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COMPARATIVE EVALUATION OF NOVEL ACARICIDES AGAINST TWO SPOTTED SPIDER MITE. *TETRANYCHUS URTICAE* KOCH. INFESTING CUCUMBER (*CUCUMIS SATIVUS*) UNDER LABORATORY AND GREEN HOUSE CONDITIONS

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ABSTRACT
Five commercially available new acaricides viz., Abamectin, Fenazaquin, Spiromesifen, Fenpyroximate and Hexythiazox were compared to a standard acaricide, Dicofol and Propargite for efficacy against the two spotted spider mite, *Tetranychus urticae* (koch) under laboratory and green house field conditions. In laboratory trials, all the acaricides resulted in 31.13 to 100 percent mortality with highest in Fenazaquin and Abamectin treatments during I season and 46.32 to 100 percent in II season with lowest percent mortality in Hexythiazox @ 0.75 mL/L. No mite were found to be alive after 48h of treatment in Fenazaquin and Abamectin treatment compared to other acaricides and control, however in the treatments of Propargite, Hexythiazox, and Dicofol, lower mortality (<70 percent) was observed even 48 hrs after treatment during both the seasons. During first crop season, Fenazaquin 10EC @ 1.7mL/L and Abamectin 1.9EC @1.0 ml/L caused mortality in the range of 92.39–100 percent compared to Spiromesifen (88.87%), Fenpyroximate (70.03%), Hexythiazox (37.40-60.80%), Propargite (45.06%) and Dicofol (26.30%) where the efficacy declined on 14th day observation. During II season observation, lower mortality of mites was recorded in standard acaricides viz., Dicofol (74.00%; 22.30%) and Propargite (81.30%; 39.24%) on 1 and 14th day, respectively indicating that at initial period though the mortality was higher but these acaricides lost their efficacy over a period of time and may be failure in control of spider mites. Abamectin @ 0.5ml/L (89.29%; 94.55%) and 1.0ml/L (93.85%; 98.71%), Fenazaquin (97.68%; 94.33%), Spiromesifen (93.90%; 87.30%), Fenproximate (79.20%; 59.74%), Hexythiazox @ 1.25 ml/L (83.87%; 55.73%) showed higher mortality on 1st and 14th day, respectively and efficacy in terms of mortality was prolonged till last day observation. All the acaricides tested in both laboratory and green house conditions were proved superior over control and Abamactin and Fenazaquin were superior over other acarcides tested.

INTRODUCTION

Vegetable crops were found to be attacked by phytophagous mites almost throughout the year, the mite problem remained extremely severe during the summer months (Prasad, 2006). Among the various species of mites, Spider mites, mostly polyphagous species, are common pests in modern agroecosystems worldwide, and some of them are among the most important crop pests (Dejan Marcic *et al*., 2011). These mites can cause considerable crop yield and quality losses, because they have short life span and under favorable conditions their populations quickly reach high abundance (Helle and Sabelis, 1985a, b; Lindquist *et al*., 1996; Zhang, 2003; Van Leeuwen *et al*., 2010). Two spotted spider mite (*Tetranychus urticae* Koch.), a highly polyphagous species is particularly dominant in intensive high yielding cropping system and also one of the most important pests in greenhouses throughout the world (Whalon *et al*., 2008, 2010; Alzoubi and Cobonoglu, 2008). They impose a great expense on green growers worldwide in terms of damage and control cost and are therefore globally considered an important agricultural pest (Jeppson *et al*., 1975). It causes significant economic losses in cucumber, tomato, pepper and bean grown in green houses. (Sikha Deka *et al*., 2011). Pranab Barma and Shantanujha *et al*. (2013) observed that two spotted red spider mite (*Tetranychus urticae* Koch.) occurred throughout the period of observations from first week of March to second week of September during each of the three years of study on pointed gourd.

There is a continual need for application of new acaricides with novel biochemical modes of action, but their use to be optimized in order to prevent or delay the evolution of resistance and prolong their life span (Dekeyser, 2005). Hence in this regard, study was initiated to understand the efficacy of novel acaricides against two spotted spider mite, *Tetranychus urticae* infesting cucumber under greenhouse and laboratory conditions.

