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RESEARCH PAPER

New insecticide molecule to manage groundnut leaf miner *Aproaerema modicella* (Deventer)

M. U. ANUSHA AND ROOPA S. PATIL

Department of Agricultural Entomology, College of Agriculture, Dharwad
University of Agricultural Sciences, Dharwad - 580 005, Karnataka, India
E-mail: anushahebbar1996@gmail.com

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Abstract: Field experiment was conducted to evaluate the new insecticide molecules against groundnut leaf miner *Aproaerema modicella* (Deventer) at Agricultural Research Station, Kumta, Uttara Kannada district of Karnataka state during *rabi*/ summer season of 2018-19. Among the new insecticide molecule tested, minimum mean larval population of 0.70 and 0.57 larvae/plant with maximum reduction of 78.65 and 78.49 per cent over control was recorded in chlorantraniliprole 18.5 SC @ 0.2 ml/l treated plot followed by spinosad 45 SC @ 0.12 ml/l with mean larval population of 0.96 and 0.70 larvae/plant with reduction of 70.73 and 73.58 per cent over control, in first and second spray, respectively. Whereas, maximum mean larval population of 1.94 and 1.31 larvae/plant with minimum reduction of 40.85 and 50.56 per cent over control was recorded in botanicals azadirchtin 10,000 ppm treated plot. Chlorantraniliprole 18.5 SC recorded highest yield and net return of 28.17q/ha and Rs. 71,144/ha while it was 15.56q/ha and Rs. 12,702/ha respectively in untreated plot.

Keywords: Groundnut, Larval population, Leaf miner, Spray

Introduction

Groundnut (*Arachis hypogaea* L.) is an important oilseed crop in the world and called as king of oilseeds. Groundnut is native to South America and is cultivated in over 100 countries. In the world, China is the leading producer followed by India. The area under groundnut in India is 4.5 m ha with the production of 6.7 m t, which accounts for productivity of 1,465 kg per ha (Anon., 2017). Karnataka stands 5th in area of 0.6 m ha, production of 0.4 m t and productivity of 629 kg per ha (Anon., 2017). In coastal Karnataka, groundnut is cultivated in Uttara Kannada, Udupi and Dakshina Kannada district as *rabi*/summer crop. The crop is sown immediately after the harvest of paddy on assured residual soil moisture throughout the growing period. In Uttara Kannada district, area under groundnut crop was 5,800 ha in the year 2008-09 and has decreased drastically to 832 ha in 2018-19 (Anon., 2019). Among the biotic stresses, insect pests are known to inflict considerable loss in pod yield. More than 100 species of insects and mites are known to attack groundnut (Nandagopal, 1992).

In India groundnut leaf miner is a serious pest on groundnut both in rainy and post rainy season. It is an oligophagous pest when feeds on groundnut, soybean and other leguminous host plants (Reddy, 1988). Under severe infestation yield loss can reach upto 76 per cent (Anon., 1986). Many new insecticide molecules with different mode of action have been developed which are having high bioefficacy, selectivity and very less mammalian toxicity. These recent molecules are used at lower rate which inturn reduces the resistance development, have less residual effect and safer to environment (Mandeep *et al.*, 2018). The present study is carried out in the coastal belt (Kumta) of Uttara Kannada to evaluate efficacy of the new insecticide molecules against groundnut leaf miner *A. modicella*.

Material and methods

A field experiment was conducted during *rabi*/summer of 2018-19 at Agricultural Research Station, Kumta Uttara Kannada district of Karnataka state. The experiment was laid out using Randomised Block Design (RBD) with eight treatments and three replications inclusive of untreated check. The variety G-2-52 was sown in plots of size 3.0 × 3.0 m with spacing of 30 × 10 cm. The sowing was carried out during last week of December 2018. The entire dose of fertilizer was applied as basal through placement in the furrows. The recommended package of practice was followed except for plant protection measures. Spraying was carried out twice at 45 and 65 days after sowing. The observation on larval population reduction was recorded on randomly selected 10 plants in all treatments at one day before spray and followed by 1, 3, 5, 7 and 15 days after spray. Reduction in larval population over untreated check was calculated by the formula

$$\text{Per cent reduction over control} = \frac{\text{Larval population in control-larval population in treatment}}{\text{Larval population in control}} \times 100$$

At maturity, pod and haulm weight was recorded. The plot wise yield was computed on hectare basis for statistical interpretations. The economics of different treatments was worked out based on the pod and haulm yield and cost of protection. The data in numbers were transformed to $\sqrt{x + 0.5}$ values and subjected to one-way ANOVA. Statistical differences among the means were assessed by DMRT P=0.05. The pod and haulm yield obtained from each treatment were subjected to statistical analysis. Based on the yield data, the gross and net returns were calculated for each treatment.

