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## Efficacy of different botanical extracts on *Thrips palmi* in cotton

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#### Abstract

The melon thrips, *Thrips palmi* (Karny) (Thysanoptera: Thripidae), is one of the major early season cotton pests. Efficacy of NSKE 5%, Neem oil 1%, *Andrographis paniculata* leaf extract 10%, *Mirabilis jalapa* root extract 10%, *Lantana camara* leaf extract 10%, *Vitex negundo* leaf extract 10% was evaluated on two life stages (2<sup>nd</sup> instars and adults) of *Thrips palmi* by leaf disc method and pot culture experiment. Both NSKE and neem oil recorded more than 40 per cent mortality after 48 hours of treatment in both the experiments against 2<sup>nd</sup> instar and adults of *Thrips palmi*. All botanicals were significantly more toxic to 2<sup>nd</sup> instar compared to adults. NSKE 5% was the most effective against both nymphs and adults in both the bioassay studies followed by Neem oil 1% and *Andrographis paniculata* leaf extract 10%. *Vitex negundo* leaf extract 10% had the least toxicity.

**Keywords:** *Thrips palmi*, NSKE, neem oil, leaf disc bioassay, pot culture

#### Introduction

In recent decades, inappropriate use of insecticides has led to adverse effects on the non-target organisms, pesticide residues in food, toxic effects on human beings and environmental pollution. Their continuous usage resulted in cropping out of many negative consequences, mainly the three evil 'R's viz., Resurgence, Resistance and Residue aspects [7]. These problems caused by synthetic pesticides and their residues have necessitated the need for effective biodegradable pesticides with greater selectivity. Alternative strategy included the search for new types of pesticides which are often effective against a limited number of specific target species, are biodegradable into nontoxic products and are suitable for use in integrated pest management programs. The natural plant products, termed "botanicals" derived from plants effectively meet this criterion and have enormous potential to influence modern agrochemical research.

Botanicals are now emerging as one of the prime means to protect crops, their products and the environment from pesticide pollution. Botanicals degrade more rapidly than most chemical pesticides, and are, therefore, considered relatively environment friendly and less likely to kill beneficial pests than synthetic pesticides with longer environmental retention. Most of the botanical pesticides generally degrade within few days and sometimes within few hours and so these pesticides need to be applied more frequently. The commonly and widely used plant products are neem, pyrethrin, rotenone, lemon oil (limonene, linalool), ryania, sabadilla, nicotine, etc. Higher cost of production coupled with frequent application makes botanicals more expensive to use than conventional pesticides. Knowledge on these botanicals if carried out intelligently will be both effective and safe.

Cotton plant is ravaged by multitude of sucking pests and there is a constant change in pest scenario. Sucking pests like thrips (*Thrips palmi* Karny), leafhopper (*Amrasca devastans* Dist.), aphids (*Aphis gossypii* Glover), and whiteflies (*Bemisia tabaci* Gen.) are responsible for the major threat and destruction of cotton crop [6]. Most of these insects have developed resistance to many conventional insecticides [21]. Thrips the early season sucking pest of cotton is now becoming a threat to cotton because of the spread of TSV, a viral disease. In order to counteract this disease spread, an eco-friendly management tool is needed. Hence different plant extracts, botanicals were tested for their efficacy against this pest under glass house condition using leaf disc bioassay and pot culture experiments.

#### Materials and Methods

##### Mass Rearing of *Thrips palmi*

The pure culture of *Thrips palmi* was mass reared under glass house condition in Department of Plant Pathology, TNAU, Coimbatore. Twenty five days old seedlings of cotton variety,

MCU 13 was used for mass rearing of thrips in insect rearing chamber inside glass house condition [8]. *Thrips palmi* were collected from cotton field at Department of Cotton, TNAU, Coimbatore using aspirator. This aspirator consisting of a glass tube (30cm length and 0.5cm diameter) and rubber tube (45cm length and 0.5cm diameter). Leaves were turned upward gently and thrips were sucked into the glass tubes of the aspirator. Collected thrips were carefully examined under magnifier for admixture of different thrips species. *Thrips palmi* was isolated from other population based on their morphological characters including seven segmented antennae and red coloured ocelli. After examination thrips were released to the cotton plants using camel hair brush and maintained separately for fast establishment of thrips population under protected insect proof condition.

