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Bio-efficacy of different insecticides against thrips infesting groundnut (*Arachis hypogaea* L.)

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Abstract

A field experiment was conducted at Main Oilseeds Research Station, Junagadh Agricultural University, Junagadh during summer, 2022 & 2023 to check efficacy of different insecticides against thrips infesting groundnut (*Arachis hypogaea* L.). Among evaluated insecticides the treatment of spinetoram 11.7 SC; 0.012% recorded the lowest population (1.38 thrips/trifoliolate leaves/plant), which was found statistically at par with the treatment of spinosad 45 SC; 0.014% (1.63 thrips/trifoliolate leaves/plant) and cyantraniliprole 10.26 OD; 0.010% (1.78 thrips/trifoliolate leaves/plant) after 3 days of the first spray. A similar trend was seen after 7 and 10 days after first spray as well as 3, 7 and 10 days after second spray. The highest (2506 kg/ha) pod yield was recorded in the plots treated with spinetoram 11.7 SC at 0.012%. However, the highest 1:13.15 incremental cost-benefit ratio (ICBR) was obtained with thiamethoxam 12.6% + lambda-cyhalothrin 9.5% ZC at 0.007%.

Keywords: Evaluation, newer insecticides, summer, thrips and groundnut

Introduction

Groundnut or peanut *A. hypogaea* L. (Fab.) is a valuable cash crop for millions of small scale farmers in the semi-arid tropics and is the principal oilseed crop in India. The word groundnut (*A. hypogaea* Linn.) is derived from the Greek word “Arachis” meaning legume and “hypogaea” meaning below ground. It is commonly known as peanut, monkey-nut and goobernut. Groundnut is native to South America. The crop can be grown successfully in areas receiving rainfall from 600 mm to 1200 mm. The best soil for the groundnut crop is sandy loam, loamy and medium black Anonymous (1990) [1]. The plant suffers from the ravages of insect pests and a loss in production both in terms of quantity and quality. As many as 52 species of insect pests and two species of mites have been recorded infesting the groundnut crop in India Singh *et al.* (1990) [2]. Among these insect pests infesting groundnut crop in Gujarat, the thrips are considered a key pest. The important species include *Scirtothrips dorsalis* Hood, *Frankliniella shultzeri* Trybom and *Thrips palmi* Karny. The damage caused by thrips depends on the population of damaging stage of an insect, crop growth stage, cropping pattern in the area and prevailing environmental conditions Patel and Patel (1983) [3]. Thrips are known to transmit bud necrosis disease in groundnut, which has been widely reported from different states of India such as Tamil Nadu, Karnataka, Andhra Pradesh, Maharashtra, Gujarat, Rajasthan and Madhya Pradesh Amin (1984) [4]. The chemical management of insect-pests is most practiced by the groundnut farmers for the management of thrips. However, the continuous and indiscriminate use of insecticides has led to the development of resistance in thrips populations. In recent years, several new insecticide molecules and combination products have become available in the market. Therefore, it is necessary to evaluate the efficacy of these insecticides against thrips in groundnut.

Materials and Methods

A field experiment was conducted at Main Oilseeds Research Station, Junagadh Agricultural University, Junagadh during the summer, 2022 & 2023 to check the efficacy of different insecticides against thrips in summer groundnut using a Randomized Block Design (RBD) with three replications. The first spray of the respective insecticides was applied at the initiation of thrips infestation and second at 10 days after first spray.

The data on population of thrips were recorded on three trifoliolate leaves (top, middle and bottom canopy of the plants) per plant by randomly selecting five plants from each net plot. The pre-treatment observation was recorded at one day before spray and post treatment observations were recorded at 3, 7 and 10 days after each spray. Pod and haulm yield was recorded at harvest. Statistical analysis was carried out using ANOVA (Panse and Sukhatme, 1985) [5].

Results and Discussion

The population of thrips was found homogenous in all treatments before spray as treatment differences were non-significant (Table 1). The thrips population before spray ranged from 5.45 to 6.94 thrips/trifoliolate leaves/plant.

