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Effect of selected insecticides and essential oils on the population of chilli thrips (*Scirtothrips dorsalis* Hood) and chilli yield

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Abstract
The current study was carried out at Central Research Farm, SHUATS, Naini, Prayagraj, U.P. during *kharif* season of 2021. Two applications of seven insecticides were used against *Scirtothrips dorsalis* and the results revealed that among the different treatments Spinosad 0.3ml/lit (95.09%) proved to be most effective treatments followed by Fipronil 2ml/lit. (92.74%), Thiomethoxam WG25% 0.25ml/lit. (90.65%), Neem oil 2.5ml/lit (88.53%), Garlic extract 4gm/lit. (85.11%) and Eucalyptus oil 3ml/lit (81.90%). The least effective treatment Pongamia oil 4ml/lit (76.70%). Among the treatment studied, the best and most economical treatment was Spinosad (1:11.07), followed by Fipronil (1:10.36), Thiomethoxam (1:9.69), Neem oil (1:7.89), Garlic sap extract (1:6.93), Eucalyptus oil (1:5.81), Pongamia oil (1:4.93) and Control (1:3.73).

Keywords: *Capsicum annum*, benefit cost ratio, efficacy, insecticides, *Scirtothrips dorsalis*

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. Chilli popularly known as 'Mirchi' in Hindi. The pungency in chillies is due to crystalline volatile alkaloid 'Capsaicin'. The red color of chillies is due to the presence of pigment 'Capsanthin'. (Mondal and Mondal 2012) [9].
Chilli (*Capsicum annum* L.) is cultivated throughout India, specially in Andhra Pradesh, Tamilnadu, Karnataka (Kumari *et al*., 2001) [6]. Capsaicin, an alkaloid responsible for pungency in chillies has medicinal properties and it prevents heart attack by dilating the blood vessels. It is rich in proteins, lipids, carbohydrates, fibres, mineral salts (Ca, P, Fe) and in vitamins A, D3, E, C, K, B2 and B12. (Sahu and Kumar 2018) [12].
India is the largest producer and largest consumer of chilli in the world. In India, total area and production of chilli is 9,21,610 Ha. and 21,49,230 MT in the year of 2019- 2020. Uttar Pradesh occupies about 1.8 thousand ha area and 1.7 thousand tons production respectively. The area occupied in Prayagraj is 2,455 ha. and the production is 2,715.2 MT (Tirkey and Kumar 2017) [15].
Thrips (*Scirtothrips dorsalis*) and fruit borer (*Helicoverpa armigera*) are the most important recurring pests in chilli (Reddy and Puttaswamy 1983) [11]. Nearly 25 insects have been recorded attacking chilli leaves and fruits in India, of which thrips, *Scirtothrips dorsalis* Hood (Thripidae: Thysanoptera) is considerd as the most serious and important pest (Ananthakrishnan, 1971) [1] the symptoms of chilli leaf curl caused by feeding injury of thrips was described by, which is locally known as "*Kokadava"* in Gujarat. Nymphs and adults of thrips suck the sap from tender crop canopy, resulting shriveling of leaves. The infested leaves curled upward presenting a boat shaped appearance. The affected leaves and fruits are deformed, twisted, brittle and crumpled (Reddy and Puttaswamy 1983) [11].

Materials and Methods
The experiment was conducted during *kharif* season 2021 at Central Research Field (CRF) of Sam Higginbottom University of Agriculture, Technology and Sciences, Naini, Prayagraj, Uttar Pradesh, India, in a randomized block design with eight treatments replicated three times using variety G-4, in a plot size of 2m×2m at a spacing of 45cm ×30cm with a recommended package of practices excluding plant protection. The soil of the experimental site was well drained and medium high.

The observations on population of chilli thrips were recorded visually using a magnifying lens early on three leaves at top, middle and bottom canopy from five randomly selected and tagged plants in each plot. The population were recorded a day before spray and 3, 7 and 14 days after spray and the per cent reduction were worked out using the formula.

