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BL Naga
Department of Entomology, SKN College of Agriculture, SKN Agriculture University, Jobner, Rajasthan, India

Ashok Sharma
Department of Entomology, SKN College of Agriculture, SKN Agriculture University, Jobner, Rajasthan, India

KC Kumawat
Department of Entomology, SKN College of Agriculture, SKN Agriculture University, Jobner, Rajasthan, India

SK Khinchi
Department of Entomology, SKN College of Agriculture, SKN Agriculture University, Jobner, Rajasthan, India

RP Naga
Department of Entomology, SKN College of Agriculture, SKN Agriculture University, Jobner, Rajasthan, India

Correspondence
BL Naga
Department of Entomology, SKN College of Agriculture, SKN Agriculture University, Jobner, Rajasthan, India

Efficacy of pesticides against mite, *Tetranychus cinnabarinus* (Boisduval) of okra, *Abelmoschus esculentus* (L.) Moench

BL Naga, Ashok Sharma, KC Kumawat, SK Khinchi and RP Naga

Abstract
Studies under field conditions were conducted on the efficacy of pesticides against mite, *Tetranychus cinnabarinus* (Boisduval) infesting Okra, *Abelmoschus esculentus* (L.) Moench at S.K.N. College of Agriculture, Jobner (Rajasthan) during *kharif* 2004 and 2005. The overall efficacy of pesticidal treatments at one, three, seven, ten and 15 days intervals against mite population revealed ethion (0.05%) as most effective with maximum fruit yield of 69.5 q/ha and 69.86 q/ha in 2004 and 2005, respectively; followed by monocrotophos (0.036%) with 65.25 q/ha in 2004 and 65.42 q/ha in 2005. The treatments of NSKE (5%), azadirachtin (0.00015%), *datura* extract (1%) proved least effective followed by *calotropis* extract (1%). The treatments of dicofol (0.04%), thiamethoxam (0.01%), acephate (0.05%) and imidacloprid (0.006%) existed in the middle order of effectiveness. The benefit cost ratio was highest in the treatment of ethion (1.87 and 1.84 in 2004 and 2005, respectively) and lowest in *datura* extract (1.09 and 1.06 in 2004 and 2005, respectively).

Keywords: Efficacy, Pesticides, Mite, *Tetranychus cinnabarinus* (Boisduval) and Okra

Introduction
Okra, *Abelmoschus esculentus* (L.) Moench also known as *Bhindi* or lady's finger, is grown throughout India for its immature fruits and occupies important position among vegetables cultivation (Saroda and Lal, 1981) [24]. In India, it occupied over 0.31 million hectares area with an annual production of 3.65 million tonnes (FAO Report, 2007) [13], whereas, Rajasthan occupied 4456.0 hectares area with an annual production of 11447.0 tonnes during 2005-06 (Anonymous, 2006) [6]. The fully ripened fruits and stem contain carbohydrate (7.7%), protein (2.2%), fat (0.02%), fibres (1.2%), minerals (0.7%) and calcium (0.9%) and are good source of iron, iodine and vitamins (Chauhan, 1965) [10].

The okra crop is attacked by several species of insect pests right from the germination to the harvesting (Ambegaonkar and Bilapate, 1984) [2]. In the recent years, the importance of mites as a pest of vegetable crops has been reported all over the world. The main contributing factor has been the excessive reliance on pesticide leading to serious upset in natural balance (Baker and Pritchard, 1960). Among the vegetable crops, okra and brinjal are the most affected by mites causing economic loss throughout the country. The red spider mites *viz*., *Tetranychus cinnabarinus* (Boisduval), *T. ludeni* Zacher and *T. neocaledonicus* Andre are of major significance to vegetable crops in India (Gupta, 1991 and Rai *et al.*, 1991) [14, 23]. Among the mite pests, *T. cinnabarinus* become abundant and cause appreciable damage to okra crop particularly during dry months of the year, even under drought conditions, as high as 20 per cent loss in okra has been estimated (Shankarappa *et al*., 1981) [25]. The crop loss in Parbhani kranti variety of okra was reported to be 11-52 per cent at different places of India (Anonymous, 2004) [5].

The mite is polyphagous in nature and has been reported to infest more than 110 plants including fruits, vegetables and field crops (Jeppson *et al.*, 1975) [17]. It sucks the cell sap from the leaves and produce white spots which latter get covered by thick web. In windy weather, these webs are filled with soil particles. The photosynthetic activity is retarted, affected leaves loose green colour, dry up and drop premature, finally resulting in poor fruit setting (Rahman and Sapra, 1945; Khot and Patel, 1956; Bharodia and Talati, 1976 and Puttaswamy and Reddy, 1980) [22, 18, 8, 21]. Expanding vegetable cultivation due to availability of high yielding hybrids is

Providing sufficient food and congenial environment for the mite to multiply on regular basis. As such, the present investigations have been Studies on efficacy of pesticides against mite, *T. cinnabarinus* of okra, *A. esculentus*.

