.88%) which was at par with wettable sulphur 0.05 percent (27.50%), acephate 0.10 percent (26.38%). Among the pesticides the lowest egg mortality was recorded with the treatment of fenazaquin 0.005 percent (2.13%) which were at par with diafenthiuron 0.04 percent (2.19%), it was followed by diafenthiuron 0.05 percent (3.13%). The mortality in all the insecticidal treatments increased 24 hrs after their application. The highest egg mortality was exhibited by wettable sulphur 0.06 percent (46.88%) and was followed by acephate 0.10 percent, ethion 0.06 percent and wettable sulphur 0.05 percent (37.12, 34.34 and 30.20% mortality, respectively) while, lowest percent mortality was achieved with treatment with the fenazaquin 0.005 percent (2.32%) it was followed by diafenthiuron 0.04 percent, fenazaquin 0.010 percent and spiromesifen 0.0129 percent each caused 4.00, 4.18 and 4.38 percent egg mortality. However, 36 hours after pesticides treatment highest egg mortality *i.e.* 72.82 percent was recorded with the treatment of ethion 0.06 percent and it was followed by acephate 0.10 percent (69.58%), wettable sulphur 0.06 percent and 0.05 (53.51 and 43.59%, respectively) whereas, fenazaquin 0.005 percent caused lowest egg mortality (2.30%) which was at par with fenazaquin 0.010 percent (3.10%) and diafenthiuron 0.04 percent (3.39%). After 48 hours of treatment acephate 0.10 percent caused highest egg mortality (56.41%) followed by wettable sulphur 0.06 percent (53.29%) and was at par with ethion 0.06 percent (52.74%). Significantly lowest egg mortality was recorded for treatment of fenazaquin 0.005 percent (2.68%) which was at par with fenazaquin 0.010 percent (3.15%) and diafenthiuron 0.04 percent (3.23%). Perusal of mortality data obtained indicated that no egg mortality was recorded in control.

The order of toxicity of different pesticides on the basis of mortality caused to eggs of *A. finlandicus* in descending order were acephate 0.10 percent> wettable sulphur 0.06 percent> ethion 0.06 percent> wettable sulphur 0.05 percent> acephate 0.09 percent> propergite 0.067 percent> ethion 0.05 percent> chlorfenpyre 0.015 percent> chlorfenpyre 0.01 percent> chlorfenpyre 0.005 percent> wettable sulphur 0.04 percent> acephate 0.08 percent> propergite 0.057 percent> chlorantriliniprole 0.0285 percent> ethion 0.04 percent> chlorantriliniprole 0.0185 percent> spiromesifen 0.0329 percent> fenpyroximate 0.06 percent> chlorantriliniprole 0.0085 percent> spiromesifen 0.0229 percent> propergite 0.047 percent> diafenthiuron 0.06 percent> fenpyroximate 0.05 percent> diafenthiuron 0.05 percent> fenpyroximate 0.04 percent> spiromesifen 0.0129 percent> fenazaquin 0.015 percent> diafenthiuron 0.04 percent> fenazaquin 0.01 percent> fenazaquin 0.005 percent. According to Hassan [5] propergite 0.067 percent, wettable sulphur 0.05 and 0.06 percent, ethion 0.05 and 0.06 percent, acephate 0.09 and 0.10 percent, chlorfenpyre 0.010 and 0.015 were slightly harmful as they recorded more than 30 percent egg mortality while, other were classified as harmless for the eggs of predatory mite. Pokle and Shukla [6] reported that under the laboratory conditions, diafenthiuron was comparatively less toxic as it showed lower mortality to the eggs of *A. longispinosus* for longer period after treatment, while wettable sulphur and triazophos were more toxic as they killed all the eggs of predatory mite, *A. longispinosus* within 6 hours after treatment. While, in the polyhouse triazophos was found highly toxic to predatory mite whereas diafenthiuron was found least toxic to the predatory mite with least percent mortality. Kalpan [5] also reported that the pesticides *viz.,* spirodiclofen, diflubenzuron and abamectin were harmless to eggs of predatory mite, *N. californicus*, while indoxacarb was also toxic to the eggs of predatory mite. It was also supported by Nadimi *et al*. [8] who also found fenpyroximate as safe to the eggs of *P. persimilis*, while Naik [9] reported dicofol 0.04 percent and ethion 0.1 percent as highly toxic to the eggs of *A. longispinosus*. These findings are closely support the present findings on toxicity of various pesticides against egg stage of *A. finlandicus*.

