Original Research Article

Efficacy of newer insecticides against the major sucking pests of groundnut (*Arachis hypogea* L.*)*

ABSTRACT

The field experiments on the efficacy of newer insecticides on sucking insect pests of groundnut was conducted at Regional Agricultural Research Station, Palem, of Nagarkurnool district, Telangana during *rabi*, 2021-22 in a randomized block design with eight treatments *viz*., Tolfenpyard 15 %EC @ 1.5ml L^{-1} and Tolfenpyard 15% EC @ 2 ml L^{-1}, Tolfenpyard 15% EC @ 2.5ml L^{-1}, Spinetoram 11.7% SC @ 0.5ml L^{-1}, Thiamethoxam 12.6+ Lamdacyhalothrin 9.5% ZC @ 0.4ml L^{-1}, Clothianidin 50% WDG @ 0.3g L^{-1}, Afidopyropen 50g/IDC @ 2ml L^{-1} and Sulfoxaflor 21.89% SC @ 0.5ml L^{-1}. Among all the tested insecticides clothianidin @ 0.3g L^{-1} worked very effective on the population of leafhoppers and thrips. Further, the next best treatments were afidopyropen @ 2ml L^{-1} and tolfenpyard @ 2.5ml L^{-1}. Followed by tolfenpyard 15 %EC @ 2.5ml L^{-1}, tolfenpyard @ 2.5ml L^{-1}, thiamethoxam+ lamdacyhalothrin @ 0.4ml L^{-1}. The treatment spinetoram @ 0.5ml L^{-1} was less effective on the sucking pest. The highest ICBR is recorded from the plots sprayed with clothianidin @ 0.3g L^{-1} (1.4.83) followed by afidopyrofen @ 2ml L^{-1} (1:3.94).

Key words: *Bio-efficacy, Groundnut Leafhoppers, Thrips, Newer insecticides, Sucking pests etc.*

1. INTRODUCTION

Groundnut (*Arachis hypogea*) L. is a member of the Fabaceae or Leguminosae family of legumes. It's also a popular oilseed crop in tropical and subtropical areas around the world (10). Among oilseeds, groundnut has first place in the country. It's referred to as the "King of Oil Seeds." It is native to South America. The major groundnut-producing countries are China, Nigeria, the USA, Taiwan, Indonesia, Ghana, Argentina, and Brazil. And in India is mainly produced in states like Gujarat, Andhra Pradesh, Karnataka, Telangana Tamil Nadu, Rajasthan, and Maharashtra. China produces the most groundnuts (17.39 million hectares), followed by India (6.70 million tonnes). In India, over 4.76 lakh ha were planted in 2021, with Karnataka leading the way with 1.32 lakh ha, followed by Telangana (0.87 lakh ha). (2). There are several constraints for the low productivity of groundnut and the biggest threat is due to major insect pests. Among them 13 species of sucking insects which would damage the crop (5). The major sucking insect pest complex of groundnut includes thrips, (*Scirtothrips dorsalis* Hood), *(Frankliniella schultzei* Trybom), *(Thrips palmi* Karny), (*Caliothrips indicus* Bagnall), leafhopper, (*Empoasca kerri* Pruthi); aphid, (*Aphis craccivora.* Koch). Aphids are vectors for groundnut rosette virus and peanut mottle virus, resulting in a 40% loss (7), and thrips acts as vectors for peanut bud necrosis. The indiscriminate use of chemicals causes the resistance, resurgence of the pests, and secondary pest outbreak, and they are more persistent. There is a need to use the insecticides in a right time, right dose and right direction. The following study was taken up by using the newer insecticides which are having multiple mode of action were evaluated and their efficacy is tested against sucking pests of groundnut.

2. MATERIALS AND METHODS

The experiment was conducted at Regional Agricultural Research Station, Palem, PJTSAU, Nagarkurnool district during the *rabi,* 2021-22. Groundnut variety K-6 was raised in 3×3m^2 area of plots with 22.5×10cm spacing. All the agronomic practices were followed for raising the crop.