Materials and Methods

The experiment was laid out in a simple randomized block design with 11 treatments (Table1) including untreated check and three replications with each plot measuring 2.25 x 3.90 m^2 with row to row and plant to plant distance of 45 cm and 30 cm, respectively. The experiment was conducted on the efficacy of pesticides against mite, *T. cinnabarinus* of okra, *A. esculentus* at Horticulture Farm, S.K.N. College of Agriculture, Jobner during *kharif*, 2004 and 2005. The variety Arka Anamika was sown in the second week of July 2004 and 2005 for this purpose. The pesticides were sprayed in the evening hours on the crop with the help of foot sprayer when the mite population built up sufficiently. In all, two sprays were applied in the first (500 liter water/ha) and fourth week of September (600 liter water/ha) during 2004 and 2005.

Table 1: Details of pesticides used

S. No.	Name of pesticides	Trade name	Formulation	Concentration (%)
1.	Monocrotophos	Nuvacron	36 SL	0.036
2.	Dicofol	Kelthane	18.5 EC	0.04
3.	Acephote	Asataf	75 SP	0.05
4.	Ethion	Ethion	50 EC	0.05
5.	Thiamethoxam	Actara	25 WG	0.01
6.	Imidacloprid	Confidor	17.8 S L	0.006
7.	NSKE	-	-	5.0
8.	Azadirechtin	Nimbecidine	0.03 EC	0.00015
9.	*Calotropis* leaf extract	-	-	1.0
10.	*Datura* leaf extract	-	-	1.0

Preparation of fresh leaf extract of *datura* and *aak*

To prepare leaf extract, 100 g of fresh leaves of each plant *viz*; *datura stramonium* L. and *Calotropis procera* L. were washed with sterilized distilled water and grinded in 100 ml distilled water. The macerate was filtered through double layered cheese cloth and centrifuged at 3500 rpm for 20 minutes. The supernatant was filtered through whatman's filter paper No. 42. Extract (100%) thus obtained was utilized for further experimentation (Jayadevi *et al.*, 2003) [16].

Preparation of neem seed kernel extract (NSKE-5%)

Half kilogram of neem seed kernels were powdered well using wooden beam. Powdered neem seed kernel was soaked in one litre of water for overnight. After 24 hrs the filtrate was made up to 10 litres and used for spraying.

Method of observations

Absolute mite, *T. cinnabarinus* population counts were made just before treatment (pre-treatment) and 1, 3, 7, 10 and 15 days after each treatment (post-treatment). The observations were recorded on randomly selected five plants. The three leaves one each from top (young), middle (mature) and bottom (old) portions of tagged okra plants were plucked randomly, collected in separate properly labeled polythene bags and brought to the laboratory without disturbing mites for assessing population under stereo binocular microscope. Both upper and lower portions of the leaves were examined. The data so obtained were subjected to statistical analysis of variance.

For evaluating the efficacy of pesticides, the per cent mortality data were computed for analysis of variance after angular transformation, using the formula given by Henderson and Tilton (1955), which is a modification of Abbott (1925) formula:

$$\text{Per cent reduction in mite population} = 1 - \left(\frac{Ta \times Cb}{Tb \times Ca} \right) \times 100$$

Where:

Ta = Population in treated plots after treatment

Tb = Population in treated plots before treatment

Ca = Population in untreated plots after treatment

Cb = Population in untreated plots before treatment

Results and Discussion

The relative efficacy of 10 pesticides, namely, monocrotophos (0.036%), dicofol (0.04%), acephate (0.05%), ethion (0.05%), thiamethoxam (0.01%), imidacloprid (0.006%), NSKE (5%), azadirachtin (0.00015%), *calotropis* extract (1%) and *datura* extract (1%) was evaluated against mite, *T. cinnabarinus* under field conditions. Two sprays were made with recommended dosage of pesticides when the population of mite built up.

The data revealed a significant difference among the sprays, as well as interaction between insecticidal treatments and sprays. The data indicated that all the pesticidal treatments spray after one day reduced mite population significantly, over untreated check (Table2). In 2004, the treatment of monocrotophos proved most effective in reducing the mite population (82.67%) and was found superior to rest of the treatments. The next effective treatments were ethion and dicofol with 71.12 and 66.87 per cent reduction, respectively. The treatments of thiamethoxam, acephate and imidacloprid were found at par and in middle order of efficacy resulting in 61.30, 59.72 and 60.50 per cent reduction in mite population, respectively. These trends were followed by NSKE (44.42%). azadirachtin (38.30%), *calotropis* extract (35.90%) and *datura* extract (35.62%) proved least effective and did not differ significantly. In 2005, monocrotophos (80.87%) emerged as the most effective treatment spray after one day reducing the mite population and was found significantly superior over rest of the treatments (table 2). The treatments of ethion (68.32%) and dicofol (65.92%) were observed as the second best group of treatments. The thiamethoxam (60.35%), imidacloprid (60.30%) and acephate (58.90%) ranked in middle order of efficiency. However, the NSKE (45.17%) treatment differed significantly with these treatments. The azadirachtin (37.77%), *calotropis* extract (35.95%) and *datura* extract (35.95%) were found to be least effective and stood at par. The pooled data revealed that monocrotophos reduced the mite population to a level of 81.77 per cent and proved significantly superior to rest of the treatments (table 2). The second best treatments were ethion (69.72%) and