The population of thrips recorded after three days of spray, indicated that spinetoram 11.7 SC; 0.012% performed better than other insecticides and recorded the significantly lowest (1.36 thrips/trifoliolate leaves/plant) thrips population which was statistically at par with spinosad 45 SC; 0.014% (1.63 thrips/trifoliolate leaves/plant) and cyantraniliprole 10.26 OD; 0.010% (1.78 thrips/trifoliolate leaves/plant). The next better treatments were thiamethoxam 12.6 + lambda-cyhalothrin 9.5 ZC; 0.007%, pyriproxyfen 10 + bifenthrin 10 EC; 0.020% and imidacloprid 19.81 + beta-cyfluthrin 8.49 OD; 0.01% in which thrips populations were observed 2.63, 3.46 and 3.62 thrips/trifoliolate leaves/plant. More or less similar trend was observed after seven and ten days of first spray.

Pooled over period data of second spray (Table 3) indicated that the lowest (0.64 thrips/ trifoliolate leaves/plant) population of thrips was recorded in treatment of spinetoram 11.7 SC; 0.012% which was statistically at par with spinosad 45 SC; 0.014% (0.76 thrips/trifoliolate leaves/plant) and cyantraniliprole 10.26 OD; 0.010% (0.90 thrips/trifoliolate leaves/plant) after three days of second spray. The next treatment in the order of effectiveness was thiamethoxam 12.6 + lambda-cyhalothrin 9.5 ZC; 0.007%

(1.35 thrips/trifoliolate leaves/plant) pyriproxyfen 10 + bifenthrin 10 EC; 0.020% (1.39 thrips/trifoliolate leaves/plant) and imidacloprid 19.81 + beta-cyfluthrin 8.49 OD; 0.01% (1.49 thrips/trifoliolate leaves/plant). The treatment of afidopyropen 50 DC and lambda-cyhalothrin 5 EC remained least effective among all other insecticides evaluated which showed 2.05 and 2.27 thrips/trifoliolate leaves/plant, respectively. More or less similar trend was observed after seven and ten days of second spray.

The present finding is more or less in conformation with the reports of earlier workers who reported that spinosad 45% SC; 0.014% proved significantly more effective and recorded lowest thrips (0.79 thrips/trifoliolate leaves/plant) in groundnut Bhut *et al.* [6]. Spinosad 45% SC; 0.014% was most effective against chilli thrips Shinde *et al.* [7]. Spinosad 45 SC @ 200 ml /ha, thiamethoxam 25 WG @ 100 g /ha was very effective against thrips on groundnut at Kadiri Anonymous [8]. Application of spinetoram reduces the population density of *T. tabaci* infesting garlic plants and gave the highest yield Hussein *et al.* [9]. Treatment of spinosad 45 SC recorded a higher yield (t/ha) compared to the other treatments Patil *et al.* [10].

Yield and Economics

The pod and haulm yield in different insecticidal treatments varied from 1590 to 2600 kg/ha and 2621 to 3832 kg/ha, respectively (Table 4 and 5). The highest (2600 kg/ha) pod yield was recorded in the plot treated with spinetoram 11.7 SC; 0.012% and it was at par with spinosad 45 SC; 0.014% (2288 kg/ha) and cyantraniliprole 10.26 OD; 0.010% (2248 kg/ha). The highest (41255 Rs./ha) net realization was obtained in the treatment spinetoram 11.7 SC; 0.012% followed by spinosad 45 SC; 0.014% (31442 Rs./ha) and cyantraniliprole 10.26 OD; 0.010% (25213 Rs./ha) (Table 5).