MATERIALS AND METHODS

The toxicity of commercial acaricides to the spider mite was tested in the laboratory in 2011 (First crop season) and 2012(Second crop season) as per the method of Sikha Deka *et al*., 2011. Leaves with actively feeding mites along with petioles collected from the greenhouse were considered for the bioassay studies and to keep the leaves turgesent, petioles were covered with wet cotton. These leaves were sprayed with each of the concentration of acaricide and spray of distilled water served as control. After spraying, they were air dried for approximately 2h and placed at the bottom of petriplates (90mm diameter), that were lined with wet cotton and covered with lid. The number of live and dead mites in each replicate was counted under a stereomicroscope before the treatment and 24, 48 hours after the treatment. From each treated leaf, population count was made randomly from 2 cm^2 leaf area. Mites were considered dead if their appendages did not move when prodded with a fine hair brush.

Green house

The experiments was carried out in green house of Horticulture College and Research Institute Farm, Anantharajupet during 2011, first crop season and second crop season, 2012. The experiments were laid out in randomized block design with 9 treatments including control. The plot size was 2x3m^2 of "snow white" variety cucumber grown by following the recommended package of practices. Nine doses were used for seven acaricides along with three replicates and control. Two sprays were performed at an interval of 15 days and three plants were randomly selected from each plot and tagged. Spraying was done onto leaves two weeks after natural pest infestation based on pest load of the crop when the population exceeded recommended treatment thresholds i.e. 25-30 mites/ leaf. (John and Dorie, 1997). Methodology of Rachana (2004) was followed to record the incidence of mites. Three plants were randomly selected from each plot and tagged. From each tagged plant, population count was made from 1 sq. inch leaf area of three leaves (top, middle and bottom) and average population was recorded. The observations were recorded before the spray as well as 1, 3, 5, 7, 10 and 14 days after each spray. Mites not showing any moment when lightly touched with a brush were considered dead. Results were expressed as percent mortality with correction for untreated mortality using Abbott's formula (Abbott, 1925) and transformed to arcsine to homogenize the variances. The data were subjected to ANOVA tests.

RESULTS AND DISCUSSION

Seven acaricides viz., abamectin, spiromesifen, fenpyroximate, dicofol, propargite, fenazaquin and hexythiazox were evaluated against mites. Analysis of variance shows that the

Table 1: Effect of acaricides on the mortality of *T. urticae* in Laboratory (First crop season)

Treatments	Dose (ml/L)	Percent mortality of mite population after treatment	
		24hr	48hr
Abamectin 1.9EC	0.50	99.00(84.26)^{g}	97.17(80.46)^{e}
Abamectin 1.9EC	1.00	100.00(89.04)^{h}	100.00(89.05)^{g}
Spiromesifen 22.9SC	0.80	90.00(71.61)^{d}	94.34(76.26)^{d}
Fenpyroximate 5EC	1.25	92.20(73.80)^{e}	98.60(83.39)^{f}
Dicofol 18.5EC	2.70	75.47(60.32)^{b}	62.26(52.10)^{c}
Propargite 57EC	2.00	94.34(76.36)^{f}	97.17(80.58)^{e}
Fenzaquin 10EC	1.70	100.00(89.04)^{h}	100.00(89.04)^{g}
Hexythiazox 5.45EC	0.75	52.83(46.62)^{a}	31.13(33.91)^{a}
Hexythiazox 5.45EC	1.25	81.13(64.26)^{c}	56.60(48.79)^{b}
Control	-	0.00 (0.00)^{i}	0.00 (0.00)^{h}
CD(.05)		1.95	2.49
SE(m)±		0.92	1.17

P = 0.05, Mean of three replicates; Figures in parentheses are arcsine transformed values. In a column, 'means' followed by a common letter do not differ significantly at Pd"0.05 by Duncan's multiple range test.