dicofol (66.39%), both were found at par. The treatments with thiamethoxam (60.82%), imidacloprid (60.52%) and acephate (59.31%) stood superior to rest of the treatments, however NSKE (44.79%) differed significantly with these treatments. The treatments of azadirachtin (38.03%), *calotropis* extract (35.92%) and *datura* extract (35.78%) were proved to be least effective and at remained par to each other. Ascending order effectivity of pesticides was: *datura* extract, *calotropis* extract, azadirachtin, NSKE, acephate, imidacloprid, thiamethoxam, dicofol, ethion and monocrotophos.

Table2: Efficacy of different pesticides against *Tetranychus cinnabarinus* (Boisduval) infesting okra at one day after spray

S. No	Treatments	Conc. (%)	Mean per cent reduction in mite population								
			2004			2005			Pooled		
			1st spray	2nd spray	Mean	1st spray	2nd spray	Mean	1st spray	2nd spray	Mean
1.	Monocrotophos	0.036	81.25	84.10	82.67	79.30	82.45	80.87	80.27	83.27	81.77
			(64.34)	(66.50)	(65.40)	(62.94)	(65.23)	(64.09)	(63.64)	(65.87)	(64.75)
2.	Dicofol	0.04	65.70	68.05	66.87	64.15	67.70	65.92	64.92	67.87	66.39
			(54.15)	(55.58)	(54.86)	(53.21)	(55.37)	(54.29)	(53.68)	(55.47)	(54.57)
3.	Acephate	0.05	58.19	61.25	59.72	57.35	60.45	58.90	57.77	60.85	59.31
			(49.71)	(51.50)	(50.60)	(49.22)	(51.03)	(50.13)	(49.47)	(51.27)	(50.37)
4.	Ethion	0.05	71.35	70.90	71.12	69.60	67.05	68.32	70.47	68.97	69.72
			(57.63)	(57.35)	(57.49)	(56.53)	(54.97)	(55.75)	(57.08)	(56.16)	(56.62)
5.	Thiamethoxam	0.01	62.40	60.20	61.30	61.55	59.15	60.35	61.97	59.67	60.82
			(52.17)	(50.89)	(51.53)	(51.67)	(50.27)	(50.97)	(51.92)	(50.58)	(51.25)
6.	Imidacloprid	0.006	61.00	60.50	60.75	60.85	59.75	60.30	60.92	60.12	60.52
			(51.35)	(51.06)	(51.21)	(51.26)	(50.62)	(50.94)	(51.31)	(50.84)	(51.07)
7.	NSKE	5.0	45.10	43.75	44.42	44.15	46.20	45.17	44.62	44.97	44.79
			(42.18)	(41.40)	(41.79)	(41.64)	(42.82)	(42.23)	(41.91)	(42.11)	(42.01)
8.	Azadirechtin	0.00015	37.15	39.45	38.30	36.70	38.85	37.77	36.92	39.15	38.03
			(37.55)	(38.90)	(38.23)	(37.29)	(38.55)	(37.92)	(37.42)	(38.73)	(38.07)
9.	*Calotropis* extract	1.0	34.70	37.10	35.90	33.90	38.00	35.95	34.30	37.55	35.92
			(36.09)	(37.52)	(36.81)	(35.61)	(38.06)	(36.84)	(35.85)	(37.79)	(36.82)
10.	*Datura* extract	1.0	35.15	36.10	35.62	34.10	37.80	35.95	34.62	36.95	35.78
			(36.36)	(36.93)	(36.64)	(35.73)	(37.94)	(36.84)	(36.05)	(37.44)	(36.74)
	Mean		55.19	56.14	55.66	54.16	55.74	54.95	54.67	55.93	55.30
			(48.15)	(48.76)	(48.42)	(47.51)	(48.44)	(47.99)	(47.83)	(48.62)	(48.23)
			Treatment	Spray	T x S	*Treatment*	Spray	T x S	*Treatment*	Spray	T x S
		SEm±	0.77	0.34	1.10	0.79	0.35	1.13	0.61	0.24	0.78
		CD at 5%	2.22	0.99	3.14	2.28	1.02	3.23	1.72	0.70	2.22