3.2 Toxicity to nymphs: The pooled over data of the year 2014-15 and 2015-16 pertaining to the effect of different pesticides on nymphal stage of the predatory mite, *A. finlandicus* is presented in Table 2. All the treatments showed significant difference in mortality caused by them to nymphs of predatory mite, *A. finlandicus* after 12, 24, 36, 48, 60 and 72 hours after treatment. However, no mortality was recorded in case of control. The data on percent mortality of predatory mite, *A. finlandicus* nymphs over two years is summarized in Table 2. Data revealed that, interaction (Y x T) between year of observation (Y) and treatment (T) was found to be non-significant exhibiting similar response of the pesticides to the nymphs of predatory mite, *A. finlandicus* nymphs during two years. It was observed after 12 hours of chemical treatment that, treatment of nymphs with wettable sulphur 0.06 percent caused highest percent mortality of nymphs (32.38%) as compared to all other chemicals under the present study and was followed by acephate 0.10 percent (29.75%) and was at par with ethion 0.05 percent (29.50%). Significantly lowest percent mortality of nymphs was recorded with the treatment fenazaquin 0.005 percent (2.50%); it was followed by its concentration *i.e.* 0.01 percent (3.63%) and was at par with 0.015 percent (4.00%). After 24 hours the toxicity of pesticides to nymphs increased and highest percent mortality was caused by wettable sulphur 0.06 percent (33.32%) and it was followed by acephate 0.10 percent (25.50%) and wettable sulphur 0.06 percent (21.96%) whereas, lowest mortalities were recorded in case of fenazaquin 0.005 percent (2.39%) and it was at par with spiromesifen 0.0129 percent (2.51%) and was followed by spiromesifen 0.0229 percent (3.33%). After 36 hours, acephate 0.10 percent reported highest percent mortality to nymphs (49.10%) and was followed by wettable sulphur 0.06 percent, ethion 0.06 percent and acephate 0.09 percent causing 40.30, 32.55 and 23.86 percent mortality of nymphs however, fenazaquin 0.005 percent, diafenthiuron 0.04 percent, spiromesifen 0.0129 percent and fenazaquin 0.010 percent caused lowest percent mortalities among all

treatments (2.43, 2.69, 2.74 and 3.04%, respectively) and were at par with each other. Ethion at 0.06 percent recorded highest percent mortality (43.32%) after 48 hours of treatment and was followed by acephate 0.10 percent, wettable sulphur 0.06 percent and 0.05 percent by causing 38.53, 35.61 and 26.88 percent mortality of nymphs, respectively whereas, fenazaquin 0.005 percent, spiromesifen 0.04 and fenazaquin 0.010 percent recorded lowest percent mortality (2.56, 3.20 and 3.30%, respectively) and were at par with each other. Acephate at 0.10 percent caused 62.37 percent mortality after 60 hours of treatment and was followed by ethion 0.06 percent (48.70%) and acephate 0.09 percent (43.99%) while, fenazaquin 0.005 percent, diafenthiuron 0.04 percent and spiromesifen 0.0129 percent were at par with each other causing lowest percent mortality of 2.55, 2.62 and 3.25 percent, respectively. The highest percent mortality (81.16%) was recorded with the treatment of acephate 0.10 percent after 72 hours and it was at par with ethion 0.06 percent (80.23%), it which was followed by wettable sulphur 0.06 percent (58.19%). Significantly lowest mortality was recorded by the treatment of fenazaquin 0.005 percent, 0.010 percent, spiromesifen 0.0129 percent and diafenthiuron 0.04 percent (2.23, 2.56, 2.58 and 2.68%, respectively) and they were at par with each other. Perusal of mortality data recorded in the present experiment indicated that other chemicals also showed mortality at various concentrations and at different time intervals however, no mortality of nymphs was recorded in case of control.

The order of toxicity of different pesticides on the basis of mortality caused to the nymphal stages of predatory mite, *A. finlandicus* in descending order were acephate 0.10 percent> ethion 0.06 percent> wettable sulphur 0.06 percent> acephate 0.09 percent> wettable sulphur 0.05 percent> ethion 0.05 percent> chlorfenpyre 0.015 percent> chlorantriliniprole 0.0285 percent> ethion 0.04 percent> chlorfenpyre 0.01 percent> wettable sulphur 0.04 percent> acephate 0.08 percent> chlorantriliniprole 0.0185 percent> chlorfenpyre 0.005 percent> propergite 0.067 percent> fenpyroximate 0.06 percent> chlorantriliniprole 0.0085 percent> fenpyroximate 0.05 percent> propergite 0.057 percent> diafenthiuron 0.06 percent> propergite 0.047 percent> spiromesifen 0.0329 percent> diafenthiuron 0.05 percent> fenpyroximate 0.04 percent> spiromesifen 0.0229 percent> fenazaquin 0.015 percent> diafenthiuron 0.04 percent> spiromesifen 0.0129 percent> fenazaquin 0.01 percent> fenazaquin 0.005 percent. According to Hassan [5] wettable sulphur 0.05 percent and 0.06, ethion 0.05 percent, acephate 0.09 percent, chlorantriliniprole 0.0285 and chlorfenpyre 0.015 percent were slightly harmful as they recorded more than 30 percent nymphal mortality while, acephate 0.10 percent and ethion 0.06 percent were moderately harmful to the nymphs of predatory mite, *A. finlandicus* as they recorded more than 79 percent nymph mortality however, other were classified as harmless for the nymphs of predatory mite. Further, the present findings are closely supported by the other workers *viz*., Naik [9], Nadimi [8] and Pokle and Shukla [6] who also recorded similar results against nymphs of other related species *i.e. A. longispinosus* and *P. persimilis*.