Table 2: Effect of acaricides on the mortality of *T. urticae* in Laboratory (Second crop season)

Treatments	Dose(ml/L)	Percent mortality of mite population after treatment	
		24hr	48hr
Abamectin 1.9EC	0.50	90.89(72.31)^{c}	89.02(70.66)^{e}
Abamectin 1.9EC	1.00	96.54(79.44)^{d}	97.22(80.85)^{g}
Spiromesifen 22.9SC	0.80	88.58(70.30)^{c}	93.12(74.85)^{f}
Fenpyroximate 5EC	1.25	90.61(72.19)^{c}	83.25(65.86)^{d}
Dicofol 18.5EC	2.70	72.90(58.64)^{b}	58.89(50.12)^{b}
Propargite 57EC	2.00	74.39(59.60)^{b}	78.33(62.27)^{c}
Fenzaquin 10EC	1.70	95.35(77.58)^{d}	100.00(89.04)^{h}
Hexythiazox 5.45EC	0.75	57.65(49.40)^{a}	46.32(42.89)^{a}
Hexythiazox 5.45EC	1.25	75.45(60.30)^{b}	77.15(61.46)^{c}
Control	-	0.00 (0.00)^{e}	0.00(0.00)^{i}
CD (.05)		2.16	2.71
SE(m)±		1.02	1.27

P = 0.05, Mean of three replicates; Figures in parentheses are arcsine transformed values. In a column, 'means' followed by a common letter do not differ significantly at Pd"0.05 by Duncan's multiple range test

acaricide application had significant effect on the mortality of *T. urticae* proving thereby that their application of acaricides on an average was more effective in reducing the mite population as compared to control. (Tables 1, 2, 3 and 4). The trend of relative efficacy of various treatments has been described below

Effect of new acaricides on mites in the laboratory

The efficacy of acaricides was observed in the laboratory. After 24hr of treatment, abamectin 1.9EC @ 1.0ml and fenazaquin 10EC were found to inflict highest mite mortality (100%), followed by abamectin at lower dose of 0.5ml/L causing 99.00% mortality. Abamectin has reported to be active even at lower concentrations (Croft *et al*., 1987). The mite mortality increased in most of the treatments after 48hr of application in both the seasons except dicofol, hexythiazox and abamectin (0.5ml/L). All treatments were significantly effective in comparison to control in first and second crop seasons. It was observed in first crop season (48 hr after treatment) that abamectin at lower dose and propargite 57EC @ 2.0ml/L were at par with each other, whereas in second crop season, 24hr after application, hexythiazox @1.25ml, dicofol

and propargite though showed varied mortality but statistically on par whereas abamectin @ 0.5ml, spiromesifen and fenpyroximate caused mortality in the range of 88.58-90.89% which were however statistically at par with each other. Al-Lala *et. al.,* (2012) conducted laboratory bioassays to evaluate the toxicity of spiromesifen against seven population of adult females of two spotted spider mite infesting cucumber and in general spiromesifen induced 74% mortality to all populations tested. From all these observations, the result of laboratory experiments indicated that fenzaquin, abamectin @1.0mL were most effective closely followed by spiromesifen due to unique mode of action of these new acaricides as compared to conventional acaricides viz., dicofol. In conforming of our findings, Akashe *et al*. (2003) evaluated miticides for their toxicity against *T. urticae* under laboratory conditions and from his findings it was evident that abamectin was more toxic causing 100 percent mortality followed by clofentazine and amitraz and least effective miticide was sulphur. Similarly Sheeba Joyle Roseleen *et al*. (2011) evaluated profenofos 50EC and abamectin 1.8EC with different doses were tested against coconut eriophyid mite through button dip and bunch peduncle dip methods in the laboratory and showed abamectin @ 0.0144% recorded 99.6% and 80.06% reduction, respectively of mite population over control as compared to profenofos and monocrotophos. Pushpa and Nandihalli (2010) reported fenazaquin 10EC reduced the population of coconut mite by 31% under laboratory conditions.

Efficacy of acaricides on mites in the greenhouse

The acaricide treatments are effective in controlling mite population in the laboratory, so an experiment was set to determine the toxicity of these acaricides in green house also. The results indicated a significant reduction in the mite population. All these treatments recorded 74.00 to 100% mite mortality which proved significantly superior over control after 1 day of treatment in both the seasons (tables 3 and 4). After 1 day of application, among the treatments in first crop season (table 3), fenazaquin 10EC @ 1.7ml/L inflicted the highest per cent mortality (100%) of the mites, followed by abamectin @1.0ml (92.39%). Longhurst *et al*. (1992) reported fenazaquin a novel acaricide for the management of spider mites in variety of crops. In second crop season also (table 4), fenazaquin inflicted the highest percent mortality (97.68%) of the mites,