Table 1: Effect of chemical insecticides against thrips in groundnut (After first spray)

Sr. No.	Treatments	No. of thrips/trifoliolate leaves/plant					
		Before spray			3 DAS		
		2022	2023	Pooled	2022	2023	Pooled
1	Cyantraniliprole 10.26 OD	2.63* (6.43)	2.82 (7.47)	2.73 (6.94)	1.43 ^d (1.55)	1.58 ^{de} (2.01)	1.51 ^d (1.78)
2	Spinosad 45 SC	2.77 (7.19)	2.73 (6.93)	2.75 (7.06)	1.39 ^d (1.43)	1.53 ^{de} (1.83)	1.46 ^d (1.63)
3	Spinetoram 11.7 SC	2.62 (6.36)	2.78 (7.23)	2.70 (6.79)	1.31 ^d (1.21)	1.42 ^e (1.53)	1.37 ^d (1.36)
4	Lambda-cyhalothrin 5 EC	2.66 (6.58)	2.68 (6.66)	2.67 (6.62)	2.19 ^{ab} (4.31)	2.26 ^{ab} (4.62)	2.23 ^{ab} (4.47)
5	Pyriproxyfen 10 + Bifenthrin 10 EC	2.61 (6.31)	2.66 (6.58)	2.64 (6.44)	1.95 ^{bc} (3.32)	2.03 ^{bc} (3.61)	1.99 ^{bc} (3.46)
6	Acephate 50 + Imidacloprid 1.8 SP	2.53 (5.92)	2.35 (5.01)	2.44 (5.45)	2.13 ^{ab} (4.05)	2.22 ^{ab} (4.44)	2.18 ^{ab} (4.25)
7	Afidopyropen 50 DC	2.49 (5.70)	2.77 (7.15)	2.63 (6.41)	2.16 ^{ab} (4.15)	2.25 ^{ab} (4.58)	2.21 ^{ab} (4.36)
8	Imidacloprid 19.81 + Beta-cyfluthrin 8.49 OD	2.59 (6.21)	2.67 (6.61)	2.63 (6.41)	1.99 ^{bc} (3.47)	2.07 ^{bc} (3.77)	2.03 ^{bc} (3.62)
9	Thiamethoxam 12.6 + Lambda-cyhalothrin 9.5 ZC	2.61 (6.33)	2.54 (5.97)	2.58 (6.15)	1.71 ^{cd} (2.44)	1.82 ^{cd} (2.82)	1.77 ^{cd} (2.63)
10	Control	2.62 (6.38)	2.61 (6.29)	2.62 (6.34)	2.40 ^a (5.28)	2.52 ^a (5.85)	2.46 ^a (5.56)
T	S. Em. ±	0.15	0.16	0.11	0.12	0.11	0.08
	C.D. at 5%	NS	NS	NS	0.37	0.34	0.24
Y x T	S. Em. ±	--	--	0.16	--	--	0.12
	C.D. at 5%	--	--	NS	--	--	NS
C.V.%		10.16	10.38	10.27	11.44	9.97	10.70

Figures in parenthesis are retransformed value, while outsides are square root transformed values; Treatment mean(s) with letter(s) in common are non-significant by DNMRT at 5% level of significance; NS: non-significant

Table 2: Effect of chemical insecticides against thrips in groundnut (After first spray)