Reduction of pest population in different treatments over control were calculated from the following formula as described by Fleming and Retnakaran (1985) [4].

$$\% \text{ population reduction} = 100 \times \left[1 - \frac{T_a \times C_b}{T_b \times C_a} \right]$$

Where

Ta = number of insects in treated plot after insecticides application

Tb=number of insects in treated plot before insecticides application

Ca= number of insects in Untreated check after insecticide application

Cb= number of insects in untreated check before insecticide application

(Lakshmi and Kumar 2021) [7]

Benefit Cost Ratio

Cost effectiveness of each treatment was assessed based on net returns. Net return of each treatment was worked out by deducting total cost of the treatment from gross returns. Total cost of production included both cultivation as well as plant protection charges.

Gross return = Marketable yield × Market price Net return = Gross return – Total cost

$$\text{Benefit: Cost Ratio} = \frac{\text{Gross Returns}}{\text{Total cost}} \times 100$$

(Sujay *et al*. 2010) [14]

Results and Discussion

The data on the mean per cent population reduction of first spray, second spray and overall mean revealed that all the treatments except untreated control are effective and at par. Among all the treatments lowest per cent reduction of chilli thrips was recorded in Spinosad. Spinosad was more effective in per cent reduction of thrips with (95.09%). Similar finding was reported by Lakshmi and Kumar (2021) [7] with 91.4%. Fipronil was effective in reducing the population of *Scirtothrips dorsalis* (92.74%). Similar finding was reported by Babu *et al.*, (2021) [2] with 92.86%.

Thiamethoxam 25%WG was effective in controlling *Scirorthrips dorsalis* (90.65%). Similar findings was reported by Gosh *et al.* (2009) [5] with 90.1%. Neem oil 88.53%. Similar finding was reported by Venkateswarlu *et al.* (2021) [17] with 88.69%. Followed by Garlic extract 85.11% and this treatment is supported by Menna and Tayde (2017) [8] Followed by treatment Eucalyptus oil 81.90%. this results are in supported by Venkateswarlu *et al.* (2021). with 87.48%. Followed by treatment Pongamia oil 76.70%. these results are in supported by Menna and Tayde (2017) [8] with 55.78%.

Economics of various treatments

The increased per cent yield over control treatment was different. All the treatments were superior over control. The highest yield was recorded in Spinosad (93q/ha), followed by Fipronil (87q/ha), Thiamethoxam (79 q/ha). These results are in support with Vanisree *et al*. (2017) [16] Neem oil (65 q/ha), Garlic sap extract (57q/ha), Eucalyptus oil (52 q/ha), Pongamia oil (42 q/ha) as compared to control T0 (28 q/ha). Similar findings are made by Barot and patel (2012) [3].

When cost benefit ratio was worked out, interesting result were achieved. Among the treatment studied, the best and most economical treatment was Spinosad (1:11.07). Similar finding was reported by Menna and Tayde (2017) [8] with (1:11.36). followed by Fipronil (1:10.36) and Thiamethoxam (1:9.69) this results are in supported by Samota *et al*. (2017) [13] with (1:10.90) and (1:10.39). Followed by Neem oil (1:7.89), Garlic sap extract (1:6.93) this results are in supported by Patel and Kumar (2017) [10]. Eucalyptus oil (1:5.81), Pongamia oil (1:4.93) Similar finding are made by Venkateswarlu *et al.* (2021) [17] as compared to control (1:3.73).

Table 1: Efficacy of selected insecticides and essential oils against chilli thrips (*Scirtothrips doralis)* on chilli (*Capsicum annum*) (1st spray)

Treatments		Population of *Scirtothrips dorslis* /5 plants	% Population reduction of *Scirtothrips dorsalis* /5 plants			
		1DBS	3 DAS	7 DAS	14 DAS	Mean
T1	Fipronil 5 SC	8.200	93.35	91.89	87.60	90.947
T2	Garlic sap extract	8.467	83.62	84.34	78.71	82.223
T3	Pongamia oil	8.400	78.38	76.13	70.33	74.947
T4	Eucalyptus oil	8.667	83.36	80.91	73.87	79.380
T5	Spinosad45 SC	8.467	95.76	94.97	90.75	93.827
T6	Thiamethoxam 25% WG	8.933	91.89	89.28	85.14	88.770
T7	Neem oil	8.267	89.040	87.853	82.37	86.420
T0	Control	9.000	0.00	0.00	0.00	0.00
F- test		NS	S	S	S	S
S.Ed.(±)		0.184	1.745	1.568	1.529	2.65
C.D. (P=0.05)		0.55	3.745	3.364	3.517	1.23