Figures in parenthesis are angular transformed values, T = treatment, S = Spray

The data revealed a significant difference among the sprays as well as interaction between treatments and sprays (Table3). In *kharif* 2004, the spray of ethion and monocrotophos after three days revealed a high degree of reduction of mite population, *viz.*, 85.80 and 83.30 per cent, respectively and stood at par to each other but proved significantly superior over rest of the treatments. the next effective group comprised of dicofol (68.10%), thiamethoxam (65.97%), imidacloprid (63.92) and acephate (62.37%) also stood at par to each other. the azadirachtin (45.45%), *datura* extract (45.35%), NSKE (45.10%) and *calotropis* extract (43.65%) provided a low reduction of the mite population and remained at par and significantly inferior to other treatments in *kharif* 2005, it was evident from the data that ethion (83.55%) and monocrotophos (82.02%) stood significantly superior over rest of the treatments and both were at par to each other (table 3) The azadirachtin (45.75%), NSKE (44.52%), *Datura* extract (44.41%) and *Calotropis* extract (43.42%) remained at par to each other and stood at lower order of efficacy. However, treatments of dicofol (67.40%), thiamethoxam (65.25%), imidacloprid (63.25%) and acephate (62.77%) exhibited their efficacy in middle order and stood at par to each other. The pooled mean revealed wide variability among the efficacy of different pesticides in reducing mite population. ethion (84.67%) and monocrotophos (82.66%) emerged as the most effective treatments and reduced the mite population significantly over the other treatments, however both were statistically at par. The dicofol stood second with regards to reduction of mite population (67.75%). The treatments of azadirachtin (45.60%), *Datura* extract (44.88%), NSKE (44.81%) and *Calotropis* extract (43.53%) stood at lower order with respect to the reduction of mite population, however, statistically remained at par. The other treatments existed in the middle order of efficacy against the mite. The overall trend of efficacy in ascending order wa: *calotropis* extract, NSKE, *datura* extract, azadirachtin, acephate, imidacloprid, thiamethoxam, dicofol, monocrotophos and ethion.

Table 3: Efficacy of different pesticides against *Tetranychus cinnabarinus* (Boisduval) infesting okra at three days after spray

S. No	Treatments	Conc. (%)	Mean per cent reduction in mite population								
			2004			2005			Pooled		
			1st spray	2nd spray	Mean	1st spray	2nd spray	Mean	1st spray	2nd spray	Mean
1.	Monocrotophos	0.036	82.75	83.85	83.30	81.60	82.45	82.02	82.17	83.15	82.66
			(65.46)	(66.30)	(65.88)	(64.60)	(65.23)	(64.91)	(65.03)	(65.63)	(65.33)
2.	Dicofol	0.04	67.15	69.05	68.10	66.85	67.95	67.40	67.00	68.50	67.75
			(55.03)	(56.20)	(55.62)	(54.85)	(55.52)	(55.18)	(54.94)	(55.86)	(55.40)
3.	Acephate	0.05	61.70	63.05	62.37	60.85	64.70	62.77	61.27	63.87	62.57
			(51.77)	(52.56)	(52.17)	(51.27)	(53.55)	(52.40)	(51.52)	(53.06)	(52.29)

4.	Ethion	0.05	84.15	87.45	85.80	81.50	85.60	83.55	82.82	86.52	84.67
			(66.54)	(69.25)	(67.90)	(64.53)	(67.70)	(66.07)	(65.54)	(68.48)	(67.01)
5.	Thiamethoxam	0.01	65.10	66.85	65.97	64.70	65.80	65.25	64.90	66.32	65.61
			(53.79)	(54.85)	(54.32)	(53.55)	(54.21)	(53.88)	(53.67)	(54.53)	(54.10)
6.	Imidacloprid	0.006	63.05	64.80	63.92	62.90	65.00	63.95	62.97	64.90	63.93
			(52.56)	(53.61)	(53.09)	(52.48)	(53.73)	(53.11)	(52.52)	(53.67)	(53.10)
7.	NSKE	5.0	44.20	46.00	45.10	43.90	45.15	44.52	44.05	45.57	44.81
			(41.67)	(42.71)	(42.19)	(41.50)	(42.22)	(41.86)	(41.59)	(42.47)	(42.03)
8.	Azadirechtin	0.00015	45.00	45.90	45.45	44.80	46.70	45.75	44.90	46.30	45.60
			(42.13)	(42.65)	(42.39)	(42.02)	(43.11)	(42.57)	(42.08)	(42.88)	(42.48)
9.	*Calotropis* extract	1.0	43.15	44.15	43.65	42.90	43.95	43.42	43.02	44.05	43.53
			(41.06)	(41.64)	(41.35)	(42.07)	(41.53)	(41.80)	(41.57)	(41.59)	(41.58)
10.	*Datura* extract	1.0	44.85	45.85	45.35	43.95	44.87	44.41	44.40	45.36	44.88
			(42.04)	(42.62)	(42.33)	(41.53)	(42.06)	(41.80)	(41.79)	(42.34)	(42.06)
	Mean		60.11	60.69	61.90	59.39	61.21	60.30	59.75	61.45	60.60
			(51.21)	(52.21)	(51.71)	(50.84)	(51.89)	(51.36)	(51.02)	(52.05)	(51.54)
			Treatment	Spray	T x S	*Treatment*	Spray	T x S	*Treatment*	Spray	T x S
		SEm±	0.88	0.39	1.25	0.91	0.40	1.29	0.69	0.28	0.90
		CD at 5%	2.53	1.13	3.58	2.62	1.17	3.70	1.96	0.80	2.53