The experiment was laid out with eight treatments and three replications in a randomized block design to investigate the efficacy of different insecticides like tolfenpyard @ 1.5ml L^{-1} and tolfenpyard @ 2 ml L^{-1}, tolfenpyard @ 2.5ml L^{-1}, spinetoram @ 0.5ml L^{-1}, thiamethoxam + lamdacyhalothrin @ 0.4ml L^{-1},

clothianidin @ 0.3g L^{-1}, afidopyropen @ 2ml L^{-1} and sulfoxaflor @ 0.5ml L^{-1}. Two sprays were given first spray was given after the pest reached ETL. The periodic observations on leafhoppers (No. leafhoppers/3 leaves/plant) and thrips (No. thrips/plant). The observations on insect pests population was recorded on one day before the spray and 1, 3, 5 and 7 days after the spray.

The data was analyzed by using OPSTAT. The average no. of defoliators and sucking pests were square root transformed by using the Poisson formula $\sqrt{X+0.5}$.

The Per cent reduction (PRC %) of insect pest population in treatments over control was estimated by using the formula given by Abbott (1).

$$\text{Population reduction Over control (\%)} = \frac{\text{Population in the untreated plot} - \text{population in the treated plot}}{\text{population in the untreated check}} \times 100$$

3. RESULTS AND DISCUSSION

3.1 Efficacy of different insecticidal treatments on leafhoppers, *Empoasca Kerri*

3.1.1 First spray

Data from the table suggests that the population of leafhoppers is uniformly distributed and found to be non significant among the treatments. The pre count was ranging from 3.00 to 3.67 leafhoppers/3 leaves. The spray of clothianidin @ 0.3g L^{-1} registered the least number of leafhoppers with 0.95 leafhoppers/3 leaves. Followed by afidopyropen @ 2ml L^{-1} with 1.06 leafhoppers/3 leaves and tolfenpyard @ 2.5ml L^{-1} with 1.24 leafhoppers/3 leaves. Further, the best treatments were tolfenpryad @ 2 ml L^{-1} (1.41 leafhoppers/3 leaves), tolfenpryad @ 1.5 ml L^{-1} (1.56 leafhoppers/3 leaves), sulfoxaflor @ 0.5ml L^{-1} (1.69 leafhoppers/3 leaves), thiamethoxam+ lamdacyhalothrin @ 0.4ml L^{-1} (1.93 leafhoppers/3 leaves). There was more survival of leafhoppers in the plots sprayed with spinetoram @ 0.5g L^{-1} with 2.09 leafhoppers/3 leaves according to the pooled mean observation on 1, 3, 5 and 7 days after the spray.

The per cent reduction over the control showed that clothianidin @ 0.3g L^{-1} with 77.5% was found to be effective on leafhoppers followed by afidopyropen @ 2ml L^{-1} (74.6%), tolfenpyard @ 2.5ml L^{-1} (67.9%), tolfenpryad @ 2 ml L^{-1} (64.1%), tolfenpryad @ 1.5 ml L^{-1} (59.1%), sulfoxaflor @ 0.5ml L^{-1} (57.1%), thiamethoxam+ lamdacyhalothrin @ 0.4ml L^{-1} (54.8%). Spinetoram @ 0.5g L^{-1} (46.6%) found to be less effective in the controlling leafhoppers (Table 1).

3.1.2 Second spray

The results from the efficacy of insecticides on the leafhoppers after the second spray resulted that there was no significant difference between the treatments one day before the spray. The treatment clothianidin @ 0.3g L^{-1} was found significantly superior among all the treatments in the suppression of the leafhoppers population with 0.70 leafhoppers/3 leaves. The next effective treatments were afidopyropen @ 2ml L^{-1} with 0.82 leafhoppers/3 leaves and tolfenpyard @ 2.5ml L^{-1} with 1.03 leafhoppers/3 leaves. Followed by the treatments tolfenpryad @ 2 ml L^{-1} (1.18 leafhoppers/3 leaves), tolfenpryad @ 1.5 ml L^{-1} (1.28 leafhoppers/3 leaves), sulfoxaflor @ 0.5ml L^{-1} (1.47 leafhoppers/3 leaves), thiamethoxam+ lamdacyhalothrin @ 0.4ml L^{-1} (1.63 leafhoppers/3 leaves). The population was more with 1.67 leafhoppers/3 leaves in the treatment spinetoram @ 0.5 g L^{-1} (Table 1).