Thrips rearing chamber was made of (340 $\mu$ ) insect proof net on all sides. The culture chamber was maintained at 28 to 30°C temperature and 30 to 50% relative humidity [11]. Periodical examination of thrips from the colony never revealed the presence of any other species during experimentation.

### Acute toxicity bioassay of botanicals against *Thrips palmi*

#### Preparation of botanical extract

##### For kernals and root extracts

Botanical extracts of Neem Seed Kernal Extract (NSKE) and *Mirabilis jalapa* roots were prepared by taking required quantity of dry sample and grinding them to powder. Powdered samples were soaked overnight in one liter of water. The solution was stirred in the morning till solution becomes milky white and filtered through double layer of muslin cloth. Before spraying 1ml/litre of sticking agent (Tween 20) was added and mixed well (Table 1).

##### For leaf extracts

Hundred gram of leaf samples were shade dried and then ground into powder using pestle and mortar. Powdered leaf samples were soaked in one litre of water. Then the crude extract was filtered through muslin cloth and the clear solution was used for the study. Before spraying 1 ml/litre of sticking agent (Tween 20) was added and mixed well.

#### List of botanicals used in the study

S. No.	Botanicals used	Plant parts used	Quantity (grams/litre)
1	Neem seed kernel extract (NSKE)	Kernels	50
2	Neem oil	Kernals	10
3	<i>Andrographis paniculata</i> Burm.f.	Leaf	100
4	<i>Mirabilis jalapa</i> L. root extract	Root	100
5	<i>Vitex negundo</i> L. leaf extract	Leaf	100
6	<i>Lantana camara</i> L. leaf extract	Leaf	100

#### Leaf disc bioassay

Bioassays were conducted by standard leaf disc method [10]. Newly emerged 2<sup>nd</sup> instar and adults of *Thrips palmi* were used for study.

Leaf discs of 50 mm diameter were cut from 2 week old cotton plants (cv Co14) and dipped into the botanical solution for 30s. These leaves were air dried at room temperature for 15 min by spreading on a filter paper. Leaf disc dipped in sterile distilled water only served as control. Leaves treated with botanicals were then transferred to petri dish (90mm dia X 10mm deep) lined with moistened filter paper. The leaf discs were placed into the petriplates with their adaxial surface downwards. Two such sets of petridishes were

maintained separately for 2<sup>nd</sup> instar nymphs and adults *T. palmi*. Using a fine hair brush 20 instars/adult thrips per replication were then transferred on to the treated leaf disc and the petriplates were closed with lids. The experiments were conducted in completely randomized design with seven treatments and three replications. The treatment details are given in Table 1.

The bioassays were conducted at 25  $\pm$  2°C, 75  $\pm$  5 per cent relative humidity, and photoperiod of 16:8 (Light: Dark). Mortality was recorded 12, 24, 48, 72 h after exposure to the botanicals. Mortality was corrected using Abbott's formula [1].

#### Pot culture experiment

Pot culture experiments were conducted on cotton variety, Co14. The acute toxicity of botanicals against 2<sup>nd</sup> instars and adults of *Thrips palmi* was assessed under glass house condition. The experiments were conducted in a completely randomized blocks design (CRD) with seven treatments and three replications. Each medium sized pot was sown with five cotton seedlings and after twenty five days, cotton seedlings were used for studies. Potted plants were sprayed with the botanical solution using atomizer. Plants were artificially inoculated with 20 numbers of thrips per plant and individual potted-plants were enclosed with mylar cages. The treatment details are given as in Table 3. Mortality was recorded 24h after exposure to the botanicals till 120h. Per cent mortality was worked out as follows,

$$\text{Per cent mortality} = \frac{\text{No. of 2}^{\text{nd}} \text{ instar /adult thrips dead}}{\text{Total number of thrips released}} \times 100$$