3.3 Toxicity to adults: The pooled over data of detrimental effect of different pesticides to the adult stage of predatory mites, *A. finlandicus* during the year 2014-15 and 2015-16 are summarized in Table 3. The data on percent mortality of predatory mite, *A. finlandicus* adults revealed that, the interaction (Y x T) between the year of observation (Y) and treatment (T) was found to be non-significant exhibiting similar response of the pesticides to the adults of predatory mite, *A. finlandicus* during two years. It was observed after 12 hours of chemical treatment that, the treatment of adults with acephate 0.10 percent caused highest percent mortality of adults (28.75%) as compared to all other chemicals under the study which was at par with ethion 0.06 percent (28.00%) and was followed by wettable sulphur 0.06 percent (24.00%) and acephate 0.09 percent (19.25%). Significantly lowest percent mortality of adults was recorded with the treatment spiromesifen 0.0129 percent (2.26%) which was at par with diafenthiuron 0.04 percent and fenazaquin 0.005 percent (2.30 and 2.33%, respectively). After 24 hours the toxicity of pesticides to adults increased and highest percent mortality was caused by ethion 0.06 percent (39.48%), acephate 0.10 percent (39.29%) and wettable sulphur 0.06 percent (37.41%), which were at par with each other. while, lowest mortalities were recorded by spiromesifen 0.0129 percent, fenazaquin 0.005 percent and diafenthiuron 0.04 percent (2.21, 2.22 and 2.37%, respectively) which were at par with each other's. At 36 hours, wettable sulphur 0.06 percent recorded highest percent mortality to adults (59.04%) which was followed by ethion 0.06 percent, acephate 0.10 percent and wettable sulphur 0.05 percent (46.11, 33.12 and 29.08%, respectively) however, diafenthiuron 0.04 percent, spiromesifen 0.0129 percent and fenazaquin 0.005 percent recorded lowest mortality of adults (2.31, 2.32 and 2.47%, respectively) and were at par with each other. Wettable sulphur at 0.06 percent recorded highest percent mortality (41.74%) after 48 hours of treatment and it was followed by acephate 0.10 percent (39.64%) and was at par with ethion 0.06 percent (37.88%) whereas, fenazaquin 0.005 percent recorded lowest percent mortality (2.36%) which was at par with spiromesifen 0.0129 percent and diafenthiuron 0.04 percent causing 2.45 and 2.55 percent mortality of adults, respectively. Wettable sulphur at 0.06 percent dose caused 59.98 percent mortality after 60 hours of treatment and it was followed by acephate 0.10 percent (52.06%) and was at par with ethion 0.06 percent (51.75%) while, spiromesifen 0.001 percent (2.43%) and fenazaquin 0.005 percent (2.48%) recorded lowest mortality and were at par with each other and followed by spiromesifen 0.0229 percent (2.66%) and fenazaquin 0.010 percent (3.88%) and were at par with each other. Mortality was highest (83.10%) in the treatment of wettable sulphur 0.06 percent after 72 hours and it was followed by acephate 0.10 percent (71.60%), however it was at par with chlorfenpyre 0.015 percent (70.31%) and it was followed by ethion 0.06 percent (68.21%). Significantly lowest mortality was recorded in the treatment of spiromesifen 0.0129 percent (2.36%) and was at par with fenazaquin 0.005 percent (2.44%) however, it was followed by spiromesifen 0.0129 percent (3.36%). Perusal of mortality data obtained indicated that other chemicals also showed mortality at various concentrations and at different time intervals while no mortality of adult predatory mite, *A. finlandicus* was recorded in case of control.