Figures in parenthesis are angular transformed values, T = treatment, S = Spray

The data indicated a higher per cent reduction after seven days in mite population in all the treatments as compared to three days interval. During *kharif*, 2004, the most effective treatments were observed to be ethion and monocrotophos resulting in 88.82 and 87.01 per cent reduction, respectively; both were statistically at par. The treatments of dicofol (69.00%), thiamethoxam (67.15%) and acephate (64.15%) proved moderately effective with non-significant difference among them. these treatments were followed by imidacloprid (62.40%). The least effective treatments were NKSE (48.52%), azadirachtin (46.87%), *datura* extract (46.00%) and *calotropis* extract (44.99%). In *kharif* 2005, the most effective treatments consisted of ethion and monocrotophos and showed non-significant difference between them (table4). The second best group comprised of dicofol, thiamethoxam, acephate and imidacloprid, however, NKSE, azadirachtin, *datura* extract and *calotropis* extract proved least effective. The pooled analysis indicated after seven days that ethion and monocrotophos resulted in the highest per cent reduction in mite population with 88.61 per cent and 86.38 per cent, respectively. These two treatments stood at par to each other. The treatments of thiamethoxam, dicofol, acephate and imidacloprid could reduce the population by 72.28, 68.56, 63.76 and 61.86 per cent respectively. The least effective treatments with non-significant difference were NSKE, azadirachtin, *datura* extract and *calotropis* extract resulting in 48.48, 46.99, 45.03 and 44.28 per cent reduction in the population of mite, respectively. The efficacy of pesticides in ascending order was: *calotropis* extract, *datura* extract, azadirachtin, NSKE, imidacloprid, acephate, dicofol, thiamethoxam, monocrotophos and ethion.

Table 4: Efficacy of different pesticides against *Tetranychus cinnabarinus* (Boisduval) infesting okra at seven days after spray

S. No	Treatments	Conc. (%)	Mean per cent reduction in mite population								
			2004			2005			Pooled		
			1st spray	2nd spray	Mean	1st spray	2nd spray	Mean	1st spray	2nd spray	Mean
1.	Monocrotophos	0.036	86.17	87.85	87.01	85.15	86.35	85.75	85.66	87.10	86.38
			(68.17)	(69.60)	(68.89)	(67.33)	(68.32)	(67.83)	(67.75)	(68.96)	(68.36)
2.	Dicofol	0.04	68.15	69.85	69.00	67.10	69.15	68.12	67.62	69.50	68.56
			(55.64)	(56.70)	(56.17)	(55.00)	(56.26)	(55.63)	(55.32)	(56.48)	(55.90)
3.	Acephate	0.05	63.13	65.17	64.15	64.05	62.70	63.37	63.59	63.93	63.76
			(52.61)	(53.83)	(53.22)	(53.16)	(52.36)	(55.76)	(52.89)	(53.10)	(52.99)
4.	Ethion	0.05	88.10	89.55	88.82	87.70	89.10	88.40	87.90	89.32	88.61
			(69.82)	(71.14)	(70.48)	(69.47)	(70.72)	(70.10)	(69.65)	(70.93)	(70.29)
5.	Thiamethoxam	0.01	66.05	68.25	67.15	65.45	67.38	66.41	65.75	78.81	72.28
			(54.36)	(55.70)	(55.03)	(54.00)	(55.17)	(54.59)	(54.18)	(55.44)	(54.81)
6.	Imidacloprid	0.006	61.85	62.95	62.40	60.90	61.75	61.32	61.37	62.35	61.86
			(51.85)	(52.51)	(52.18)	(51.30)	(51.80)	(51.55)	(51.58)	(52.16)	(51.87)
7.	NSKE	5.0	48.15	48.90	48.52	47.90	49.00	48.45	48.02	48.95	48.48
			(43.94)	(44.37)	(44.16)	(43.80)	(44.43)	(44.12)	(43.87)	(44.40)	(44.14)
8.	Azadirechtin	0.00015	47.10	46.65	46.87	46.35	47.90	47.12	46.72	47.27	46.99
			(43.34)	(43.08)	(43.21)	(42.91)	(43.80)	(43.36)	(43.13)	(43.44)	(43.28)
9.	*Calotropis* extract	1.0	45.05	44.93	44.99	44.30	42.85	43.57	44.67	43.89	44.28
			(42.12)	(42.09)	(42.11)	(41.73)	(40.89)	(41.31)	(41.93)	(41.49)	(41.71)
10.	*Datura* extract	1.0	46.15	45.85	46.00	44.45	43.70	44.07	45.30	44.77	45.03
			(42.79)	(42.62)	(42.71)	(41.81)	(41.38)	(41.60)	(42.30)	(42.00)	(42.15)
	Mean		61.99	62.99	62.49	61.33	61.98	61.65	61.66	63.58	62.62
			(52.46)	(53.16)	(52.81)	(52.05)	(62.51)	(52.28)	(52.26)	(52.84)	(52.55)
			Treatment	Spray	T x S	*Treatment*	Spray	T x S	*Treatment*	Spray	T x S
		SEm±	0.91	0.40	1.29	0.94	0.42	1.34	0.72	0.29	0.93
		CD at 5%	2.61	1.16	3.69	2.71	1.21	3.84	2.03	0.82	2.62