Sr. No.	Treatments	No. of thrips/trifoliolate leaves/plant					
		7 DAS			10 DAS		
		2022	2023	Pooled	2022	2023	Pooled
1	Cyantraniliprole 10.26 OD	1.37 ^{de} (1.36)	1.44 ^{de} (1.56)	1.40 ^{de} (1.46)	1.22 ^{de} (0.99)	1.26 ^{de} (1.10)	1.24 ^{de} (1.04)
2	Spinosad 45 SC	1.27 ^{de} (1.10)	1.37 ^{de} (1.39)	1.32 ^{de} (1.24)	1.17 ^e (0.88)	1.19 ^{de} (0.91)	1.18 ^{de} (0.89)
3	Spinetoram 11.7 SC	1.17 ^e (0.88)	1.27 ^e (1.11)	1.22 ^e (0.99)	1.14 ^e (0.80)	1.09 ^e (0.70)	1.12 ^e (0.75)
4	Lambda-cyhalothrin 5 EC	1.75 ^{bc} (2.57)	2.15 ^{ab} (4.11)	1.95 ^{bc} (3.30)	1.75 ^b (2.57)	1.97 ^{ab} (3.39)	1.86 ^b (2.97)
5	Pyriproxyfen 10 + Bifenthrin 10 EC	1.95 ^b (3.32)	1.90 ^{bc} (3.12)	1.93 ^{bc} (3.22)	1.48 ^{bcd} (1.68)	1.76 ^{bc} (2.61)	1.62 ^{bc} (2.12)
6	Acephate 50 + Imidacloprid 1.8 SP	2.06 ^{ab} (3.76)	2.10 ^{ab} (3.92)	2.08 ^{ab} (3.84)	1.53 ^{bc} (1.83)	1.98 ^{ab} (3.42)	1.75 ^{bc} (2.57)
7	Afidopyropen 50 DC	2.11 ^{ab} (3.94)	2.15 ^{ab} (4.11)	2.13 ^{ab} (4.02)	1.65 ^{bc} (2.22)	2.02 ^{ab} (3.58)	1.84 ^b (2.87)
8	Imidacloprid 19.81 + Beta-cyfluthrin 8.49 OD	1.89 ^{bc} (3.07)	1.96 ^{bc} (3.33)	1.92 ^{bc} (3.20)	1.46 ^{cd} (1.62)	1.81 ^{bc} (2.78)	1.63 ^{bc} (2.17)
9	Thiamethoxam 12.6 + Lambda-cyhalothrin 9.5 ZC	1.56 ^{cd} (1.93)	1.68 ^{cd} (2.33)	1.62 ^{cd} (2.13)	1.43 ^{cde} (1.55)	1.54 ^{cd} (1.87)	1.49 ^{cd} (1.71)
10	Control	2.38 ^a (5.15)	2.43 ^a (5.40)	2.40 ^a (5.28)	2.32 ^a (4.87)	2.30 ^a (4.81)	2.31 ^a (4.84)
T	S. Em. ±	0.11	0.12	0.083	0.09	0.12	0.07
	C.D. at 5%	0.34	0.36	0.24	0.25	0.37	0.21
Y x T	S. Em. ±	--	--	0.12	--	--	0.11
	C.D. at 5%	--	--	NS	--	--	NS
C.V.%		11.28	11.23	11.25	9.81	12.62	11.47

Figures in parenthesis are retransformed value, while outsides are square root transformed values; Treatment mean(s) with letter(s) in common are non-significant by DNMRT at 5% level of significance; NS: non-significant

Table 3: Effect of insecticides against thrips in groundnut (After second spray)