The toxicity of pesticides on the basis of mortality caused to the adults of *A. finlandicus* in descending order were wettable sulphur 0.06 percent> acephate 0.10 percent> chlorfenpyre 0.015 percent> ethion 0.06 percent> wettable sulphur 0.05 percent> ethion 0.05 percent> acephate 0.09 percent> propergite 0.067 percent> chlorfenpyre 0.01 percent> ethion 0.04 percent> chlorfenpyre 0.005 percent> chlorantriliniprole 0.0285 percent> propergite 0.057 percent> wettable sulphur 0.04 percent> acephate 0.08 percent> chlorantriliniprole 0.0185 percent> fenpyroximate 0.06 percent>

chlorantriliniprole 0.0085 percent> propergite 0.047 percent> fenpyroximate 0.05 percent> fenpyroximate 0.04 percent> diafenthiuron 0.06 percent> spiromesifen 0.0329 percent> fenazaquin 0.015 percent> diafenthiuron 0.05 percent> fenazaquin 0.01 percent> spiromesifen 0.0229 percent> diafenthiuron 0.04 percent> fenazaquin 0.005 percent> spiromesifen 0.0129 percent. According to Hassan [5] propergite 0.067 percent, wettable sulphur 0.05 percent, ethion 0.05 percent and 0.06, acephate 0.09 percent and 0.10, chlorfenpyre 0.01 percent and 0.015 were slightly harmful as they recorded more than 30 percent adult mortality while, wettable sulphur 0.06 percent recorded more than 79 percent adult mortality so classified as moderately harmful to adults of phytoseiid mites. However, other pesticides were classified as harmless for adult phytoseiid mites. The present findings are more or less in accordance with the earlier work of Naik [9] and Pokle and Shukla [6] who also recorded similar type of results by using some of these acaricides/insecticides against the predatory mite, *A. longispinosus* under laboratory, polyhouse and field conditions.

Table 1: Effect of different pesticides on eggs of *A. finlandicus*

Treatments		Pre treatment	Pooled of two years				
			48 hrs	12hrs	24hrs	36 hrs	48 hrs
T1	Propergite 0.047%	50	9.99 (18.40)ijk	7.63 (15.97)kl	12.26 (20.47)j	12.69 (20.84)k	9.67 (18.09)ijk
T2	Propergite 0.057%	50	19.76 (26.37)g	14.00 (21.96)h	20.27 (26.74)fg	27.10 (31.35)g	19.83 (26.42)g
T3	Propergite 0.067%	50	42.02 (40.39)d	20.75 (27.08)d	32.54 (34.77)c	54.80 (47.75)c	42.26 (40.53)d
T4	Spiromesifen 0.0129%	50	3.71 (11.03)lm	5.38 (13.36)m	4.38 (12.00)o	5.23 (13.16)n	3.88 (11.27)lmn
T5	Spiromesifen 0.0229%	50	10.75 (19.11)ij	7.75 (16.13)kl	7.59 (15.95)lm	9.37 (17.79)l	10.21 (18.60)ij