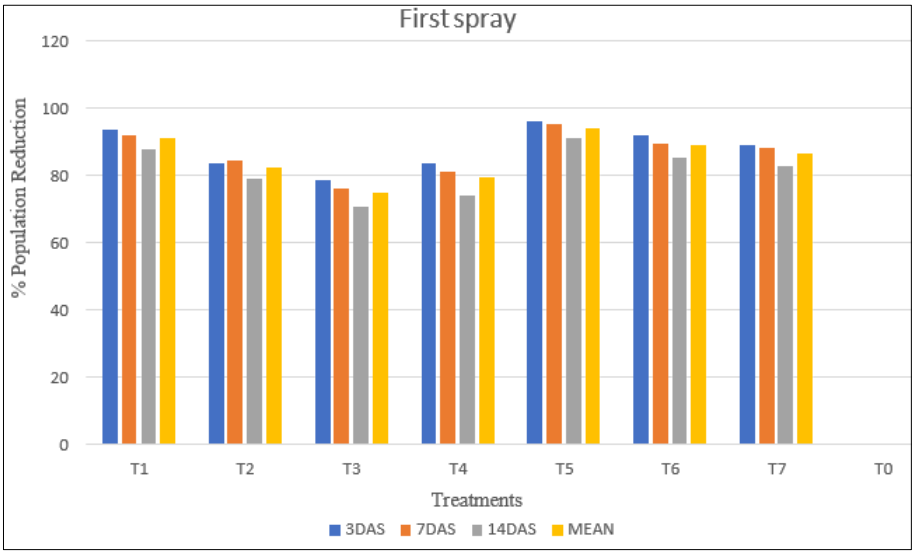

Fig 1: Graphical representation of efficacy of insecticides and essential oils against chillithrips (*Scirthrips dorsalis*) on chilli (*Capiscum annum*) 1st spray

Table 2: Efficacy of selected insecticides and essential oils against chilli thrips (*scirtothrips doralis*) on chilli (*Capsicum annum*) (2nd spray)

Treatments		% Population reduction of *Scirtothrips dorsalis* / 5 plants				
		1 DBS	3 DAS	7DAS	14 DAS	Mean
T1	Fipronil 5 SC	87.60	96.29	94.86	92.49	94.54
T2	Garlic sap extract	78.71	89.41	88.21	86.38	88.00
T3	Pongamia oil	70.33	80.64	78.38	76.38	78.46
T4	Eucalyptus oil	73.87	87.01	83.94	82.35	84.43
T5	Spinosad45 SC	90.75	97.92	96.50	94.69	96.37
T6	Thiamethoxa m25% WG	85.14	94.72	92.54	90.35	92.53
T7	Neem oil	82.37	92.70	91.25	88.00	90.65
T0	Control	0.00	0.00	0.00	0.00	0.00
F- test		S	S	S	S	S
S.Ed.(±)		1.529	1.648	1.894	2.156	0.670
C.D. (P=0.05)		3.517	3.53	4.21	4.62	1.439