Sr. No.	Treatments	No. of thrips/trifoliolate leaves/plant								
		3 DAS			7 DAS			10 DAS		
		2022	2023	Pooled	2022	2023	Pooled	2022	2023	Pooled
1	Cyantraniliprole 10.26 OD	1.17 ^{def} (0.86)	1.20 ^{def} (0.94)	1.18 ^{def} (0.90)	1.04 ^{de} (0.58)	1.13 ^{de} (0.78)	1.09 ^{def} (0.68)	0.99 ^{cd} (0.48)	1.10 ^{de} (0.70)	1.04 ^{cd} (0.59)
2	Spinosad 45 SC	1.11 ^{ef} (0.73)	1.14 ^{ef} (0.79)	1.12 ^{ef} (0.76)	1.06 ^{de} (0.63)	1.07 ^e (0.65)	1.07 ^{ef} (0.64)	0.98 ^{cd} (0.47)	1.04 ^e (0.57)	1.01 ^{cd} (0.52)
3	Spinetoram 11.7 SC	1.04 ^f (0.58)	1.09 ^f (0.70)	1.07 ^f (0.64)	0.96 ^e (0.42)	1.05 ^e (0.61)	1.01 ^f (0.51)	0.92 ^d (0.35)	1.01 ^e (0.53)	0.97 ^d (0.43)
4	Lambda-cyhalothrin 5 EC	1.64 ^b (2.19)	1.69 ^b (2.36)	1.67 ^b (2.27)	1.59 ^b (2.04)	1.66 ^b (2.27)	1.63 ^b (2.15)	1.49 ^b (1.72)	1.61 ^b (2.09)	1.55 ^b (1.90)
5	Pyriproxyfen 10 + Bifenthrin 10 EC	1.35 ^{cde} (1.32)	1.40 ^{cde} (1.45)	1.37 ^{cde} (1.39)	1.28 ^{bcd} (1.14)	1.35 ^{cde} (1.31)	1.31 ^{cdef} (1.22)	1.20 ^{bcd} (0.94)	1.29 ^{de} (1.17)	1.25 ^{bcd} (1.05)
6	Acephate 50 + Imidacloprid 1.8 SP	1.42 ^{bcd} (1.51)	1.47 ^{bcd} (1.65)	1.44 ^{bcd} (1.58)	1.35 ^{bcd} (1.33)	1.40 ^{bcd} (1.47)	1.38 ^{bcd} (1.40)	1.28 ^{bcd} (1.15)	1.36 ^{bcd} (1.35)	1.32 ^{bc} (1.25)
7	Afidopyropen 50 DC	1.58 ^{bc} (2.01)	1.61 ^{bc} (2.10)	1.60 ^{bc} (2.05)	1.44 ^{bc} (1.58)	1.60 ^{bc} (2.06)	1.52 ^{bc} (1.82)	1.31 ^{bc} (1.22)	1.57 ^{bc} (1.96)	1.44 ^b (1.57)
8	Imidacloprid 19.81 + Beta-cyfluthrin 8.49 OD	1.40 ^{bcd} (1.45)	1.42 ^{bcd} (1.53)	1.41 ^{bcd} (1.49)	1.34 ^{bcd} (1.29)	1.39 ^{bcd} (1.42)	1.36 ^{bcd} (1.35)	1.27 ^{bcd} (1.10)	1.34 ^{cd} (1.30)	1.31 ^{bc} (1.20)
9	Thiamethoxam 12.6 + Lambda-cyhalothrin 9.5 ZC	1.33 ^{cdef} (1.28)	1.39 ^{cde} (1.42)	1.36 ^{cdef} (1.35)	1.26 ^{cde} (1.09)	1.31 ^{cde} (1.22)	1.29 ^{cdef} (1.16)	1.21 ^{bcd} (0.97)	1.26 ^{de} (1.09)	1.24 ^{bcd} (1.03)
10	Control	2.27 ^a (4.64)	2.30 ^a (4.77)	2.28 ^a (4.71)	2.17 ^a (4.21)	2.27 ^a (4.67)	2.22 ^a (4.44)	2.09 ^a (3.88)	2.16 ^a (4.15)	2.13 ^a (4.02)
T	S. Em. ±	0.09	0.09	0.06	0.10	0.09	0.06	0.11	0.08	0.07
	C.D. at 5%	0.25	0.26	0.18	0.29	0.26	0.19	0.31	0.25	0.19
Y x T	S. Em. ±	--	--	0.09	--	--	0.09	--	--	0.09
	C.D. at 5%	--	--	NS	--	--	NS	--	--	NS
C.V.%		10.35	10.26	10.31	12.34	10.80	11.56	14.36	10.44	12.42

Figures in parenthesis are retransformed value, while outsides are square root transformed values; Treatment mean(s) with letter(s) in common are non-significant by DNMRT at 5% level of significance; NS: non-significant