Table 3: Effect of acaricides on the mortality of *T. urticae* in greenhouse (First crop season)

Treatments	Dose(ml/L)	Percent mortality of mite population after treatment					
		1days	3days	5days	7days	10days	14days
Abamectin 1.9EC	0.50	90.10 (71.67)^{d}	92.20 (73.79)^{c}	100.00 (89.04)^{e}	100.00 (89.04)^{e}	98.00 (82.05)^{c}	93.80 (75.60)^{g}
Abamectin 1.9EC	1.00	92.39 (74.04)^{e}	98.00 (82.05)^{e}	100.00 (89.04)^{e}	100.00 (89.04)^{e}	100.00 (89.04)^{d}	100.00 (89.04)^{i}
Spiromesifen 22.9SC	0.80	83.80 (66.29)^{b}	100.00 (89.04)^{f}	98.63 (83.65)^{d}	100.00 (89.04)^{e}	100.00 (89.04)^{d}	88.87 (70.56)^{f}
Fenpyroximate 5EC	1.25	86.50 (68.44)^{c}	95.10 (72.24)^{d}	93.64 (75.58)^{c}	86.96 (68.84)^{c}	72.32 (58.25)^{b}	70.03 (56.81)^{e}
Dicofol 18.5EC	2.70	83.33 (65.94)^{b}	72.60 (58.43)^{b}	62.70 (52.35)^{a}	45.30 (42.30)^{a}	45.20 (42.24)^{a}	26.30 (30.85)^{a}
Propargite 57EC	2.00	90.00 (71.58)^{d}	68.00 (55.55)^{a}	97.80 (81.87)^{d}	86.96 (68.73)^{c}	73.41 (58.96)^{b}	45.06 (42.16)^{c}
Fenazaquin 10EC	1.70	100.00 (89.04)^{f}	100.00 (89.04)^{f}	100.00 (89.04)^{e}	100.00 (89.04)^{e}	100.00 (89.04)^{d}	96.86 (80.06)^{h}
Hexythiazox 5.45EC	0.75	73.33 (58.90)^{a}	68.0 (55.55)^{a}	88.46 (70.15)^{b}	73.59 (59.08)^{b}	63.52 (59.02)^{b}	37.40 (37.70)^{b}
Hexythiazox 5.45EC	1.25	88.28 (69.99)^{cd}	91.29 (72.84)^{c}	100.00 (89.04)^{e}	90.41 (71.72)^{d}	74.00 (59.34)^{b}	60.80 (51.24)^{d}
Control	-	0.00 (0.00)^{g}	0.00 (0.00) ^{g}	0.00 (0.00) ^{f}	0.00 (0.00) ^{f}	0.00 (0.00) ^{f}	0.00 (0.00) ^{j}
CD (.05)		1.99	1.64	3.19	0.99	6.95	2.43
SE(m) ±		0.94	0.77	1.50	0.47	3.27	1.14

P = 0.05, Mean of three replicates; Figures in parentheses are arcsine transformed values. In a column, 'means' followed by a common letter do not differ significantly at Pd"0.05 by Duncan's multiple range test

Table 4: Effect of acaricides on the mortality of *T. urticae* in greenhouse (Second crop season)