T6	Spiromesifen 0.0329%	50	14.36 (22.24)h	11.38 (19.69)ij	12.26 (20.46)j	11.97 (20.20)k	13.34 (21.38)h
T7	Wet Sulphur 0.04%	50	23.51 (28.97)f	19.75 (26.37)ed	17.03 (24.34)h	22.85 (28.53)h	23.78 (29.16)f
T8	Wet Sulphur 0.05%	50	47.72 (43.67)c	27.50 (31.61)c	30.20 (33.32)d	43.59 (41.30)d	50.15 (45.07)c
T9	Wet Sulphur 0.06%	50	54.04 (47.30)b	31.63 (34.20)a	46.88 (43.19)a	53.51 (46.99)c	53.29 (46.87)b
T10	Difenthiuron 0.04%	50	3.38 (10.51)m	2.13 (8.36)p	4.00 (11.49)o	3.39 (10.54)o	3.23 (10.25)no
T11	Difenthiuron 0.05%	50	5.06 (12.90)l	3.13 (10.10)o	5.91 (14.04)n	5.67 (13.72)mn	4.94 (12.78)l
T12	Difenthiuron 0.06%	50	9.03 (17.46)jk	4.00 (11.51)n	6.77 (15.04)nm	6.70 (14.96)m	8.68 (17.10)jk
T13	Fenpyroximate 0.04%	50	4.38 (12.01)lm	7.00 (15.29)l	4.76 (12.55)o	5.61 (13.66)mn	4.55 (12.29)lm
T14	Fenpyroximate 0.05%	50	8.78 (17.21)k	8.63 (17.03)k	6.87 (15.17)nm	8.66 (17.08)l	8.47 (16.88)k
T15	Fenpyroximate 0.06%	50	11.24 (19.53)i	11.38 (19.69)ij	8.08 (16.47)kl	9.96 (18.37)l	11.35 (19.65)i
T16	Ethion 0.04%	50	18.24 (25.24)g	12.00 (20.22)i	16.65 (24.06)h	19.96 (26.52)i	18.60 (25.51)g
T17	Ethion 0.05%	50	41.81 (40.27)d	20.25 (26.73)d	20.19 (26.68)fg	39.36 (38.84)e	41.14 (39.88)d
T18	Ethion 0.06%	50	53.31 (46.88)b	29.88 (33.12)b	34.34 (35.86)c	72.80 (58.55)a	52.74 (46.55)b
T19	Acephate 0.08%	50	19.97 (26.52)g	10.88 (19.24)ij	16.56 (23.99)h	17.47 (24.66)j	19.87 (26.45)g
T20	Acephate 0.09%	50	47.97 (43.81)c	18.63 (25.54)ef	25.77 (30.48)e	35.87 (36.77)f	47.70 (43.66)c
T21	Acephate 0.10%	50	57.56 (49.33)a	26.38 (30.88)c	37.12 (37.52)b	69.58 (56.51)b	56.41 (48.67)a
T22	Fenazaquin 0.005%	50	3.23 (10.30)m	2.19 (8.48)p	2.32 (8.72)p	2.30 (8.69)p	2.68 (9.34)o
T23	Fenazaquin 0.01%	50	3.53 (10.73)m	3.75 (11.08)no	4.19 (11.79)o	3.10 (10.01)op	3.15 (10.09)no
T24	Fenazaquin 0.015%	50	4.02 (11.53)lm	5.13 (13.03)m	5.96 (14.08)n	5.40 (13.37)n	3.62 (10.87)mno
T25	Chlorantriliniprole 0.0085%	50	10.97 (19.28)ij	8.13 (16.55)k	8.97 (17.42)k	9.64 (18.07)l	10.75 (19.10)i
T26	Chlorantriliniprole 0.0185%	50	14.26 (22.15)h	10.13 (18.54)j	11.15 (19.48)j	12.04 (20.29)k	14.27 (22.17)h
T27	Chlorantriliniprole 0.0285%	50	19.69 (26.31)g	12.13 (20.37)i	13.73 (21.74)i	15.78 (23.39)j	19.22 (25.98)g
T28	Chlorfenpyre 0.005%	50	24.80 (29.84)f	14.13 (22.07)h	16.48 (23.94)h	19.61 (26.27)i	24.47 (29.63)f

