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Field efficacy of certain botanical and chemical insecticides against chilli thrips [*Scirtothrips dorsalis* (Hood)] on Chilli (*Capsicum annuum* L.)

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Abstract
A field experiment was conducted during *kharif,* 2016 at SHUATS, Allahabad (U.P.) to efficacy of certain botanical and chemical insecticides against chilli thrips (*Scirtothrips dorsalis* (Hood)) in trans Yamuna region of district Allahabad compare the all the eight different treatments, consisting application of NSKE 5% (T_1), Garlic sap extract 10g/lit (T_2), Neem oil 2.5ml/l (T_3), Dimethoate 1.6ml/l (T4), Imidacloprid 0.5ml/l (T5), Cypermethrin 1.8ml/l (T6), Spinosad 0.2ml/l (T7) and untreated control (T_o) reduced the infestation as compared to the untreated control. revealed that all the treatments were significantly superior over control among all the treatments Spinosad 0.2ml/l recorded highest reduction of *Scirtothrips dorsalis* population *i.e.* (79.79%) which was significantly superior over control followed by Imidacloprid 0.5ml/l (76.81%), Cypermethrin 1.8ml/l (71.38%) *var*. Dimethoate 1.6ml/l (66.02%), Neem oil 2.5ml/l (53.22%), NSKE 5% (48.11%) and Garlic sap extract 10g/Lit. (47.13%) was least effective among all the treatments. Among the treatment the best and most economical treatment was Spinosad 0.2ml/l (1:11.55) followed by Imidacloprid 0.5ml/l (1:10.53), Cypermethrin 1.8ml/l (1:9.14), Dimethoate 1.6ml/l (1:8.3), Neem oil 2.5ml/l (1:7.79), NSKE 5% (1:7.02) and Garlic sap extract 10g/l (1:5.67), as compared to control T_o (1:3.37).

Keywords: Botanicals, *Scirtothrips dorsalis*, efficacy

Introduction
Chilli or red pepper, (*Capsicum annum* L). Belonging to family solanaceae is an important spice cum vegetable crop commonly used in Indian dietary and grown throughout India as a cash crop. (Anonymous 2016) [1].

In Indian Chilli growing states are Andhra Pradesh (46%), Karnataka (15%), Maharashtra, Madhya Pradesh, Orissa, West Bengal, Rajasthan and Tamil Nadu. Indian Chilli can be grown during the entire year at one or the other part of the country. India exports around 80000 – 100000 tons of chilies a year. India exports chilies in the form of dried chilies, Chilli powder, picked chilies and Chilli oleoresin. Indian Chilli is mainly exported to USA, Sri Lanka, Bangladesh, the Middle East and the Far East. Uttar Pradesh is the ninth largest spice producing state accounting for 4.1% of total production of spices in the country. Thrips (S. dorsalis) and fruit borer (Helicoverpa armigera) are the most important recurring pests in chilli (Reddy and Puttaswamy, 1983 and 1984) [6] The stages of the life cycle of *S. dorsalis* include the egg, first and second instar larva, prepupa, pupa and adult. Gravid females lay eggs inside the plant tissue (above the soil surface) and eggs hatch between 5-8 days depending upon environmental conditions (Seal *et al.,* 2010) [8]. Use of chemicals is one of the most common and popular method for its management. So by using the chemicals having novel mode of action with higher bioefficacy on insect control and safer to environment and mammals. Bioefficacy of these chemicals need to be studied for formulating effective and economical management strategies of the chilli thrips.

Materials and Method
The trial was conducted in *kharif,* season 2016 the central research field, SHUATS, Allahabad (U.P.). Trial was laid out in a randomized block design consisting of seven different treatments. Seedlings of Chilli variety Chilli-G4 plot of (2m x 1m) at a spacing of (45x30cm) with recommended package of practices excluding plant protection. The spraying was done after the population reaching its ETL (5 thrips/plant). Will be maintain between bedlings. The spraying was done after the population reaching its ETL (5 thrips/plant). The observation of the pests was recorded from three tender leaves of five randomly selected plants from each net plot area and three leaves (top, middle, and bottom) from each plant were selected.

The average percent reduction of pest population of all three sprays was worked out by using Henderson and Tilton's formula described as under:
Percent reduction = 100(1-Ta x Cb / Tb x Ca)
Where Ta = number of insects in treated plot after insecticide application.
Tb = number of insects in treated plot before insecticide application.
Ca = number of insects in untreated check after insecticide application.
Cb = number of insects in untreated plot check before insecticide application.
The percent reduction was transformed to angular values from which analysis of variance was calculated for determining the critical difference (CD) at 5 percent level of significance.
The data on thrips population thus converted to the percentage of mortality and were subjected to statistically analysis after arcsine transformation. The data on percentage reduction obtained are presented in table 1(overall mean 1st2ndspray). The insecticide treatments include NSKE, Garlic sap extract, Neem oil, Dimethoate, Imidacloprid, Cypermethrin, Spinosad and untreated control. The incidence of the chilli thrips was recorded from the five randomly selected plants. Observations were recorded one day before spray and 3rd, 10th days after spraying. Treatment wise yield of healthy marketable fruits was recorded at each picking, converted them in Kg/ha and data thus obtained were statistically analyzed (steel and Torrie, 1980).Economics of different treatments were worked out based on yield and cost of treatments. The values of Insecticides cost-benefit ratio obtained for different treatments are furnished in table 2.