Treatments	Dose(ml/L)	Percent mortality of mite population after treatment					
		1day	3days	5days	7days	10days	14days
Abamectin 1.9EC	0.50	89.29 (70.91)^{d}	93.62 (75.40)^{d}	95.60 (77.94)^{e}	100.00 (89.04)^{d}	96.89 (79.93)^{g}	94.55 (76.74)^{f}
Abamectin 1.9EC	1.00	93.85 (75.66)^{e}	99.29 (85.88)^{e}	100.00 (89.04)^{g}	99.28 (89.56)^{d}	100.00 (89.04)^{h}	98.71 (83.63)^{g}
Spiromesifen 22.9SC	0.80	93.90 (75.73)^{e}	87.60 (69.39)^{c}	92.10 (73.69)^{d}	96.10 (78.62)^{c}	90.50 (72.06)^{f}	87.30 (69.13)^{e}
Fenpyroximate 5EC	1.25	79.20 (62.87)^{b}	84.40 (66.19)^{b}	96.10 (78.62)^{e}	78.60 (62.45)^{b}	60.80 (51.24)^{c}	59.74 (50.62)^{d}
Dicofol 18.5EC	2.70	74.00 (59.34)^{a}	73.90 (59.28)^{a}	62.70 (52.36)^{a}	60.30 (50.94)^{a}	50.70 (45.40)^{a}	22.30 (28.17)^{a}
Propargite 57EC	2.00	81.30 (64.39)^{b}	88.60 (70.27)^{c}	70.80 (57.29)^{b}	79.20 (62.86)^{b}	72.50 (58.37)^{e}	39.24 (38.78)^{b}
Fenazaquin 10EC	1.70	97.68 (81.39)^{f}	94.27 (76.25)^{d}	97.20 (80.65)^{f}	100.00 (89.04)^{d}	100.00 (89.04)^{h}	94.33 (76.24)^{f}
Hexythiazox 5.45EC	0.75	84.22 (66.59)^{c}	88.29 (69.99)^{c}	89.07 (70.70)^{c}	71.45 (57.70)^{b}	53.80 (47.18)^{b}	39.40 (38.88)^{b}
Hexythiazox 5.45EC	1.25	83.87 (66.32)^{c}	93.14 (74.97)^{d}	88.15 (69.87)^{c}	97.09 (80.83)^{c}	63.14 (52.62)^{d}	55.73 (48.29)^{c}
Control	-	0.00 (0.00)^{g}	0.00 (0.00)^{f}	0.00 (0.00)^{h}	0.00 (0.00)^{e}	0.00 (0.00)^{i}	0.00 (0.00)^{h}
CD (.05)		1.85	2.95	1.83	6.38	1.31	2.09
SE(m) ±		0.87	1.39	0.86	3.01	0.62	0.99

P = 0.05, Mean of three replicates; Figures in parentheses are arcsine transformed values. In a column, 'means' followed by a common letter do not differ significantly at Pd"0.05 by Duncan's multiple range test

followed by spiromesifen (93.90%) and abamectin @1.0mL (93.85%), though the percent mortality varied between the former and latter acaricides, they were statistically on par with each other. The trials of Negi and Gupta *et al*. (2007) found that in laboratory, all the horticultural mineral oils at 0.5, 1.0 and 1.5 percent resulted in 0-8.62 percent egg hatch and proved superior to fenazaquin except control, whereas under field conditions, fenazaquin registered the least motile counts per leaf for initial 7-10 days and was at par with many of oil treatments at 1.5 and 1 percent against *Tetranychus urticae* infesting apple.

Similarly 3 days after application, fenazaquin and spiromesifen caused higher mortality followed by abamectin @1.0ml, but all these treatments were statistically on par with each other in relation to second crop season where the latter acaricide caused 99.29% mite mortality compared to the former acaricides i.e. fenazaquin and spiromesifen causing 94.27 and 87.60 %, respectively. Abamectin @ 0.5mL recorded mortality of mites in the range of 89.29-93.62% in both the seasons on 1 and 3 day after treatment indicating that it is effective even at lower dose. The greater efficacy of abamectin in reducing the mite population has been recorded in all doses and this may be due to its mode of action (GABA- agonist) and the translaminar activity which provides residual activity against the feeding mites.

The treatment (3days after application) with hexythiazox @ 0.75mL and propargite caused only 68% mortality in first season as compared to dicofol which recorded 72.60% mites mortality, whereas in second season, the former acaricide namely hexythiazox (88.29%) and propargite (88.60%) caused higher mortality as compared to latter acaricide (73.90%), dicofol. Bhardwaj and Sharma (2010) found that out of seven acaricides evaluated against 2 spotted spider mite, abamectin @ 0.01%, fenazaquin @ 0.001%, hexythiazox @0.0025% and propargite @ 0.05% provided excellent control in apple. In 3, 5, 7, 10 and 14 days after treatment, the mite mortality was 22.30-73.90% and 39.24-97.80% in dicofol and propargite treatments, respectively, in both the seasons. indicating that these acaricides doesn't show longer residual control compared to newer acaricides viz., fenpyroximate (59.74-96.10%), and hexythiazox (55.73-100%) though hexythiazox at lower dose of 0.75ml caused low mortality on 1 and 3rd day, but the efficacy remained for longer period i.e. it was significantly superior over dicofol and propargite during 14 days observational period. In support of our results, propargite and fenpyroximate were found to be effective in reducing mites population and remained effective till 15 days after spray as reported by Tomar and Singh (2011)