Table 4: Effect of insecticides on pod and halum yield of groundnut

Sr. No.	Treatments	Pod yield (Kg/ha)			Halum yield (Kg/ha)		
		2022	2023	Pooled	2022	2023	Pooled
1	Cyantraniliprole 10.26 OD	2290 ^{ab}	2205 ^{ab}	2248 ^{ab}	3333 ^{abc}	3243 ^{abc}	3288 ^{abc}
2	Spinosad 45 SC	2327 ^{ab}	2248 ^{ab}	2288 ^{ab}	3587 ^{ab}	3502 ^{ab}	3544 ^{ab}
3	Spinetoram 11.7 SC	2695 ^a	2505 ^a	2600 ^a	3867 ^a	3797 ^a	3832 ^a
4	Lambda-cyhalothrin 5 EC	1720 ^c	1617 ^{cd}	1668 ^c	2735 ^{cd}	2698 ^{cd}	2717 ^{cd}
5	Pyriproxyfen 10 + Bifenthrin 10 EC	1977 ^{bc}	1900 ^{bcd}	1938 ^{bc}	3081 ^{bcd}	3039 ^{bcd}	3060 ^{bcd}
6	Acephate 50 + Imidacloprid 1.8 SP	1700 ^c	1637 ^{cd}	1668 ^c	2815 ^{cd}	2830 ^{cd}	2822 ^{cd}
7	Afidopyropen 50 DC	1803 ^c	1717 ^{cd}	1760 ^c	2855 ^{cd}	2812 ^{cd}	2833 ^{cd}
8	Imidacloprid 19.81 + Beta-cyfluthrin 8.49 OD	2010 ^{bc}	1940 ^{bc}	1975 ^{bc}	3141 ^{bcd}	3085 ^{bcd}	3113 ^{bcd}
9	Thiamethoxam 12.6 + Lambda-cyhalothrin 9.5 ZC	2050 ^{bc}	1950 ^{bc}	2000 ^{bc}	3179 ^{bcd}	3112 ^{bcd}	3145 ^{bcd}
10	Control	1663 ^c	1517 ^d	1590 ^c	2643 ^d	2598 ^d	2621 ^d
S. Em. ±		129.97	115.25	86.86	201.72	178.614	134.72
C.D. at 5%		386.19	342.44	249.33	599.37	530.7091	386.72
C.V.%		11.13	10.38	10.78	11.19	10.07	10.65
Treatment mean (s) with letter(s) in common are non-significant by DNMRT at 5% level of significance							

Table 5: Economics of insecticides against thrips in groundnut

Sr. No.	Treatment	Yield (kg/ha)		Yield increased over control (kg/ha)		Additional income (Rs) (From column No.4)	Cost of treatment (Pesticides, labour charge etc.) (Rs/ha)	Net realization (Rs)	ICBR
		3	4	Pod	Haulm				
1	2	Pod	Haulm	Pod	Haulm	5	6	7 (5-6)	8 (5/6)
1	Cyantraniliprole 10.26 OD	2248	3288	658	668	36213	11000.00	25213	1: 3.29
2	Spinosad 45 SC	2288	3544	698	923	39492	8050.00	31442	1: 4.91
3	Spinetoram 11.7 SC	2600	3832	1010	1211	56555	15300.00	41255	1: 3.70
4	Lambda-cyhalothrin 5 EC	1668	2717	78	96	4395	1350.00	3045	1: 3.26
5	Pyriproxyfen 10 + Bifenthrin 10 EC	1938	3060	348	439	19614	3000.00	16614	1: 6.54
6	Acephate 50 + Imidacloprid 1.8 SP	1668	2822	78	202	4924	2460.00	2464	1: 2.00
7	Afidopyropen 50 DC	1760	2833	170	213	9563	8400.00	1163	1: 1.14
8	Imidacloprid 19.81 + Beta-cyfluthrin 8.49 OD	1975	3113	385	492	21710	1720.00	19990	1: 12.62
9	Thiamethoxam 12.6 + Lambda-cyhalothrin 9.5 ZC	2000	3145	410	525	23123	1759.00	21364	1: 13.15
10	Control	1590	2621	--	--	--	--	--	--
Note:									
	1.	Quantity of water: 500 l/ha							
	2.	Price of Groundnut pod: Rs 50/kg							
	3.	Price of Groundnut haulm: Rs 5/kg							
	4.	Labourer charges for spray: Rs 500/ha							

Conclusion

Among the evaluated insecticides, the treatments spinetoram 11.7 SC; 0.012%, spinosad 45 SC; 0.014% and cyantraniliprole 10.26 OD; 0.010% were found to be the most effective and economical insecticides for management of thrips in groundnut. The highest (2600 kg/ha) pod yield was recorded in the plot treated with spinetoram 11.7 SC; 0.012% and it was at par with spinosad 45 SC; 0.014% (2288 kg/ha) and cyantraniliprole 10.26 OD; 0.010% (2248 kg/ha). The lowest ICBR was observed in Afidopyropen 50 DC; 0.10% (1: 1.14) followed by Acephate 50 + Imidacloprid 1.8 SP; 0.10% (1: 2.00).

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