Results and Discussion

The data the average percent reduction of pest population of all three sprays was worked out by using Henderson and Tilton's formula described as under:
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Results and Discussion

The data on percent population reduction of *Scirtothrips dorsalis* over control on first and second spray revealed that all the treatments were significantly superior over control among all the treatments Spinosad 0.2ml/l recorded highest reduction of *Scirtothrips dorsalis* population *i.e*. (79.79%) which was significantly superior over control followed by Imidacloprid 0.5ml/l (76.81%), Cypermethrin 1.8ml/l (71.38%) *var*. Dimethoate 1.6ml/l (66.02%), Neem oil 2.5ml/l (53.22%), NSKE 5% (48.11%) and Garlic sap extract 10g/Lit. (47.13%) was least effective among all the treatments. (Table 1). The statistical analysis of data showed that all the treatments are significantly effective. Vanisree *et al.* (2013) they reported that Spinosad was found most effective in reducing the population of *Scirtothrips dorsalis* as well as in increasing yield. Similar results were also reported by Seal *et al.* (2006) [9] with spinosad and imidacloprid most effective in reducing the density of *Scirtothrips dorsalis* upto (0.015%). Ravi Kumar *et al*. (2016) reported that Spinosad was found most effective in reducing the population of *Scirtothrips dorsalis* up to 81.77%. Sathyan *et al.* (2017) revealed Dimethoate 30 EC @ 0.15% was the effective treatment in percentage reduction of in the result Dimethoate @0.03% was the effective treatment in percentage reduction of chilli thrips were (63.24%) reduction over control reported by. Similar results were also found by chilli thrips with (62%). Ravi Kumar *et al*. (2016) [4] reported that Dimethoate was found effective in reducing the population of *Scirtothrips dorsalis* up to (75.32%).
The yields among the treatment were significant. The highest yield was recorded in Spinosad 0.2ml/l (275.22 q/ha), followed by Imidacloprid 0.5ml/l (253.98 q/ha), Cypermethrin 1.8ml/l (223.54 q/ha), Dimethoate 1.6ml/l (202.56 q/ha), Neem oil 2.5ml/l (186.7 q/ha), NSKE 5% (168.65 q/ha) and Garlic sap extract 10g/l (146.34 q/ha), as compared to control T_o (95.54 q/ha). When cost benefit ratio was worked out, interesting result was achieved. Among the treatment studied, the best and most economical treatment was Spinosad 0.2ml/l (1:11.55) followed by Imidacloprid 0.5ml/l (1:10.53), Cypermethrin 1.8ml/l (1:9.14), Dimethoate 1.6ml/l (1:8.3), Neem oil 2.5ml/l (1:7.79), NSKE 5% (1:7.02) and Garlic sap extract 10g/l (1:5.67), as compared to control T_o (1:3.37). The statistical analysis of data showed that all the treatments are significantly recorded highest marketable yield compared to control. Vanisree *et al.* (2013) [10] they reported that Spinosad was found most effective in reducing the population of *Scirtothrips dorsalis* as well as in increasing yield. This result supported by Patel *et al.,* (2009) [5]. Recorded among the treatments spinosad the highest yield of 16.10 kg plot-1 (8942.26 kg ha-1) with an increase of 219.37% yield over the untreated check and was found significantly superior to all the other treatments. Ravi kumar *et al.* (2016) [4] reported that application of Spinosad 45 SC @ 0.01 percent recorded the highest yield (30050 kg ha-1)

Table 1: Field efficacy of certain botanicals and chemical insecticides against Chilli thrips (*Scirtothrips dorsalis*) on Chilli (*Capsicum annuum* L.), during kharif season 2016 (Overall mean). % Reduction over control population of *Scirtothrips dorsalis.*

Treatments		1st Spray Mean	2nd Spray Mean	Overall Mean
T_1	NSKE	45.14	51.08	48.11
		(42.21)	(45.61)	(43.91)
T_2	Garlic Sap extract	44.78	49.48	47.13
		(42.03)	(44.70)	(43.35)
T_3	Neemoil	50.99	55.45	53.22
		(45.56)	(48.12)	(46.84)
T_4	Dimethoate	65.22	66.82	66.02
		(53.86)	(54.82)	(54.34)
T_5	Imidacloprid	75.84	77.78	76.81
		(60.55)	(61.87)	(61.21)
T_6	Cypermethrin	72.83	69.94	71.38
		(58.58)	(56.75)	(57.65)
T_7	Spinosad	79.47	80.12	79.79
		(63.05)	(63.52)	(63.28)
T_0	Control	0.00	0.00	0.00
		(0.00)	(0.00)	(0.00)
F- test		S	S	S
S. Ed. (±)		2.247	1.632	2.859
C. D. (P = 0.05)		5.003	3.460	4.182

*Figures in parenthesis are arc sin transformed values

Table 2: Economics of Cultivation

Tr. No:	Treatment	Yield q/ha	Cost of yield Rs/q	Total cost of yield in Rs	Common cost in Rs	Treatment cost in Rs	Total cost in Rs	Net returns in Rs	C:B ratio
T_1	NSKE	168.65	1500	252975	29885	1620	31505	221470	1:7.02
T_2	Garlic sap extract	146.34	1500	219510	29885	3000	32885	186625	1:5.67
T_3	Neem oil	186.7	1500	280050	29885	1950	31835	248215	1:7.79
T_4	Dimethoate	202.56	1500	303840	29885	2475	32360	271480	1:8.3
T_5	Imidacloprid	253.98	1500	380970	29885	3150	33035	347935	1:10.53
T_6	Cypermethrin	223.54	1500	335310	29885	2880	32765	299545	1:9.14
T_7	Spinosad	275.22	1500	412830	29885	3000	32885	379945	1:11.55
T_0	Untreated/Control	95.54	1500	143310	29885	2880	32765	110545	1:3.37

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