The per cent reduction over the control revealed that clothianidin @ 0.3g L^{-1} was more effective with 85% in controlling leafhoppers population. The next best treatments were afidopyropen @ 2ml L^{-1} (82.5%) and tolfenpyard @ 2.5ml L^{-1} (77.5%) followed by tolfenpryad @ 2 ml L^{-1} (72.5%), tolfenpryad @ 1.5 ml L^{-1} (69.2%), sulfoxaflor @ 0.5g L^{-1} (65%), thiamethoxam+ lamdacyhalothrin @ 0.4ml L^{-1} (63.5%). The

effectiveness of spinetoram @ 0.5 g L^{-1} was less on the leafhoppers with 58.2%. The results are in accordance with Kadam *et al*. (4) the spray of clothianidin @ 20 g a.i ha^{-1} was found to be the most effective chemical on the suppression of sucking pests. Robert *et al*. (9) in his findings reported that the afidopyrofen was effective in sucking pests and it was found to be safer to the natural enemies. Pachundkar *et al.* (8) observed that the spray clothianidin @ (0.025%) showed a maximum efficacy in the reduction of the leafhoppers population.

From both sprays it is evident that a similar trend was noticed after 1, 3, 5 and 7 days after the spray of clothianidin @ 0.3g L^{-1} was superior when compared to other treatments. Further, the order of efficacy was afidopyropen @ 2ml L^{-1} and tolfenpryad @ 2 ml L^{-1}. Followed by tolfenpryad @ 2 ml L^{-1}, tolfenpryad @ 1.5 ml L^{-1}, sulfoxaflor @ 0.5ml L^{-1}, thiamethoxam+ lamdacyhalothrin @ 0.4ml L^{-1}. While the efficacy was comparatively less by the spray of spinetoram @ 0.5 g L^{-1} on the population of leafhoppers.

Table 1. Effect of different insecticides on the mean population of leafhoppers on groundnut