Results and discussion

The efficacy of insecticides on larval population is presented in Table 1 and 2. The population of leaf miner one day before imposition of spray ranged from 3.20 to 3.50 larvae per plant in all the plots including untreated check and was statistically at par with each other. One day after the spray, significant differences in larval population was observed and ranged from 0.73 to 3.30 larvae per plant and the lowest population was recorded in chlorantraniliprole 18.5 SC treated plot which was on par with spinosad 45 EC (1.20 larvae/plant) and profenophos 50 EC (1.70 larvae/plant). At three days after spray lowest population of 0.53 larvae per plant recorded in chlorantraniliprole 18.5 SC treated plot which was on par with spinosad 45 EC and flubendiamide 480 SC with population of 0.83 and 0.97 larvae per plant, respectively. At 5 days after spray low population of 0.33 and 0.50 larvae per plant was recorded in chlorantraniliprole 18.5 SC and spinosad 45 EC treated plot respectively whereas highest population of 1.67 larvae per plant was recorded in Azadirachtin 10,000 ppm treated plot. After 7 days of spray, similar trend of larval population was observed. Observations recorded at 15 days after spray on larval population ranged from 1.67 to 2.83 larvae per plant, the lowest population of 1.67 larvae per plant recorded in chlorantraniliprole 18.5 SC treated plot.

The mean larval population among treatments varied from 0.70 to 1.94 larvae per plant and the lowest larval population was recorded chlorantraniliprole 18.5 SC treated plot (0.70 larvae/ plant) followed by spinosad 45 SC (0.96 larvae/plant). Per cent reduction over control was maximum in chlorantraniliprole 18.5 SC (78.65 %) followed by spinosad 45 SC (70.73 %) and the lowest of 40.85 per cent reduction was recorded in azadirachtin 10,000 ppm treated plot.

One day before, second spray population ranged from 2.37 to 2.60 larvae per plant which was statistically at par with each other. One day after spray, lowest population was recorded in chlorantraniliprole 18.5 SC, spinosad 45 SC and flubendiamide 480 SC treated plot with 0.70, 0.77 and 0.90 larvae per plant, respectively. Three days after spray, lowest population of 0.47 larvae per plant recorded in chlorantraniliprole 18.5 SC and highest of 1.30 larvae per plant in azadirachtin 10,000 ppm treated plot. After 5 days lowest population of 0.40 larvae per plant recorded in chlorantraniliprole 18.5 SC treated plot which was on par with spinosad 45 SC and flubendiamide 480 SC which recorded 0.50 and 0.63 larvae per plant, respectively. Almost similar trend was followed at 7 and 15 days after spray with lowest population recorded in chlorantraniliprole 18.5 SC treated plot which was on par with spinosad 45 SC. whereas, the maximum larval population was recorded in azadirachtin 10,000 ppm treated plot.

The mean larval population ranged from 0.57 to 2.65 larvae per plant. The reduction in larval population over control followed same trend as noticed in the first spray and maximum of 78.49 per cent was recorded in chlorantraniliprole 18.5 SC treated plot which was followed by spinosad 45 SC and flubendiamide 480 SC treated plot with 73.58 and 69.43 per cent reduction over control. The lowest per cent reduction over control was recorded in azadirachtin 10,000 ppm treated plot. The present findings are supported by Gadad and Hegde (2014) who reported that spinosad was superior in reducing leaf miner larva. Similarly, the experiment conducted at Vridhachalam revealed spinosad 48 SC was found superior in reducing per cent defoliation due to leaf miner (Anon., 2015). The efficacy of flubendiamide is in accordance with Kumar (2015) who reported flubendiamide was superior in reducing leaf miner population with 95.9 per cent reduction over control. Whereas it is in contrary with findings of Praveena (2010) who documented that flubendiamide (37.62 %) was not effective in reducing leaf miner population.