#### Statistical analysis

Data were subjected to analysis of variance (ANOVA) and the treatment means were statistically differentiated by performing Least Square Means test (LSD) at  $p < 0.05$  levels using AGRESS software. The per cent mortality was corrected using Abbot's (Abbot, 1925) formula,

$$\text{Per cent corrected mortality} = \frac{\text{Per cent test mortality} - \text{Per cent control mortality}}{100 - \text{Per cent control mortality}} \times 100$$

#### Results

##### Leaf disc bioassay against 2<sup>nd</sup> instars and adult *Thrips palmi*

The bioassay study was conducted with six botanicals against 2<sup>nd</sup> instar nymphs of *Thrips palmi*, among which NSKE 5% (51.67%) recorded the highest mortality and when compared to all other treatments after 24 hours (Table 1). This was followed by Neem oil 1% (45.00%), *Andrographis paniculata* leaf extract 10 % (38.33%) and *Mirabilis jalapa* root extract 10% (33.00%) after 24 HAT. The least mortality was recorded in *Lantana camara* leaf extract 10% (28.33%) and *Vitex negundo* leaf extract 10% (26.67%) after 24 HAT.

After 72 hours of treatment, all the botanicals recorded more than 50 per cent mortality. NSKE 5% recorded the highest mortality of 95.00 per cent, whereas lowest mortality was recorded by *Vitex negundo* leaf extract 10% (60.00%) in the same timeframe. NSKE 5% treatment was followed by neem oil 1% (88.33%) and *Andrographis paniculata* leaf extract 10% (75.00%). *Mirabilis jalapa* root extract 10% and *Lantana camara* leaf extract 10% were found on par with each other and recorded 68.33 per cent and 66.67 per cent mortality, respectively. The control plants treated with water recorded about 5 per cent mortality.

In the case of adult, *T. palmi* after 24 hours of treatments, NSKE 5% (51.67%) recorded the highest mortality followed by neem oil 1% (45.00%). The least mortality was recorded in *Vitex negundo* leaf extract 10% treatment with 26.67% (Table 2).

The results of the leaf disc bioassay study revealed that NSKE 5% and neem oil 1% recorded maximum mortality of 45.00 and 38.33 per cent after 72 hours of treatment. *Andrographis paniculata* leaf extract 10% (30.00%) and *Mirabilis jalapa* root extract 10% (25.00%) were the next best treatments. *Lantana camara* leaf extract 10% (20.00) and *Vitex negundo* leaf extract 10% (18.33%) recorded the least mortality and were on par with each other after 72 hours of treatment, respectively.

The order of efficacy of different botanicals treatments based on the per cent mortality of 2<sup>nd</sup> instar and adult thrips over control was as follows: NSKE 5% > Neem oil 1% > *Andrographis paniculata* leaf extract 10% > *Mirabilis jalapa* root extract 10% > *Lantana camara* leaf extract 10% > *Vitex negundo* leaf extract 10%

#### Pot culture against 2<sup>nd</sup> instars and adult *Thrips palmi*

The mortality data on acute toxicity of botanicals to the population of 2<sup>nd</sup> instar and adult *Thrips palmi* are presented in Tables 3 & 4.

Among the six botanical extracts tested, NSKE 5% recorded the highest mortality and was significantly superior to all other treatments (Table 3). After 24 hours of spraying, the highest mortality was recorded in NSKE 5% (23.33%) followed by neem oil 1% (18.33%), *Andrographis paniculata* leaf extract 10% (13.33%) and *Mirabilis jalapa* root extract 10% (11.67%). The least mortality percentage was recorded in *Lantana camara* leaf extract 10% (8.33%) and *Vitex negundo*

leaf extract 10% (7.00%).