Figures in parenthesis are angular transformed values, T = treatment, S = Spray

The pooled data indicated that ethion and monocrotophos gave highest reduction (Table 5) after 10 days of spray in mite population with 86.86 and 85.92 per cent, respectively. These two treatments were found statistically at par. Next best treatments were dicofol (66.23%) and thiamethoxam (62.20%) and both were comparable. The treatments of acephate (61.53%) and imidacloprid (56.12%) were in middle order, whereas azadirachtin (48.08), NSKE (47.33%), *calotropis* extract (45.21%) and *datura* extract (45.07%) proved less effective. The ascending order of efficacy was: *datura* extract, *calotropis* extract, NSKE, azadirachtin, imidacloprid, acephate, thiamethoxam, dicofol, monocrotophos and ethion.

Table 5: Efficacy of different pesticides against *Tetranychus cinnabarinus* (Boisduval) infesting okra at 10 days after spray

S. No	Treatments	Conc. (%)	Mean per cent reduction in mite population								
			2004			2005			Pooled		
			1st spray	2nd spray	Mean	1st spray	2nd spray	Mean	1st spray	2nd spray	Mean
1.	Monocrotophos	0.036	87.14	85.15	86.14	86.20	85.19	85.69	86.67	85.17	85.92
			(68.99)	(67.33)	(68.16)	(68.19)	(67.37)	(67.78)	(68.59)	(67.35)	(67.97)
2.	Dicofol	0.04	65.10	68.13	66.61	64.85	66.85	65.85	64.97	67.49	66.23
			(53.79)	(55.63)	(54.71)	(53.64)	(54.85)	(54.25)	(53.72)	(55.24)	(54.48)
3.	Acephate	0.05	61.15	62.85	62.00	62.15	60.00	61.07	61.65	61.42	61.53
			(51.44)	(52.45)	(51.95)	(52.03)	(50.77)	(51.40)	(51.74)	(51.61)	(51.67)
4.	Ethion	0.05	89.10	86.60	87.85	87.85	83.90	85.87	88.47	85.25	86.86
			(70.72)	(68.53)	(69.63)	(69.60)	(66.34)	(67.97)	(70.16)	(67.44)	(68.80)
5.	Thiamethoxam	0.01	61.25	63.35	62.30	60.05	64.15	62.10	60.65	63.75	62.20
			(51.50)	(52.74)	(52.12)	(50.80)	(53.20)	(52.00)	(51.15)	(52.97)	(52.06)
6.	Imidacloprid	0.006	55.45	57.65	56.55	54.75	56.65	55.70	55.10	57.15	56.12
			(48.12)	(49.40)	(48.76)	(47.73)	(48.82)	(48.28)	(47.93)	(49.11)	(48.52)
7.	NSKE	5.0	48.00	46.90	47.45	47.55	46.90	47.22	47.77	46.90	47.33
			(43.85)	(43.22)	(43.54)	(43.60)	(43.22)	(43.41)	(43.73)	(43.22)	(43.47)
8.	Azadirechtin	0.00015	49.85	47.55	48.70	46.95	48.00	47.47	48.40	47.77	48.08
			(44.91)	(43.60)	(44.26)	(43.25)	(43.85)	(43.55)	(44.08)	(43.73)	(43.90)
9.	*Calotropis* extract	1.0	46.10	45.75	45.92	45.35	43.65	44.50	45.72	44.70	45.21
			(42.76)	(42.56)	(42.66)	(42.33)	(41.35)	(41.84)	(42.55)	(41.96)	(42.25)
10.	*Datura* extract	1.0	45.65	46.95	46.30	43.65	44.05	43.85	44.65	45.50	45.07
			(42.50)	(43.25)	(42.88)	(41.35)	(41.58)	(41.47)	(41.93)	(42.42)	(42.17)
	Mean		60.87	61.08	60.98	59.94	59.93	59.93	60.40	60.51	60.45
			(51.86)	(51.87)	(51.86)	(51.25)	(51.14)	(51.19)	(51.56)	(51.50)	(51.53)
			Treatment	Spray	T x S	*Treatment*	Spray	T x S	*Treatment*	Spray	T x S
		SEm±	0.89	0.39	1.25	0.90	0.40	1.28	0.69	0.28	0.89
		CD at 5%	2.54	1.14	3.60	2.60	1.16	3.67	1.96	0.80	2.53