Table 1. Bioefficacy of new insecticide molecules on groundnut leaf miner (First spray)

Sl. No.	Treatments	1 DBSlarvae /plant	Larval population per plant					Mean	Per cent reduction over control
			1 DAS	3DAS	5DAS	7 DAS	15 DAS		
1	Azadirchtin 10,000 ppm (1 ml)	3.30 (1.94)^{a}	2.23 (1.65)^{ab}	1.83 (1.52)^{d}	1.67 (1.47)^{e}	1.57 (1.43)^{d}	2.40 (1.70)^{bc}	1.94	40.85
2	Chlorantraniliprole 18.5 SC (0.2 ml)	3.33 (1.96)^{a}	0.73 (1.11)^{a}	0.53 (1.01)^{a}	0.33 (0.91)^{a}	0.23 (0.85)^{a}	1.67 (1.47)^{a}	0.70	78.65
3	Spinosad 45 EC (0.12 ml)	3.43 (1.98)^{a}	1.20 (1.30)^{a}	0.83 (1.15)^{ab}	0.50 (0.99)^{ab}	0.37 (0.93)^{ab}	1.90 (1.55)^{ab}	0.96	70.73
4	Flubendiamide 480 SC (0.2 ml)	3.20 (1.92)^{a}	1.17 (1.50)^{ab}	0.97 (1.21)^{abc}	0.73 (1.11)^{bc}	0.63 (1.06)^{b}	1.87 (1.54)^{ab}	1.07	67.37
5	Emamectin benzoate 5 SG (0.2 g)	3.30 (1.95)^{a}	1.90 (1.48)^{ab}	1.60 (1.45)^{d}	1.47 (1.40)^{e}	1.37 (1.36)^{d}	2.20 (1.64)^{abc}	1.71	47.86
6	Novaluron 10 EC (1 ml)	3.50 (2.00)^{a}	1.77 (1.55)^{ab}	1.50 (1.41)^{cd}	1.23 (1.31)^{de}	1.10 (1.26)^{cd}	2.20 (1.64)^{abc}	1.56	52.43
7	Profenophos 50 EC (2 ml)	3.47 (1.99)^{a}	1.70 (1.29)^{a}	1.33 (1.35)^{bcd}	0.97 (1.21)^{cd}	0.77 (1.12)^{bc}	2.07 (1.60)^{ab}	1.37	58.23
8	Untreated control	3.20 (1.92)^{a}	3.30 (1.95)^{b}	3.40 (1.97)^{e}	3.40 (1.97)^{f}	3.47 (1.99)^{e}	2.83 (1.83)^{c}	3.28	-
	S.Em.±	0.06	0.10	0.07	0.06	0.06	0.06		
	C.D. (5%)	NS	0.31	0.20	0.18	0.19	0.19		
	CV (%)	6.14	10.80	8.23	8.01	8.54	6.72		

DAS- days after spraying DBS- day before spray NS- non significant Figures in the parenthesis are $\sqrt{(x + 0.5)}$ transformed values
Means followed by the same letters in the column are not significantly different by DMRT (P=0.05)

Table 2. Bioefficacy of new insecticide molecules on groundnut leaf miner (Second spray)

Sl. No.	Treatments	1 DBS larvae/ plant	Larval population per plant					Mean	Per cent reduction over control
			1DAS	3DAS	5DAS	7 DAS	15 DAS		
1	Azadirchtin 10,000 ppm (1 ml)	2.57 $(1.75)^{a}$	1.50 $(1.41)^{d}$	1.30 $(1.34)^{e}$	1.13 $(1.27)^{d}$	1.03 $(1.24)^{d}$	1.60 $(1.45)^{d}$	1.31	50.56
2	Chlorantraniliprole 18.5 SC (0.2 ml)	2.37 $(1.69)^{a}$	0.70 $(1.09)^{a}$	0.47 $(0.98)^{a}$	0.40 $(0.94)^{a}$	0.27 $(0.86)^{a}$	1.03 $(1.24)^{a}$	0.57	78.49
3	Spinosad 45 EC (0.12 ml)	2.40 $(1.70)^{a}$	0.77 $(1.12)^{a}$	0.63 $(1.06)^{b}$	0.50 $(0.99)^{ab}$	0.40 $(0.94)^{ab}$	1.20 $(1.30)^{ab}$	0.70	73.58
4	Flubendiamide 480 SC (0.2 ml)	2.47 $(1.72)^{a}$	0.90 $(1.18)^{ab}$	0.73 $(1.11)^{bc}$	0.63 $(1.06)^{abc}$	0.53 $(1.01)^{bc}$	1.27 $(1.33)^{abc}$	0.81	69.43
5	Emamectin benzoate 5 SG (0.2 g)	2.53 $(1.74)^{a}$	1.27 $(1.33)^{cd}$	1.00 $(1.22)^{d}$	0.90 $(1.18)^{dc}$	0.77 $(1.12)^{cd}$	1.53 $(1.42)^{cd}$	1.09	58.86
7	Novaluron 10 EC (1 ml)	2.53 $(1.74)^{a}$	1.17 $(1.29)^{c}$	0.90 $(1.18)^{cd}$	0.80 $(1.14)^{c}$	0.70 $(1.09)^{c}$	1.47 $(1.40)^{bcd}$	1.01	61.88
6	Profenophos 50 EC (2 ml)	2.50 $(1.73)^{a}$	1.03 $(1.23)^{bc}$	0.80 $(1.14)^{bcd}$	0.73 $(1.11)^{bc}$	0.63 $(1.06)^{bc}$	1.37 $(1.36)^{bc}$	0.91	65.66
8	Untreated control	2.60 $(1.76)^{a}$	2.67 $(1.78)^{e}$	2.73 $(1.80)^{f}$	2.70 $(1.79)^{e}$	2.73 $(1.80)^{e}$	2.43 $(1.71)^{e}$	2.65	-
	S.Em.±	0.09	0.06	0.06	0.06	0.08	0.08		
	CV (%)	6.51	8.02	8.29	8.83	12.08	9.31		
	C.D. (5%)	0.28	0.18	0.18	0.18	0.24	0.23		