After 120 hours of treatment, NSKE 5% recorded 98.33% mortality of 2<sup>nd</sup> *Thrips palmi*, whereas lowest mortality was caused by *Vitex negundo* leaf extract 10% (45.00%) in the same timeframe. The maximum mortality recorded by NSKE 5% treatment was followed by neem oil 1% (93.33%) and *Andrographis paniculata* leaf extract 10% (70.00%). *Mirabilis jalapa* root extract 10% and *Lantana camara* leaf extract 10% recorded only 66.67 per cent and 46.67 per cent mortality. These treatments did not differ significantly from one another. The control plants treated with water recorded about 5 per cent mortality.

Data on mortality of adult thrips to different botanical treatments are furnished in Table 4. After 24 hours of treatments, NSKE 5% (18.33%) recorded the highest mortality percentage followed by neem oil 1% (13.33%). The least mortality was recorded in *Vitex negundo* leaf extract 10% with 3.33%.

The results of the pot culture study revealed that NSKE 5% and neem oil 1% recorded maximum mortality of 93.33 and 88.33 per cent after 120 hours of treatment. *Andrographis paniculata* leaf extract 10% and *Mirabilis jalapa* root extract 10% were the next best treatments. *Lantana camara* leaf extract 10% and *Vitex negundo* leaf extract 10% recorded the least mortality percentage of 41.67 per cent and 40.00 per cent and was on par with each other after 120 hours of treatment, respectively.

The order of efficacy of different botanicals treatments based on the per cent mortality of 2<sup>nd</sup> instar and adult thrips over control was as follows: NSKE 5% > Neem oil 1% > *Andrographis paniculata* leaf extract 10% > *Mirabilis jalapa* root extract 10% > *Lantana camara* leaf extract 10% > *Vitex negundo* leaf extract 10%.

**Table 1:** Efficacy of botanicals against 2<sup>nd</sup> instar *Thrips palmi* (cv. CO 14) – Leaf disc bioassay

S. No.	Treatment	12HAT*		24 HAT*		48HAT*		72HAT*	
		Per cent mortality	Corrected mortality (%)	Per cent mortality	Cumulative Corrected mortality (%)	Per cent mortality	Cumulative Corrected mortality (%)	Per cent mortality	Cumulative Corrected mortality (%)
T1	Neem oil 1 %	21.67 <sup>b</sup> (27.74)	21.67	45.00 <sup>b</sup> (42.13)	44.07	70.00 <sup>b</sup> (56.79)	68.97	88.33 <sup>b</sup> (70.02)	87.72
T2	NSKE 5 %	28.33 <sup>a</sup> (32.16)	28.33	51.67 <sup>a</sup> (45.96)	50.85	73.33 <sup>a</sup> (58.91)	72.41	95.00 <sup>a</sup> (77.08)	94.74
T3	<i>Andrographis paniculata</i> leaf extract 10 %	18.33 <sup>c</sup> (25.35)	18.33	38.33 <sup>c</sup> (38.25)	37.28	56.67 <sup>c</sup> (48.83)	55.18	75.00 <sup>c</sup> (60.00)	73.68
T4	<i>Mirabilis jalapa</i> root extract 10%	16.67 <sup>d</sup> (24.10)	16.67	33.33 <sup>d</sup> (35.26)	32.20	50.00 <sup>d</sup> (45.00)	48.28	68.33 <sup>d</sup> (55.75)	66.66
T5	<i>Vitex negundo</i> leaf extract 10%	13.33 <sup>f</sup> (21.41)	13.33	26.67 <sup>f</sup> (31.09)	25.42	36.67 <sup>f</sup> (37.27)	34.49	60.00 <sup>e</sup> (50.77)	57.89
T6	<i>Lantana camera</i> leaf extract 10%	15.00 <sup>e</sup> (22.79)	15.00	28.33 <sup>e</sup> (32.16)	27.11	45.00 <sup>e</sup> (42.13)	43.11	66.67 <sup>d</sup> (54.74)	64.92
T7	Control	0.00 <sup>g</sup> (0.00)	0.00	1.67 <sup>g</sup> (7.43)	0.00	3.33 <sup>g</sup> (10.51)	0.00	5.00 <sup>f</sup> (12.92)	0.00
SEd		0.14	-	0.23	-	0.35	-	0.64	-
CD(P=0.05)		0.30	-	0.50	-	0.74	-	1.38	-

\*Mean of three replications; HAT- Hours after treatment.