Figures in parenthesis are angular transformed values, T = treatment, S = Spray

The data revealed a significant difference among the sprays, as well as interaction between treatments and sprays (Table 6). The data indicated after 15 days of spray that the treatments of ethion (74.25%) and monocrotophos (71.22%) proved most effective and did not differ significantly and proved superior over rest of the treatments. The next group in order of efficacy comprised of dicofol (59.87%), thiamethoxam (58.88%) and acephate (56.07%). The imidacloprid (48.10%), NKSE (49.02%) and azadirachtin (45.32%) stood in middle order of efficacy and remained statistically at par to each other. The treatments of *calotropis* extract (35.34%) and *datura* extract (34.61%) exhibited lower order of efficacy. Further first and second spray did not differ significantly, however, second spray was more effective in reducing mite population. As revealed in *kharif* 2005, the data were consistent with that of *kharif*, 2004 but the reduction in mite population with different treatments vary to some extent. The best effective treatments were found to be ethion and monocrotophos with a reduction of 77.02 and 73.25 per cent, respectively, both were statistically at par. These treatments were followed by dicofol (61.20%), thiamethoxam (58.82%) and acephate (56.40%). The *calotropis* extract (35.50%) and *datura* extract (34.60%) were found in lowest order of efficacy with respect to reduction in mite population and differed non-significantly. the other treatments stood in the middle order of efficacy. The pooled mean revealed a significant difference between ethion (75.88%) and monocrotophos (72.23%), the best molecules in their efficacy. These treatments differed significantly with next effective molecules, the dicofol (60.53%) and thiamethoxam (58.85%). The acephate (56.21%) differed non-significantly with thiamethoxam (58.85%). the *calotropis* extract (35.34%) and *datura* extract (34.61%) were at par in their efficacy and ranked in the lowest order. The rest of the treatments stood in the middle order with non-significant difference among treatments. The ascending order of efficacy was: *datura* extract, *calotropis* extract, azadirachtin, NSKE, imidacloprid, acephate, thiamethoxam, dicofol, monocrotophos and ethion.

The overall efficacy of pesticidal treatments at one, three, seven, 10 and 15 days intervals against mite population revealed ethion (0.05%) as most effective followed by monocrotophos (0.036%). The treatments of NSKE (5%), azadirachtin (0.00015%), *datura* extract (1%) proved least effective followed by *calotropis* extract (1%). The treatments of dicofol (0.04%), thiamethoxam (0.01%), acephate (0.05%) and imidacloprid (0.006%) existed in the middle order of effectiveness.

On the basis of overall efficacy of pesticidal treatment at one, three, seven, 10 and 15 days intervals against mite population revealed ethion 50 EC (0.05%) as most effective followed by monocrotophos 36 SL (0.036%). The treatments of dicofol 18.5 EC (0.04%), thiamethoxam 25 WG (0.01%) acephate 75 SP (0.05%) and imidacloprid 17.8 SL (0.006%) existed in the middle order of effectiveness. The treatments of NSKE (5%),

azadirachtin 0.03 EC (0.00015%) and *datura* extract (1%) proved least effective followed by *calotropis* extract (1%). Chinniah (2001) [11] also evaluated different pesticides against *T. cinnabarinus* infesting okra during *kharif* season and found ethion (0.1%) as most effective registering (80%) mortality and ranked first in order of efficacy very well support the present findings. Likewise, Sharma (2006) [28] evaluated 11 pesticides against *T. neocalidonicus* in arid and semi-arid conditions of Rajasthan infesting brinjal crop and found ethion (0.05%) as found most effective followed by monocrotophos (0.03%) fully conforms the present studies. Ethion (0.05%) has registered highest mortality of the mite, *Polyphagotarsonemus latus* on chilli crop fully support the present findings (Anonymous, 2000) [3, 4]. However, studies conducted on efficacy of different pesticides against, *P. latus* infesting chilli by Sharma (2004) [27] in arid and semi-arid condition of Rajasthan showed superiority of monocrotophos (0.05%) over other pesticides support the present findings as monocrotophos has been found at par with ethion. Monocrotophos was also proved effective by various workers in the control of *T. cinnabarinus* infesting cotton (EL-Sebae *et al.*, 1976-77) [12] and cassava (Lal and Pillai, 1984) [19] in Kerala state. Sivakumar and Marimuthu (1987) [29] reported that ethion 0.05 per cent caused maximum suppression of mite, *T. cinnabarinus* on betelvine followed by dicofol 0.05 per cent, support the present investigations. During present findings, dicofol (0.04%), thiamethoxam (0.01%), acephate (0.05%) and imidacloprid (0.06%) existed in the middle order of effectiveness. Contrary to this Puttaswamy and Channa Basavanna (1976) [20] tested the relative efficacy of different acaricides against *T. neocalidonichus* on caster plants in Karnataka and found all the chemicals effective, however, carbophenothion, dicofol and quinomethionate proved better than others. Never the less, Rai *et al.* (1991) [23] reported that dicofol (0.04%) provided maximum reduction of okra mites, *T. macfarlanei* in Gujarat followed by monocrotophos (0.05%) does not support the present findings. During present investigations botanical pesticides proved least effective. Some botanicals with conventional pesticides tested against, *T. neocalidonicus* under laboratory conditions revealed that conventional pesticides were better than botanicals as reported by Sharanabasavana *et al.* (1999) [26] support the present findings.