After 5, 7, 10 and 14 days of treatments, results of the both seasons indicated that both abamectin @ 1.0mL and fenazaquin inflicted higher mortality of the mites throughout the observational period as compared to other treatments, followed by abamectin @ 0.5mL and spiromesifen except on 10 days (I season) where the latter acaricide showed higher mortality (100%) of mites compared to the former acaricide (98.0%). The higher efficacy of these acaricides in our study were also supported by findings of Sahoo *et al*. (2003) who observed that fenazaquin was second to abamectin in terms of toxicity to adult females of red spider mite, *Oligonychus coffeae* infesting tea. Similarly Senapati *et al*. (2010) reported that fenazaquin gave best control of yellow mite up to 14days in chilli. The higher efficacy of spiromesifen was also reported by Sekh *et al.,* in 2007 that it gave excellent control of red spider mites, on brinjal along with significance increase in yield Al-Antary *et. al*., (2012) evaluated residual effective of 6 acaricides on 2 spotted spider mite (*T. urticae*) female

populations in Jordan on cucumber under plastic house conditions and stated that bifenazone, chlorfenapyr and spiromesifen induced 90% 78% and 76% mortality, respectively to all populations and toxicity persisted for 9 days.

In conclusion the present study showed that newer acaricides viz., abamectin (0.5mL and 1.0ml/L), fenazaquin and spiromesifen can be recommended along with other acaricides namely fenpyroximate and hexythiazox (1.25mL) on rotation basis under high infestation for effective management, longer residual control and to delay resistance development of red spider mites, *Tetranychus urticae* in green house.

REFERENCES

Abbott, W. S. 1925. A method of computing effectiveness of an insecticide. *J. Economic Entomology*. **18**: 265-7.

Akashe, V. B., Darekar, K. S. and Kharbade, S. B. 2003. Toxicity of selective miticides against *Tetranychus urticae* (Koch) on roses. *Pestology*. **27**: 30-31.

Al-Antary, T. M., Al-Lala, M. R. K. L. and Abdel-Wali, M. I. 2012. Residual effect of six acaricides on the two spotted spider mite (*Tetranychus urticae* Koch) females on cucumber under plastic houses conditions in three upper lands regions in Jordan. *Advances in Environment Biology*. **6**: 2992-97.

Alzoubi, S. and Cobonoglu, S. 2008. Toxicity of some pesticides against *Tetranychus urticae* and its predatory mites under laboratory conditions. American Eurasian *J. Agricultural and Environmental Science*. **3**: 30-37.

Bari, G., Vernile, P., Panzarino, O. and Lillo, E. 2013. Efficacy of Oberon against red spider mite on cucumber. *Colture Protette*. **42**: 54-56, 58-60.

Bharadwaj, S. and Sharma, S. 2010. Response of two spotted mite, *Tetranychus urticae* Koch. (Fam : Tetranychidae) to new acaricides in apple orchards of Himachal Pradesh. *Abstract of International Symposium-cum-Workshop in Acarology*. pp. 81-83.

Croft, B. A., Hoyt, S. C. and Westigard, P. H. 1987. Spider mite management on pome fruits, revisited: Organotin and Acaricide Resistance Management. *J. Economic Entomology*. **80**: 304-11.

Dejan Marcic, Pantelija, P. and Slobodan, M. 2011. Acaricides-Biological profiles, Effects and Uses in Modern Crop Protection. *Pesticides-Formulations, Effects Fate*. Margarita Stoytcheva (Ed). In Tech, Europe. pp. 37-62.

Dekeyser, M. A. 2005. Acaricide mode of action. *Pest Management Science*. **61(2):** 103-10.

Helle, W. and Sabelis, M. W. 1985a. *Spider mites*: *Their Biology, Natural Enemies and Control,* 1A, Elsevier, Amsterdam, the Nether lands. pp.

Helle, W. and Sabelis, M. W. 1985b. *Spider mites*: *Their Biology, Natural Enemies and Control,* 1B, Elsevier, Amsterdam, the Netherlands. pp.