In a column means followed by a common letter are not significantly different at P = 0.05 by LSD.

Figures in parentheses are arcsine  $\sqrt{\text{Per cent transformed value}}$

**Table 2:** Efficacy of botanicals against adult, *Thrips palmi* (cv. CO 14) – Leaf disc bioassay

S. No.	Treatment	12HAT*		24 HAT*		48HAT*		72HAT*	
		Per cent mortality	Corrected mortality (%)	Per cent mortality	Cumulative Corrected mortality (%)	Per cent mortality	Cumulative Corrected mortality (%)	Per cent mortality	Cumulative Corrected mortality (%)
T1	Neem oil 1 %	20.00 <sup>b</sup> (26.57)	20	38.33 <sup>b</sup> (38.25)	38.33	60.00 <sup>b</sup> (50.77)	59.32	83.33 <sup>b</sup> (65.90)	82.76
T2	NSKE 5 %	21.67 <sup>a</sup> (27.74)	21.67	45.00 <sup>a</sup> (42.13)	45.00	65.00 <sup>a</sup> (53.73)	64.41	93.33 <sup>a</sup> (75.03)	93.10
T3	Andrographis paniculata leaf extract 10 %	15.00 <sup>c</sup> (22.79)	15	30.00 <sup>c</sup> (33.21)	30.00	53.33 <sup>c</sup> (46.91)	52.54	78.33 <sup>c</sup> (62.26)	77.58
T4	Mirabilis jalapa root extract 10%	14.16 <sup>d</sup> (22.10)	14.16	25.00 <sup>d</sup> (30.00)	25.00	45.00 <sup>d</sup> (42.13)	44.07	68.33 <sup>d</sup> (55.75)	67.24
T5	Vitex negundo leaf extract 10%	9.16 <sup>f</sup> (17.62)	9.16	18.33 <sup>f</sup> (25.35)	18.33	30.00 <sup>f</sup> (33.21)	28.81	55.00 <sup>e</sup> (47.87)	53.45
T6	Lantana camera leaf extract 10%	13.33 <sup>e</sup> (21.41)	13.33	20.00 <sup>e</sup> (26.57)	20.00	40.00 <sup>e</sup> (39.23)	38.98	56.67 <sup>e</sup> (48.83)	55.18
T7	Control	0.00 <sup>g</sup> (0.00)	0.00	0.00 <sup>g</sup> (0.00)	0.00	1.67 <sup>g</sup> (7.43)	0.00	3.33 <sup>f</sup> (10.51)	0.00
SEd		0.12	-	0.19	-	0.30	-	0.60	-
CD(P=0.05)		0.27	-	0.42	-	0.65	-	1.29	-

\*Mean of three replications; HAT- Hours after treatment.

In a column means followed by a common letter are not significantly different at P = 0.05 by LSD.