Treatments	Dosage	Mean population of leafhoppers/3leaves/plant													
		First spray							Second spray						
		Pre count	1 DAS	3 DAS	5 DAS	7 DAS	Pooled mean	PRC (%)	Pre count	1 DAS	3 DAS	5 DAS	7 DAS	Pooled mean	PRC (%)
Tolfenpyrad 15%EC	1.5 ml L^{-1}	3.00 (1.73)	1.67^{e} (1.30)	1.60^{d} (1.26)	1.57^{c} (1.25)	1.40^{c} (1.18)	1.56	59.1	2.43 (1.56)	1.33^{d} (1.15)	1.30^{d} (1.14)	1.27^{d} (1.17)	1.23^{d} (1.11)	1.28	69.2
Tolfenpyrad 15%EC	2 ml L^{-1}	3.30 (1.81)	1.50^{d} (1.22)	1.47^{c} (1.21)	1.43^{b} (1.19)	1.23^{c} (1.11)	1.41	64.1	2.31 (1.52)	1.27^{c} (1.17)	1.20^{d} (1.10)	1.13^{c} (1.05)	1.10^{c} (1.04)	1.18	72.5
Tolfenpyrad 15%EC	2.5 ml L^{-1}	3.03 (1.74)	1.33^{c} (1.14)	1.30^{b} (1.14)	1.23^{b} (1.11)	1.10^{c} (1.04)	1.24	67.9	2.37 (1.54)	1.13^{bc} (1.05)	1.10^{c} (1.05)	1.00^{b} (1.01)	0.90^{c} (0.94)	1.03	77.5
Spinetoram 11.7%SC	0.5 ml L^{-1}	3.10 (1.76)	2.40^{g} (1.54)	2.13^{f} (1.46)	2.00^{e} (1.41)	1.83^{e} (1.35)	2.09	46.6	2.53 (1.65)	2.26^{g} (1.50)	2.10^{g} (1.50)	1.72^{f} (1.31)	1.67^{g} (1.29)	1.67	58.2
Thiamethoxam 12.6+ Lamdacyhalothrin 9.5%ZC	0.4 ml L^{-1}	3.13 (1.76)	2.20^{f} (1.48)	2.06^{e} (1.43)	1.89^{d} (1.37)	1.55^{d} (1.24)	1.93	54.8	2.35 (1.53)	1.80^{f} (1.34)	1.65^{f} (1.34)	1.62^{e} (1.27)	1.46^{f} (1.21)	1.63	63.5
Clothianidin 50% WDG	0.3 g L^{-1}	3.37 (1.83)	1.10^{a} (1.04)	1.07^{a} (1.03)	0.87^{a} (0.93)	0.77^{a} (0.87)	0.95	77.5	2.43 (1.56)	0.83^{a} (0.91)	0.70^{a} (0.83)	0.67^{a} (0.80)	0.60^{a} (0.81)	0.70	85.0
Afidopyropen 50g/IDC	2 ml L^{-1}	3.67 (1.91)	1.23^{b} (1.12)	1.17^{b} (1.08)	0.97^{b} (0.98)	0.87^{b} (0.93)	1.06	74.6	2.37 (1.54)	0.97^{b} (0.99)	0.83^{b} (0.91)	0.77^{b} (0.87)	0.70^{b} (0.83)	0.82	82.5
Sulfoxaflor 21.89% SC	0.5 ml L^{-1}	3.50 (1.87)	1.83^{f} (1.35)	1.80^{d} (1.34)	1.67^{cd} (1.29)	1.47^{d} (1.21)	1.69	57.1	2.58 (1.65)	1.55^{e} (1.23)	1.50^{e} (1.23)	1.43^{d} (1.20)	1.40^{e} (1.18)	1.47	65.0
Control		3.07 (1.75)	3.10^{h} (1.74)	3.17^{g} (1.77)	3.30^{f} (1.81)	3.43^{f} (1.85)	3.25	-	2.41 (1.55)	2.57^{h} (1.60)	2.73^{h} (1.64)	2.87^{g} (1.68)	4.00^{h} (2.03)	3.04	-
SEm±		0.4	0.03	0.02	0.02	0.04	-	-	0.9	0.04	0.02	0.03	0.02	-	-
C.D. at 5%		N/S	0.11	0.10	0.10	0.15	-	-	N/S	0.15	0.10	0.11	0.10	-	-
C.V.		8.54	3.39	3.30	4.75	6.06	-	-	4.51	3.72	3.46	3.60	4.37	-	-

DAS- Days After Spraying
PRC- Per cent Reduction over Control
* Figures in parenthesis are square root transformed

3.2 Efficacy of different insecticidal treatments on thrips, S*cirtothrips dorsalis*

3.2.1 First spray

The results regarding the first spray is presented in (Table 2). The observation on the pre count was in the range of 5.11 to 5.24 thrips/plant, and found to be non significant among the treatments. The pooled mean results after 1, 3, 5, and 7 days of the spray revealed that there was a higher reduction in the population of thrips by the spray of clothianidin @ 0.3g L^{-1} with 1.08 thrips/plant. afidopyropen @ 2ml L^{-1} with 1.19 thrips/plant and tolfenpyard @ 2.5ml L^{-1} with 1.30 thrips/plant were found to be further effective treatments. Followed by tolfenpryad @ 2 ml L^{-1} (1.41 thrips/plant), tolfenpryad @ 1.5 ml L^{-1} (1.51 thrips/plant), sulfoxaflor @ 0.5ml L^{-1} (1.87 thrips/plant), thiamethoxam+ lamdacyhalothrin @ 0.4ml L^{-1} (2.58 thrips/plant) and spinetoram 0.5 g L^{-1} (3.06 thrips/plant).

The per cent reduction over the control was resulted that the spray of clothianidin @ 0.3g L^{-1} was superior among all the treatments in reducing the population of thrips with 85%. Followed by afidopyropen @ 2ml L^{-1} (83.3%), tolfenpyard @ 2.5ml L^{-1} (81.5%), tolfenpyard @ 2ml L^{-1} (79.5%), tolfenpryad @ 1.5 ml L^{-1} (78.3%), sulfoxaflor @ 0.5ml L^{-1} (74.1%), thiamethoxam+ lamdacyhalothrin @ 0.4ml L^{-1} (62.1%) and spinetoram 0.5 g L^{-1} (52.8%).