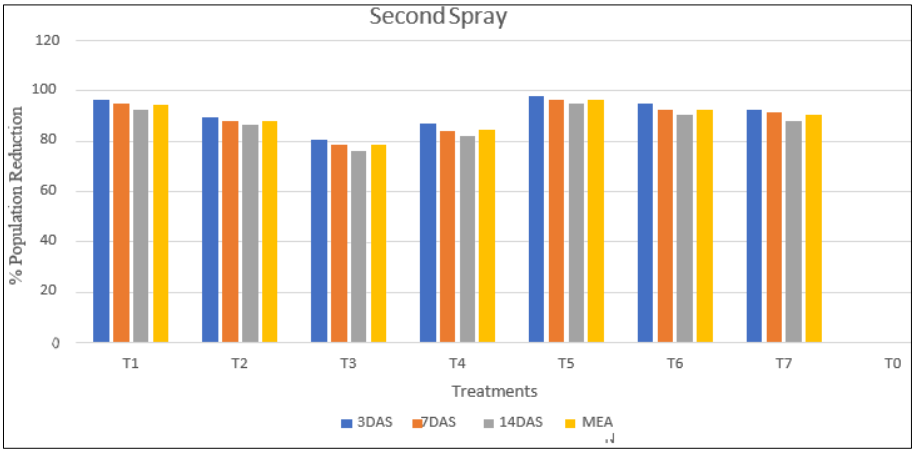

Fig 2: Graphical representation of efficacy of insecticides and essential oils against chilli thrips (*Scirthrips dorsalis*) on chilli (*Capiscum annum*) 2nd spray

Table 3: Economics of Cultivation

Sl No	Treatment	Yield q/ha	Cost of Yield (₹)/q	Total cost of Yield in (₹)	Common output cost in (₹)	Treatment cost in (₹)	Total Cost in (₹)	Net returns in (₹)	C:B ratio
T1	Fipronil 5 SC	87	4250	369750	33,457	2200	35657	334093	1:10.36
T2	Garlic extract	57	4250	242250	33,457	1480	34937	207313	1:6.93
T3	Pongamia oil	42	4250	178500	33,457	2720	36177	142323	1:4.93
T4	Eucalyptus oil	52	4250	221000	33,457	4550	38007	182993	1:5.81
T5	Spinosad45 SC	93	4250	395250	33,457	2231.7	35688	359562	1:11.07
T6	Thiamethoxam 25% WG	79	4250	335750	33,457	1160	34617	301133	1:9.69
T7	Neem oil	65	4250	276250	33,457	1550	35007	241243	1:7.89

T0	Control	28	4250	153000	33,457	-	33457	76915	1:3.73

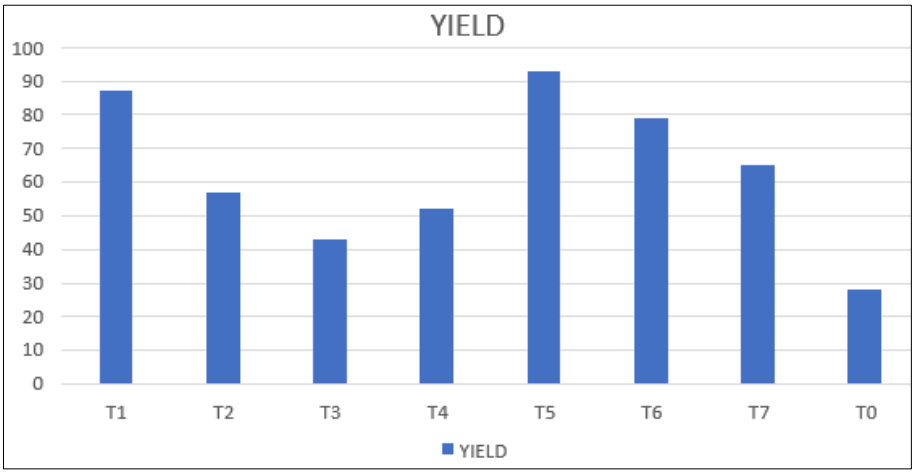

Fig 3: Graphical representation on effect of treatment production of chilli

Conclusion

From the experiment discussed above, the results revealed that the most efficient insecticide against *Scirtothrips dorsalis* was found to be Spinosad 0.3 ml/lit, followed by Fipronil 2 ml/lit and Thiomethoxam 0.25ml/lit. Pongamia oil 4ml/lit being the least effective. Spinosad had the best cost-benefit ratio followed by Fipronil, Thiomethoxam and Neem oil. Recommended dose of chemicals may be useful in devising integrated pest management strategy against chilli thrips.

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