T29	Chlorfenpyre 0.01%	50	31.31 (34.00)e	16.13 (23.67)g	19.19 (25.96)g	23.08 (28.70)h	31.04 (33.84)e
T30	Chlorfenpyre 0.015%	50	42.51 (40.67)d	18.13 (25.19)f	21.75 (27.79)f	28.53 (32.27)g	40.82 (39.69)d
T31	Control	50	0.25 (2.86)n	0.25 (2.86)q	0.25 (2.86)q	0.25 (2.86)q	0.25 (2.86)p
Treatment		SEm±	0.67	0.08	0.09	0.11	0.11
		C.D. 5%	1.89	0.24	0.24	0.32	0.32
Year		SEm±		0.33	0.34	0.44	0.45
		C.D. 5%		0.93	0.96	1.25	1.27
Y x T		SEm±		0.46	0.48	0.62	0.63
		C.D. 5%		NS	NS	NS	NS
C.V. (%)			5.25	4.73	4.45	4.92	5.00

Figures in the parentheses are arc sine transformed values.
In each column means followed by same alphabet are not statistically different from each other

Table 2: Effect of different pesticides on nymphs of *A. finlandicus*

Treatments		Pre treatment	Pooled of two years					
			12hrs	24hrs	36 hrs	48 hrs	60hrs	72hrs
T1	Propergite 0.047%	50	9.00 (17.43)ij	7.41 (15.77)mn	9.16 (17.59)jk	8.16 (16.57)lm	6.55 (14.78)no	4.45 (12.12)p
T2	Propergite 0.057%	50	10.50 (18.89)h	11.13 (19.46)hij	14.15 (22.07)h	9.22 (17.66)kl	12.89 (21.02)k	7.43 (15.81)n
T3	Propergite 0.067%	50	16.13 (23.66)f	19.34 (26.07)d	20.29 (26.75)e	13.11 (21.19)i	22.95 (28.59)h	11.89 (20.14)l
T4	Spiromesifen 0.0129%	50	5.88 (13.98)kl	2.51 (9.05)r	2.74 (9.47)o	3.20 (10.20)p	3.25 (10.30)rs	2.58 (9.23)r
T5	Spiromesifen 0.0229%	50	9.38 (17.80)hij	3.33 (10.44)q	4.51 (12.24)n	5.11 (13.04)o	5.47 (13.45)p	3.46 (10.63)q
T6	Spiromesifen 0.0329%	50	10.13 (18.52)hi	4.63 (12.39)o	7.54 (15.90)l	6.45 (14.69)n	7.31 (15.67)mn	4.40 (12.06)p
T7	Wet Sulphur 0.04%	50	17.88 (24.99)e	12.48 (20.66)gh	13.49 (21.53)h	15.08 (22.83)h	22.36 (28.21)h	22.18 (28.07)ij
T8	Wet Sulphur 0.05%	50	25.50 (30.31)c	21.96 (27.92)c	20.96 (27.23)e	26.88 (31.21)d	35.92 (36.80)d	50.28 (45.14)d
T9	Wet Sulphur 0.06%	50	32.38 (34.66)a	33.32 (35.24)a	40.30 (39.39)b	35.61 (36.62)c	43.21 (41.08)c	58.19 (49.70)b
T10	Difenthiuron 0.04%	50	4.00 (11.51)m	4.20 (11.78)opq	2.69 (9.37)o	4.80 (12.59)o	2.62 (9.30)s	2.68 (9.41)r
T11	Difenthiuron 0.05%	50	6.50 (14.74)k	7.63 (15.98)mn	4.18 (11.74)n	7.27 (15.60)mn	4.19 (11.78)q	4.38 (12.02)p
T12	Difenthiuron 0.06%	50	9.00 (17.42)ij	8.32 (16.72)lm	5.68 (13.75)m	9.34 (17.75)kl	5.83 (13.94)op	5.74 (13.83)o
T13	Fenpyroximate 0.04%	50	5.13 (13.01)l	8.27 (16.65)lm	8.85 (17.28)k	6.42 (14.64)n	7.20 (15.54)mn	4.31 (11.92)p
T14	Fenpyroximate 0.05%	50	6.13 (14.27)k	10.10 (18.50)jk	11.31 (19.63)i	8.46 (16.87)lm	8.25 (16.63)lm	7.69 (16.08)n
T15	Fenpyroximate 0.06%	50	6.88 (15.15)k	11.86 (20.12)hi	13.84 (21.82)h	10.25 (18.63)jk	11.61 (19.90)k	9.09 (17.53)m
T16	Ethion 0.04%	50	13.25 (21.31)g	9.46 (17.90)kl	15.94 (23.48)g	18.33 (25.33)g	20.30 (26.76)i	28.65 (32.34)h
T17	Ethion 0.05%	50	24.13 (29.40)c	10.65 (19.03)ijk	22.09 (28.00)e	24.68 (29.77)e	29.68 (32.99)e	41.50 (40.09)e
T18	Ethion 0.06%	50	29.50 (32.88)b	16.93 (24.27)e	32.55 (34.77)c	43.32 (41.14)a	48.70 (44.24)b	80.23 (63.59)a
T19	Acephate 0.08%	50	11.88 (20.14)g	14.68 (22.50)f	14.00 (21.94)h	14.42 (22.29)hi	22.26 (28.13)h	21.81 (27.83)ij
T20	Acephate 0.09%	50	21.00 (27.25)d	17.59 (24.77)de	23.86 (29.22)d	25.39 (30.24)de	43.99 (41.53)c	54.67 (47.66)c
T21	Acephate 0.10%	50	29.75 (33.04)b	25.50 (30.30)b	49.10 (44.46)a	38.53 (38.35)b	62.37 (52.15)a	81.16 (64.29)a
T22	Fenazaquin 0.005%	50	2.50 (9.05)n	2.39 (8.83)r	2.43 (8.93)o	2.56 (9.16)p	2.55 (9.15)s	2.23 (8.59)r
T23	Fenazaquin 0.01%	50	3.63 (10.88)m	3.47 (10.64)pq	3.04 (9.94)o	3.30 (10.33)p	3.63 (10.87)qr	2.56 (9.18)r
T24	Fenazaquin 0.015%	50	4.00 (11.45)m	4.46 (12.03)op	3.91 (11.33)n	4.19 (11.76)o	5.57 (13.62)op	2.76 (9.50)r
T25	Chlorantriliniprole 0.0085%	50	8.25 (16.68)j	6.81 (15.10)n	7.31 (15.68)l	8.25 (16.67)lm	8.63 (17.06)l	9.08 (17.53)m
T26	Chlorantriliniprole 0.0185%	50	10.38	11.43	12.78	14.73	16.79	20.59