3.2.2 Second spray

The efficacy of different insecticides on the thrips during the second spray resulted that there was a population ranged between 4.21 to 5.25 thrips/plant during the pre count and treatments had no significant difference between them. The population of thrips was less in the plots sprayed with clothianidin 0.3g L^{-1} (1.01 thrips/plant). the next effective treatments were afidopyropen @ 2ml L^{-1} (1.28 thrips/plant) and tolfenpyard @ 2.5ml L^{-1} (1.45 thrips/plant), tolfenpyard @ 2 ml L^{-1} (1.58 thrips/plant). Followed by tolfenpryad @ 1.5 ml L^{-1} (1.74 thrips/plant), sulfoxaflor @ 0.5ml L^{-1} (1.91 thrips/plant) thiamethoxam+ lamdacyhalothrin @ 0.4ml L^{-1} (2.59 thrips/plant). Whereas spinetoram 0.5 g L^{-1} (2.94 thrips/plant) proved to be the least effective in the suppression of thrips population (Table 2).

The per cent reduction over control after the seventh day resulted that clothianidin 0.3g L^{-1} found to be effective over other treatments with a reduction of 88.6%. Followed by afidopyropen @ 2ml L^{-1} (82.1%), tolfenpyard @ 2.5ml L^{-1} (80.7%), tolfenpyard @ 2 ml L^{-1} (77.8%). Followed by tolfenpryad @ 1.5 ml L^{-1} (76.3%), sulfoxaflor @ 0.5ml L^{-1} (72.9%) thiamethoxam+ lamdacyhalothrin @ 0.4ml L^{-1} (67.5%). Spinetoram 0.5 g L^{-1} found less effective with 58.9%. The findings are in line with Duraimurugan and Alivelu (3) reported that the spray of clothianidin 50 WDG reduced the population of thrips on the castor crop. Sreenivas *et al*. (11) reported that clothianidin @ 60 g a.i. ha^{-1} found to be more effective on the suppression of thrips. Vijayaraghavan and Kavitha (12) reported that spraying of clothianidin 50 WDG was effective in treating sucking pests on the black gram. Kalyan *et al*. (6) reported that tolfenpyrad 15% EC at 125 and 150g a.i. ha^{-1} found superior in the controlling of sucking pests of cotton.

The overall effect of first and second spray resulted that the spray of clothianidin 0.3g L^{-1} was effective in controlling of thrips. Further, the next best treatments were afidopyropen @ 2ml L^{-1}, tolfenpyard @ 2.5ml L^{-1}, tolfenpyard @ 2 ml L^{-1}. Followed by tolfenpryad @ 1.5 ml L^{-1}, sulfoxaflor @ 0.5ml L^{-1}, thiamethoxam+ lamdacyhalothrin @ 0.4ml L^{-1}. However, the population of thrips was more in the plots sprayed with spinetoram 0.5 g L^{-1}.

Table 2. Effect of different insecticides on the mean population of thrips on groundnut