Jeppson, L. R., Keifer, H. H. and Baker, E. W. 1975. *Mites Injurious to Economic Plants. Berkeley University of California Press*. CA, pp. 370-76.

John, B. and Dorie. 1997. Mite Counting and Pyramite Trial Project entitled on Farm Research evaluation of pyramite for spider mite control on apples Funded by Environmental Protection Agency. *http://whatcomwsuedu/ag/comhort/nooksack/pyramitehtm*

Lindquist, E. E., Sabelis, M. W. and Bruin, J. 1996. *Eriophyoid Mites*: *Their Biology, Natural Enemies and Control,* Elsevier, Amsterdam, the Netherlands. pp.

Longhurst, C., Bacci, L., Buendia, J, Hatton, C. J., Petitprez, J. and Tsakonas, P. 1992. Fenazaquin - A novel acaricide for the management of spider mites in variety of crops. *Proceedings of he Brighton Crop. Protection Conference, Pest and Diseases,* Brighton. **23**: 51-58.

Negi, M. L. and Gupta, P. R. 2007. Evaluation of Horticultural Mineral Oils for the control of the Two Spotted Spider Mite *Tetranychus urticae* (koch) on Apples. *The Bioscan.* **2(3)**: 177-181.

Pranab, B. and Shantanujha 2013. Insect and non- insect pests infesting pointed gourd (*Trichosanthes dioica* Roxb.) in West Bengal. *The Bioscan.* **8(2)**: 537-543.

Prasad, R. 2006. Occurrence and pest status of phytophagous mites infesting common vegetables. *Indian J. Entomology*. **68(3):** 235-239.

Pushpa, V. and Nandihalli, B. S. 2010. Evaluation of pesticides and biopesticides against the coconut eriophyid mite, *Aceria guerreronis* Keifer under Laboratory conditions. *Karnataka J. Agricultural Sciences*. **23**: 178-79.

Rachna, G. 2004. Incidence of *Tetranychus unnabarinus* (Boisd) infestation in different varieties of *Abelmoschus esculentus* (L). *Annals of Plant Protection Sciences*. **12**: 45-7.

Sahoo, B., Sahoo, S. K. and Somchaudhury, A. K. 2003. Studies on the toxicity of newer molecules against tea red spider mite. *Proceedings of the National Symposium on Frontier Areas of Entomological Research*. pp. 301-02.

Sekh, K., Nair, N., Bag, V. and Somchoudhury, A. K. 2007. Bioefficacy of Spiromesifen 240SC (Oberon) against red spider mite of brinjal and effect on its natural enemies. *Pestology*. **31**: 25-28.

Senapati, A. K, Maity, A. K. and Chatterjee, M. L. 2010. Effect of new acaricides against yellow mite of chilli. *Abstract of International Symposium-cum-workshop in Acarology* p. 95.

Sheeba Joyce Roseleen, S., Ramaraju, K. and Suresh, S. 2011. Laboratory Evaluation of Profenofos 50EC and Abamectin 1.8 EC against Cocount Eriophyid Mite. *Madras Agriculture J.* **98**: 263-265.

Sikha Deka, Tanwar, R. K, Sumitha, R., Naved Sabir, Bambawale, O. M. and Balraj, S. 2011. Relative efficacy of Agricultural spray oil and Azadirachtin against two-spotted spider mite (*Tetranychus urticae*) on cucumber (*Cucumis sativus*) under greenhouse and laboratory conditions. *Indian J. Agricultural Sciences*. **81**: 158-62.

Tomar, A. S. and Singh, S. P. 2011. Efficacy of selected acaricides against mite, *Tetranychus urticae* Koch (Acarina, Tetranychidae) on Okra. *Pestology*. **35**: 27-29.

Van Leeuwen, T., Witters, J., Nauen, R., Duso, C. and Tirry, L. 2010. The control of eriophyoid mites: State of the art and future challenges. *Experimental and Applied Acarology* **51**: 205-24.

Whalon, M. E., Mota-Sanchez, D. and Hollingworth, R. M. 2008. Global Pesticide Resistance in Arthropods. *CAB International,* Wallingford, UK.

Zhang, Z. O. 2003. Mites of Greenhouses, Identification, Biology and Control. *CAB International,* Wallingford, UK.