			(18.77)h	(19.74)hij	(20.93)h	(22.55)h	(24.18)j	(26.97)j
T27	Chlorantriliniprole 0.0285%	50	14.88 (22.66)f	15.14 (22.88)f	16.69 (24.09)fg	20.55 (26.94)f	24.94 (29.94)g	33.49 (35.34)g
T28	Chlorfenpyre 0.005%	50	12.38 (20.56)g	10.42 (18.81)ijk	10.32 (18.72)ij	11.27 (19.59)j	12.84 (20.98)k	15.06 (22.82)k
T29	Chlorfenpyre 0.01%	50	15.38 (23.07)f	13.64 (21.59)fg	13.68 (21.69)h	15.91 (23.49)h	18.72 (25.62)i	22.94 (28.60)i
T30	Chlorfenpyre 0.015%	50	18.38 (25.37)e	17.55 (24.74)de	17.73 (24.88)f	21.11 (27.34)f	27.48 (31.60)f	38.20 (38.15)f
T31	Control	50	0.25 (2.86)o	0.25 (2.86)s	0.25 (2.86)p	0.25 (2.86)q	0.25 (2.86)t	0.25 (2.86)s
Treatment		SEm±	0.09	0.10	0.09	0.09	0.09	0.09
		C.D. 5%	0.24	0.28	0.25	0.26	0.26	0.24
Y		SEm±	0.34	0.39	0.35	0.36	0.35	0.34
		C.D. 5%	0.96	1.11	1.00	1.03	1.01	0.96
Y x T		SEm±	0.48	0.55	0.50	0.51	0.50	0.48
		C.D. 5%	NS	NS	NS	NS	NS	NS
C.V. (%)			4.85	6.00	4.93	4.97	4.38	3.89

Figures in the parentheses are arc sine transformed values.
In each column means followed by same alphabet are not statistically different from each other

Table 3: Effect of different pesticides on adults of *A. finlandicus*

Treatments		Pre treatment	Pooled of two years					
			12hrs	24hrs	36 hrs	48 hrs	60hrs	72hrs
T1	Propergite 0.047%	50	5.38 (13.34)n	7.25 (15.59)j	5.51 (13.53)kl	8.33 (16.74)jk	7.95 (16.36)nop	9.56 (18.00)m
T2	Propergite 0.057%	50	8.38 (16.80)j	14.30 (19.46)fgh	10.67 (22.07)i	13.95 (17.66)h	14.05 (21.96)kl	21.72 (27.76)i
T3	Propergite 0.067%	50	14.00 (21.96)ef	19.35 (26.07)de	17.67 (26.75)g	21.99 (21.19)ef	19.48 (26.17)i	39.92 (39.17)e
T4	Spiromesifen 0.0129%	50	2.26 (8.62)q	2.21 (9.05)m	2.32 (9.47)o	2.45 (10.20)pq	2.43 (8.95)s	2.36 (8.82)s
T5	Spiromesifen 0.0229%	50	3.10 (10.05)p	4.86 (10.44)k	3.81 (12.24)n	4.37 (13.04)mn	3.66 (10.96)r	3.36 (10.47)r
T6	Spiromesifen 0.0329%	50	4.21 (11.83)o	7.49 (12.39)j	4.97 (15.90)lm	5.77 (14.69)l	5.08 (12.98)q	5.21 (13.17)op
T7	Wet Sulphur 0.04%	50	9.88 (18.29)hi	13.44 (20.66)gh	14.46 (21.53)h	17.10 (22.83)g	19.68 (26.32)i	19.78 (26.39)j
T8	Wet Sulphur 0.05%	50	16.75 (24.13)d	22.51 (27.92)c	29.08 (27.23)d	33.22 (31.21)c	42.93 (40.92)d	50.60 (45.32)d
T9	Wet Sulphur 0.06%	50	24.00 (29.31)b	37.41 (35.24)a	59.04 (39.39)a	41.74 (36.62)a	59.98 (50.74)a	83.10 (65.73)a
T10	Difenthiuron 0.04%	50	2.30 (8.69)q	2.37 (11.78)m	2.31 (9.37)o	2.55 (12.59)pq	5.30 (13.24)q	2.52 (9.11)s
T11	Difenthiuron 0.05%	50	3.33 (10.45)p	3.73 (15.98)l	4.30 (11.74)mn	3.16 (15.60)op	6.98 (15.29)p	4.01 (11.50)qr
T12	Difenthiuron 0.06%	50	4.30 (11.95)o	5.11 (16.72)k	6.40 (13.75)k	4.43 (17.75)mn	7.63 (16.02)op	5.88 (14.01)o
T13	Fenpyroximate 0.04%	50	5.58 (13.61)mn	5.51 (16.65)k	5.33 (17.28)l	5.18 (14.64)lm	8.95 (17.35)n	7.19 (15.52)n
T14	Fenpyroximate 0.05%	50	6.38 (14.60)lm	7.34 (18.50)j	7.82 (19.63)j	7.32 (16.87)k	11.43 (19.74)m	8.83 (17.27)m
T15	Fenpyroximate 0.06%	50	7.88 (16.28)jk	8.44 (20.12)j	9.39 (21.82)i	9.53 (18.63)j	12.47 (20.62)m	9.86 (18.28)m
T16	Ethion 0.04%	50	13.75 (21.74)ef	15.97 (17.90)f	13.97 (23.48)h	16.46 (25.33)g	19.76 (26.36)i	29.02 (32.58)g
T17	Ethion 0.05%	50	19.38 (26.10)c	24.67 (19.03)b	24.62 (28.00)e	23.15 (29.77)e	35.21 (36.37)f	50.46 (45.25)d
T18	Ethion 0.06%	50	28.00 (31.93)a	39.48 (24.27)a	46.11 (34.77)b	37.88 (41.14)b	51.75 (45.98)b	68.21 (55.67)c
T19	Acephate 0.08%	50	11.25 (19.58)g	15.19 (22.50)f	10.35 (21.94)i	14.84 (22.29)h	14.61 (22.46)k	17.94 (25.04)k
T20	Acephate 0.09%	50	19.25 (26.00)c	21.38 (24.77)c	25.39 (29.22)e	25.99 (30.24)d	32.95 (35.01)g	41.42 (40.04)e
T21	Acephate 0.10%	50	28.75 (32.41)a	39.28 (30.30)a	33.12 (44.46)c	39.64 (38.35)b	52.06 (46.16)b	71.60 (57.79)b
T22	Fenazaquin 0.005%	50	2.33 (8.73)q	2.22 (8.83)m	2.47 (8.93)o	2.36 (9.16)q	2.48 (9.04)s	2.44 (8.97)s
T23	Fenazaquin 0.01%	50	3.33 (10.43)p	3.82 (10.64)l	3.71 (9.94)n	3.54 (10.33)no	3.88 (11.31)r	3.57 (10.84)r