Treatments	Dosage	Mean population of thrips/plant													
		First spray							Second spray						
		Pre count	1 DAS	3 DAS	5 DAS	7 DAS	Pooled mean	PRC (%)	Pre count	1 DAS	3 DAS	5 DAS	7 DAS	Pooled mean	PRC (%)
Tolfenpyrad 15%EC	1.5 ml L^{-1}	5.24 (2.29)	1.70^{d} (1.30)	1.55^{c} (1.24)	1.50^{e} (1.21)	1.30^{d} (1.14)	1.51	78.3	4.23 (2.05)	1.83^{c} (1.35)	1.80^{c} (1.34)	1.73^{c} (1.31)	1.60^{c} (1.30)	1.74	76.3
Tolfenpyrad 15%EC	2 ml L^{-1}	5.11 (2.25)	1.53^{c} (1.23)	1.47^{c} (1.21)	1.40^{d} (1.18)	1.23^{d} (1.33)	1.41	79.5	4.31 (2.07)	1.67^{c} (1.29)	1.60^{c} (1.26)	1.55^{c} (1.23)	1.50^{c} (1.22)	1.58	77.8
Tolfenpyrad 15%EC	2.5 ml L^{-1}	5.20 (2.27)	1.40^{c} (1.18)	1.37^{c} (1.17)	1.33^{c} (1.15)	1.11^{c} (1.05)	1.30	81.5	4.21 (2.15)	1.60^{b} (1.26)	1.45^{c} (1.20)	1.43^{bc} (1.19)	1.30^{c} (1.14)	1.45	80.7
Spinetoram 11.7%SC	0.5 ml L^{-1}	5.10 (2.24)	3.26^{g} (1.80)	3.17^{e} (1.78)	2.97^{g} (1.72)	2.83^{f} (1.68)	3.06	52.8	5.25 (2.06)	3.17^{e} (1.78)	3.03^{f} (1.74)	2.78^{f} (1.66)	2.78^{e} (1.66)	2.94	58.9
Thiamethoxam 12.6+ Lamdacyhalotrin 9.5%ZC	0.4 ml L^{-1}	5.15 (2.27)	2.80^{f} (1.61)	2.70^{d} (1.64)	2.54^{f} (1.59)	2.27^{e} (1.50)	2.58	62.1	4.32 (2.19)	2.80^{d} (1.61)	2.77^{e} (1.66)	2.60^{ef} (1.61)	2.20^{de} (1.48)	2.59	67.5
Clothianidin 50% WDG	0.3 g L^{-1}	5.22 (2.28)	1.20^{a} (1.10)	1.13^{a} (1.12)	1.10^{a} (1.04)	0.90^{a} (0.94)	1.08	85.0	4.37 (2.09)	1.17^{a} (1.09)	1.10^{a} (1.04)	1.00^{a} (1.04)	0.77^{a} (0.87)	1.01	88.6
Afidopyropen 50g/IDC	2 ml L^{-1}	5.24 (2.29)	1.30^{b} (1.14)	1.25^{b} (1.14)	1.20^{b} (1.10)	1.00^{b} (1.01)	1.19	83.3	4.37 (2.05)	1.33^{b} (1.15)	1.30^{b} (1.14)	1.27^{b} (1.15)	1.21^{b} (1.11)	1.28	82.1
Sulfoxaflor 21.89% SC	0.5 ml L^{-1}	5.20 (2.27)	2.10^{e} (1.43)	2.00^{d} (1.41)	1.83^{e} (1.35)	1.55^{e} (1.24)	1.87	74.1	4.83 (2.08)	2.20^{d} (1.48)	2.13^{d} (1.46)	1.97^{cd} (1.41)	1.82^{d} (1.35)	1.91	73.1
Control		5.19 (2.27)	5.50^{g} (2.34)	5.70^{f} (2.38)	5.80^{h} (2.40)	6.00^{g} (2.44)	5.75	-	4.33 (2.23)	5.03^{f} (2.24)	6.33^{g} (2.60)	6.60^{g} (2.66)	6.77^{f} (2.70)	6.18	-
SEm±		0.18	0.10	0.11	0.8	0.7	-	-	0.12	0.07	0.05	0.12	0.08	-	-
C.D. at 5%		N/S	0.25	0.28	0.16	0.15	-	-	N/S	0.23	0.18	0.37	0.27	-	-
C.V.		4.21	8.02	6.43	3.73	4.03	-	-	2.05	5.39	4.44	8.91	6.95	-	-

DAS- Days After Spraying
PRC- Per cent Reduction over Control
* Figures in parenthesis are square root transformed

4. CONCLUSION

From the present study, it is concluded that the best treatment in controlling sucking pests (leafhoppers and thrips) was clothianidin @ 0.3g L^{-1} followed by afidopyropen @ 2ml L^{-1}, tolfenpyard @ 2.5ml L^{-1} when compared to other insecticides. While the per cent reduction of leafhoppers and thrips over control after the seventh day of treatment resulted that clothianidin 0.3g L^{-1} found to be effective over other treatments followed by afidopyropen @ 2ml L^{-1}, tolfenpyard @ 2.5ml L^{-1}.

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