Figures in parentheses are arcsine  $\sqrt{\text{Per cent transformed value}}$

**Table 3:** Efficacy of botanicals against 2<sup>nd</sup> instar *Thrips palmi* (cv. CO 14) – Pot culture Experiment

S. No.	Treatment	24 HAT*		48HAT*		72HAT*		96HAT*		120HAT*	
		Per cent mortality	Corrected mortality (%)	Per cent mortality	Cumulative corrected mortality (%)	Per cent mortality	Cumulative Corrected mortality (%)	Per cent mortality	Cumulative Corrected mortality (%)	Per cent mortality	Cumulative Corrected mortality (%)
T1	Neem oil 1 %	18.33 <sup>b</sup> (25.35)	18.33	40.00 <sup>b</sup> (39.23)	38.98	61.67 <sup>b</sup> (51.75)	60.35	75.00 <sup>b</sup> (60.00)	74.14	93.33 <sup>b</sup> (75.03)	92.98
T2	NSKE 5 %	23.33 <sup>a</sup> (28.88)	23.33	48.33 <sup>a</sup> (44.04)	47.45	70.00 <sup>a</sup> (56.79)	68.97	81.67 <sup>a</sup> (64.65)	81.04	98.33 <sup>a</sup> (82.57)	98.24
T3	Andrographis paniculata leaf extract 10 %	13.33 <sup>c</sup> (21.41)	13.33	30.00 <sup>c</sup> (33.21)	28.81	38.33 <sup>c</sup> (38.25)	36.21	56.67 <sup>c</sup> (48.83)	55.18	70.00 <sup>c</sup> (56.79)	68.42
T4	Mirabilis jalapa root extract 10%	11.67 <sup>d</sup> (19.98)	11.67	28.33 <sup>d</sup> (32.16)	27.11	35.00 <sup>d</sup> (36.27)	32.76	53.33 <sup>d</sup> (46.91)	51.72	66.67 <sup>c</sup> (54.74)	64.92
T5	Vitex negundo leaf extract 10%	7.00 <sup>f</sup> (15.34)	7.00	21.67 <sup>f</sup> (27.74)	20.34	23.33 <sup>f</sup> (28.88)	20.69	38.33 <sup>f</sup> (38.25)	36.21	45.00 <sup>d</sup> (42.13)	42.11
T6	Lantana camera leaf extract 10%	8.33 <sup>e</sup> (16.78)	8.33	23.33 <sup>e</sup> (28.88)	22.03	25.00 <sup>e</sup> (30.00)	22.42	36.67 <sup>e</sup> (37.27)	34.49	46.67 <sup>d</sup> (43.09)	43.86
T7	Control	0.00 <sup>g</sup> (0.00)	0.00	1.67 <sup>g</sup> (7.43)	0.00	3.33 <sup>g</sup> (10.51)	0.00	3.33 <sup>g</sup> (10.51)	0.00	5.00 <sup>e</sup> (12.92)	0.00
SEd		0.12	-	0.20	-	0.27	-	0.38	-	0.94	-
CD(P=0.05)		0.25	-	0.43	-	0.57	-	0.81	-	2.02	-

\*Mean of three replications; HAT- Hours after treatment.

In a column means followed by a common letter are not significantly different at P = 0.05 by LSD.

Figures in parentheses are arcsine  $\sqrt{\text{Per cent transformed values}}$ .

**Table 4:** Efficacy of botanicals against adult, *Thrips palmi* (cv. CO 14) – Pot culture Experiment

S. No.	Treatment	24 HAT*		48HAT*		72HAT*		96HAT*		120HAT*	
		Per cent mortality	Corrected mortality (%)	Per cent mortality	Cumulative corrected mortality (%)	Per cent mortality	Cumulative Corrected mortality (%)	Per cent mortality	Cumulative Corrected mortality (%)	Per cent mortality	Cumulative Corrected mortality (%)
T1	Neem oil 1 %	13.33 <sup>b</sup> (21.41)	13.33	40.00 <sup>b</sup> (39.23)	40.00	60.00 <sup>b</sup> (50.77)	58.62	71.67 <sup>b</sup> (57.84)	70.69	88.33 <sup>b</sup> (70.02)	87.72
T2	NSKE 5 %	18.33 <sup>a</sup> (25.35)	18.33	43.33 <sup>a</sup> (41.17)	43.33	65.00 <sup>a</sup> (53.73)	63.79	76.67 <sup>a</sup> (61.12)	75.87	93.33 <sup>a</sup> (75.03)	92.98
T3	Andrographis paniculata leaf extract 10 %	8.33 <sup>c</sup> (16.78)	8.33	30.00 <sup>c</sup> (33.21)	30.00	40.00 <sup>c</sup> (39.23)	37.93	53.33 <sup>c</sup> (46.91)	51.72	70.00 <sup>c</sup> (56.79)	68.42
T4	Mirabilis jalapa root extract 10%	6.67 <sup>d</sup> (14.97)	6.67	23.33 <sup>d</sup> (28.88)	23.33	30.00 <sup>d</sup> (33.21)	27.59	48.33 <sup>d</sup> (44.04)	46.55	58.33 <sup>d</sup> (49.80)	56.14
T5	Vitex negundo leaf extract 10%	3.33 <sup>f</sup> (10.51)	3.33	13.33 <sup>f</sup> (21.41)	13.33	20.00 <sup>f</sup> (26.57)	17.24	30.00 <sup>f</sup> (33.21)	27.59	40.00 <sup>e</sup> (39.23)	36.84
T6	Lantana camera leaf extract 10%	3.33 <sup>e</sup> (10.51)	3.33	15.00 <sup>e</sup> (22.79)	15.00	21.67 <sup>e</sup> (27.74)	18.97	33.33 <sup>e</sup> (35.26)	31.03	41.67 <sup>e</sup> (40.20)	38.60
T7	Control	0.00 <sup>g</sup>	0.00	0.00 <sup>g</sup>	0.00	3.33 <sup>g</sup>	0.00	3.33 <sup>g</sup>	0.00	5.00 <sup>f</sup>	0.00