T24	Fenazaquin 0.015%	50	4.47 (12.17)o	5.23 (12.03)k	5.93 (11.33)kl	4.08 (11.76)n	5.69 (13.77)q	4.64 (12.40)pq
T25	Chlorantriliniprole 0.0085%	50	7.13 (15.44)kl	10.05 (15.10)i	7.55 (15.68)j	7.82 (16.67)k	8.74 (17.18)no	9.61 (18.04)m
T26	Chlorantriliniprole 0.0185%	50	9.50 (17.93)i	12.81 (19.74)h	10.41 (20.93)i	11.35 (22.55)i	12.73 (20.88)lm	14.80 (22.61)l
T27	Chlorantriliniprole 0.0285%	50	12.75 (20.90)f	15.01 (22.88)fg	14.62 (24.09)h	14.50 (26.94)h	17.78 (24.93)j	22.26 (28.14)i
T28	Chlorfenpyre 0.005%	50	7.63 (16.00)jk	11.33 (18.81)i	17.06 (18.72)g	21.05 (19.59)f	26.66 (31.07)h	26.38 (30.88)h
T29	Chlorfenpyre 0.01%	50	11.00 (19.35)gh	17.85 (21.59)e	19.95 (21.69)f	27.21 (23.49)d	38.02 (38.05)e	34.27 (35.81)f
T30	Chlorfenpyre 0.015%	50	14.75 (22.56)e	20.75 (24.74)cd	24.73 (24.88)e	31.53 (27.34)c	46.15 (42.77)c	70.31 (56.97)b
T31	Control	50	0.25 (2.86)r	0.25 (2.86)n	0.25 (2.86)p	0.25 (2.86)r	0.25 (2.86)t	0.25 (2.86)t
Treatment		SEm±	0.08	0.09	0.09	0.09	0.09	0.09
		C.D. 5%	0.23	0.26	0.25	0.25	0.25	0.24
		SEm±	0.32	0.35	0.35	0.35	0.35	0.34
		C.D. 5%	0.90	1.00	1.00	0.99	0.98	0.96
		SEm±	0.45	0.50	0.50	0.49	0.49	0.48
		C.D. 5%	NS	NS	NS	NS	NS	NS
C.V. (%)			5.21	5.01	4.90	4.73	4.09	3.58

Figures in the parentheses are arc sine transformed values.
In each column means followed by same alphabet are not statistically different from each other

4. Conclusion

The effects of toxicity of different acaricides/pesticides on predatory mite, *A. finlandicus* were tested. On the basis of IOBC classification propergite 0.067 percent was slightly harmful (>30% mortality) to eggs and adults whereas Spiromesifen were found harmless (<30% mortality) to all stages of *A. finlandicus* however, wettable sulphur 0.05 percent was slightly harmful (>30% mortality) to all stages of predatory mite. Further, difenthiuron and fenpyroximate were harmless (<30% mortality) to eggs, nymphs and adults of the phytoseiid mite. These pesticides were useful in integrated pest management programme against plant feeding mites.

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