Table 6: Efficacy of different pesticides against *Tetranychus cinnabarinus* (Boisduval) infesting okra at 15 days after spray

S. No	Treatments	Conc. (%)	Mean per cent reduction in mite population								
			2004			2005			Pooled		
			1st spray	2nd spray	Mean	1st spray	2nd spray	Mean	1st spray	2nd spray	Mean
1.	Monocrotophos	0.036	70.15	72.30	71.22	74.85	71.65	73.25	72.50	71.97	72.23
			(56.88)	(58.24)	(57.56)	(59.90)	(57.83)	(58.87)	(58.39)	(58.04)	(58.21)
2.	Dicofol	0.04	61.10	58.65	59.87	59.35	63.05	61.20	60.22	60.85	60.53
			(51.41)	(49.98)	(50.70)	(50.39)	(52.56)	(51.48)	(50.90)	(51.27)	(51.09)
3.	Acephate	0.05	55.05	57.00	56.02	54.65	58.15	56.40	54.85	57.57	56.21
			(47.90)	(49.02)	(48.46)	(47.67)	(49.69)	(48.68)	(47.79)	(49.36)	(48.57)
4.	Ethion	0.05	73.65	75.85	74.75	76.05	78.00	77.02	74.85	76.92	75.88
			(59.11)	(60.57)	(59.84)	(60.70)	(62.03)	(61.37)	(59.91)	(61.30)	(60.60)
5.	Thiamethoxam	0.01	58.10	59.66	58.88	56.60	61.05	58.82	57.35	60.35	58.85
			(49.66)	(50.57)	(50.12)	(48.79)	(51.38)	(50.09)	(49.23)	(50.98)	(50.10)
6.	Imidacloprid	0.006	47.15	49.05	48.10	50.05	53.15	51.60	48.60	51.10	49.85
			(43.37)	(44.46)	(43.92)	(45.03)	(46.81)	(45.92)	(44.20)	(45.64)	(44.92)
7.	NSKE	5.0	50.65	47.75	49.20	48.65	49.00	48.82	49.65	48.37	49.01
			(45.37)	(43.71)	(44.54)	(44.23)	(44.43)	(44.33)	(44.80)	(44.07)	(44.44)
8.	Azadirechtin	0.00015	47.50	43.15	45.32	46.10	48.20	47.15	46.80	45.67	46.23
			(43.57)	(41.06)	(42.32)	(42.76)	(43.97)	(43.37)	(43.17)	(42.52)	(42.84)
9.	*Calotropis* extract	1.0	34.40	36.00	35.20	32.85	38.15	35.50	33.62	37.07	35.34
			(35.91)	(36.87)	(36.39)	(34.97)	(38.15)	(36.56)	(35.44)	(37.51)	(36.48)
10.	*Datura* extract	1.0	38.15	33.10	35.62	31.45	35.75	33.60	34.80	34.42	34.61
			(38.15)	(35.12)	(36.64)	(34.11)	(36.72)	(35.42)	(36.13)	(35.92)	(36.03)
	Mean		53.59	53.25	53.41	53.06	55.61	54.33	53.32	54.52	53.87
			(47.13)	(46.96)	(47.05)	(46.86)	(48.36)	(47.61)	(46.99)	(47.66)	(47.33)
			Treatment	Spray	T x S	*Treatment*	Spray	T x S	*Treatment*	Spray	T x S
		SEm±	0.81	0.36	1.15	0.86	0.38	1.21	0.65	0.26	0.83
		CD at 5%	2.33	1.04	3.30	2.46	1.10	3.48	1.83	0.74	2.36

Figures in parenthesis are angular transformed values, T = treatment, S = Spray

Conclusion

It is concluded that the overall efficacy of pesticidal treatments at one, three, seven, ten and 15 days intervals against mite population revealed ethion (0.05%) as most effective followed by monocrotophos (0.036%). The treatments of dicofol (0.04%), thiamethoxam (0.01%), acephate (0.05%) and imidacloprid (0.006%) existed in the middle order of effectiveness. The treatments of NSKE (5%), azadirachtin (0.00015%), *datura* extract (1%) proved least effective followed by *calotropis* extract (1%).

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