	(0.00)		(0.00)		(10.51)		(10.51)		(12.92)	
SEd	0.09	-	0.19	-	0.26	-	0.34	-	0.56	-
CD(P=0.05)	0.20	-	0.41	-	0.55	-	0.73	-	1.21	-

\*Mean of three replications; HAT- Hours after treatment.

In a column means followed by a common letter are not significantly different at P = 0.05 by LSD.

Figures in parentheses are arcsine  $\sqrt{\text{Per cent transformed values}}$

## Discussion

Results showed that botanical extracts had potential in reducing thrips population and recorded significant mortality under controlled environmental conditions. NSKE 5% and neem oil 1% were effective among the botanicals tested. This may be due to the diverse behavioural and physiological effect of neem on insects ranging from repellence to feeding deterrence, growth disruption and sterilizing effects [15], ovipositional deterrence [5] reduction in fecundity, reduction in fertility [9] and direct ovicidal action [4]. The NSKE 5% has recorded effective mortality against *Scirtothrips dorsalis* in chilli [12, 14] and grapes [3, 20], flower thrips, *Megalurothrips usitatus* Bagnall infesting green gram [19]

Neem oil 500ml/acre recorded an average of 63.27% mortality of sucking pest complex (jassid, whitefly and thrips) under field condition in cotton [13]. Ahmed *et al.* (1995) found that neem oil gave encouraging control of jassid and whitefly in the cotton field. Neem oil shows least toxic to humans and beneficial organisms and has very promising effect against many pests including *Scirtothrips dorsalis* [2, 14], *Ceraeochrysa claveri* [16], *Diaphorina citri* [22], *Nilaparvata lugens* Stal. This wide range of control may be due to their contact insecticidal and translaminar activity. Neem seed kernel extract and Neem oil were more effective against the control of sucking pest, *Thrips palmi* in cotton ecosystem.

The moderate efficacy of *Andrographis paniculata* against *Thrips palmi* in present study was earlier registered in *Solanum nigrum* [18] where maximum reduction in thrips population was recorded when plants were treated with aqueous extract of *Andrographis paniculata* 2%. *Andrographis paniculata* decoction was more effective against *Thrips tabaci* on garlic compared to *Lantana camara* which had the least effect [17]. The least effect of *Lantana camara* and *Vitex negundo* are in line with the above studies.

## Conclusion

Use of botanicals in pest management may not eradicate pests, but to keep them at tolerable levels at which they cause no appreciable harm. Thus utilization of botanical pesticides possess the advantages of reducing the pollution burden of the environment occurring due to toxic pesticides and also protect the beneficial fauna and biodiversity in the cotton agro-ecosystem. Efficacy of the above botanicals against the control of thrips make these botanicals worthy of further consideration as control measures. Although these products are safer for the management of pests, compared to synthetic chemicals, their effects in IPM must be evaluated thoroughly before field recommendation.

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