DAS- days after spraying DBS- day before spray NS- non significant Figures in the parenthesis are $\sqrt{(x + 0.5)}$ transformed values
Means followed by the same letters in the column are not significantly different by DMRT (P=0.05)

Table 3. Yield and cost economics

Sl. No.	Treatment	Pod yield (q/ha)	Haulm yield (t/ha)	Gross income from pod yield(₹/ha)	Gross income from haulm yield (₹/ha)	Gross return (₹/ha)	Total cost of cultivation (₹/ha)	Net return (₹/ha)
1	Azadirchtin 10,000 ppm	17.78^{ef}	2.47^{d}	83484	247	83731	60607	23124
2	Chlorantraniliprole 18.5 SC	28.15^{a}	3.60^{a}	132183	360	132544	61400	71144
3	Spinosad 45 EC	26.04^{ab}	3.57^{a}	122269	357	122627	60500	62127
4	Flubendiamide 480 SC	25.19^{abc}	3.42^{ab}	118269	342	118611	61300	57311
5	Emamectin benzoate 5 SG	19.63^{def}	2.71^{cd}	92180	271	92452	60670	31782
6	Profenophos 50 EC	23.67^{bcd}	3.23^{abc}	111138	323	111462	60700	50762
7	Novaluron 10 EC	21.11^{cde}	2.83^{bcd}	99137	283	99421	61500	37921
8	Untreated control	15.56^{f}	1.53^{e}	73048	153	73202	60500	12702
	S.Em.±	1.36	0.21					
	C.D.	4.12	0.64					
	CV (%)	10.64	12.48					

Means followed by same letters in the column are not statistically different by DMRT (p=0.05)

The highest yield was obtained in chlorantraniliprole 18.5 SC treated plot with 28.15 q per ha which was followed by spinosad 45 SC and flubendiamide 480 SC recorded 26.04 and 25.19 q per ha. The lowest of 17.78 q per ha was recorded in azadirachtin 10,000 ppm treated plot. The increased yield in spinosad 45 SC treated plot are in line with the findings of Gadad and Hegde (2014), who recorded highest yield of 31.39 q per ha. The higher yields in case of flubendiamide 480 SC treatment are similar with the reports of Kumar (2015) and studies conducted at Vridhachalam on groundnut (Anon., 2018) who documented maximum yield of 1,155.1 and 1,733.3 kg per ha in flubendiamide treated plot. The haulm yield among treatments ranged from 1.53 to 3.60 t per ha which correspond to untreated control and chlorantraniliprole 18.5 SC treated plot. The highest net return of ₹ 71,114 per ha was recorded in chlorantraniliprole 18.5 SC treated plot followed by spinosad 45 SC and flubendiamide 480 SC with ₹ 62,127 and ₹ 57,311 per ha respectively. The lowest net return of ₹ 23,124 per ha was recorded in azadirachtin 10,000 ppm treated plot.

Conclusion

From the results of the experiment it is evident that chlorantraniliprole 18.5 SC was superior insecticide among the treated insecticides and recorded highest reduction in larval population of 78 per cent in both sprays with highest pod yield of 28.15 q per ha and net return of ₹ 71,144 per ha. Spinosad 45 EC was next best insecticide with 70.73 per cent and 73.58 per cent reduction in larval population in first and second spray respectively, with pod yield of 26.04 q per ha and net return of ₹ 62,127 per ha. Hence, both these chemicals are effective in reducing groundnut leaf miner population.

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