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EFFECT OF DIFFERENT INSECTICIDAL TREATMENTS ON LEAF MINER (*Aproaerema modicella*), BIHAR HAIRY CATERPILLAR (*Spilosoma obliqua*), Groundnut (*Arachis hypogaea*)

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ABSTRACT

A field experiment was conducted during the pre-summer season of 2016 on groundnut at the agricultural research farm, Institute of Agriculture, Visva-Bharati, Birbhum, West Bengal with the objectives to evaluate some newer pesticide molecule against the two important insect-pests infesting groundnut i.e. leaf miner (*Aproaerema modicella*) and bihar hairy caterpillar (S*pilosoma obliqua*). The experiment was conducted taking seven insecticidal treatments including Imidacloprid 17.8% SL, Diafenthiuron 50%WP, Diflubenzuron 25%WP, Acephate 50% + imidacloprid 1.8% SP, Lambda Cyhalothrin 5% EC, Quinalphos 25% EC and Chlorpyriphos 20% EC. and an untreated check. It was revealed that incidence of leaf miner (*Aproaerema modicella*) and bihar hairy caterpillar (S*pilosoma obliqua*) was prevalent at early growth phase and flowering to pod maturity stages of the crop growth respectively. Highest efficacy against leaf miner was observed by spraying with Acephate 50% + imidacloprid 1.8% SP (@1000g/ha) followed by Quinalphos 25% EC, both insecticides giving 88% reduction in leaf miner population after 10 day of spraying. The next order of insecticidal efficacy were recorded as Chlorpyriphos 20% EC (@ 1000ml/ha) >Lambda Cyhalothrin 5% EC (@300ml/ha), Diflubenzuron 25%WP(@ 300g/ha), and Diafenthiuron 50%WP (@600g/ha). While, Diflubenzuron 25%WP and Lambda Cyhalothrin 5% EC gave more efficacy against reduction in bihar hairy caterpillar population. The maximum yield 15.33q/ha was obtained from Acephate 50% + imidacloprid 1.8% SP (@1000g/ha) as compared to other treatments. The highest benefit: cost ratio (1.14:1) as well as profit was obtained from the treatment with Acephate 50% +Imidacloprid 1.8% SP.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is a leading oilseed crop in India and an important oilseed crop of tropical and sub-tropical region of the world. In India during 2015 groundnut crop was grown on 37.054 lakh hectares area with 57.289 lakh tons of production and 1546 kg per hectare productivity (Annual groundnut report, 2015). Among the several factors responsible for low productivity in groundnut, the biggest threat to groundnut cultivation is the vulnerable and wide spread infestation by insect pests. The important insect pests causing damage to the crop are leaf miner (*Aproaerema modicella* Deventer), Bihar hairy caterpillar (S*pilosoma obliqua*), Tobacco caterpillar (*Spodoptera litura* Fab), aphid (*Aphis craccivora* Koch), thrips (*Thrips palmi*Karni*)*, *Scirtothrips dorsalis* H., *Caliothrips indicus*], jassids (*Empoasca kerri* Pruthi) and white flies (*Bemisia tabaci…….*). The extent of losses incurred by various insect-pests *viz*., leaf miner, tobacco leaf eating caterpillar, aphids, thrips and jassids were 24 to 92, 13 to 71, 16 to 42, 17 to 40 and 9 to 22 per cent, respectively in groundnut (Amin, 1987). Various methods have been tried for the control of insect-pests of groundnut but use of chemical method has proved to be an important approach for their control because of its quick action, effectiveness and adaptability to various situations. Several insecticides have been recommended and used for the effective management of groundnut insect-pests. But according to several reports many of these label claimed insecticides could not achieve effective results. Hence this experiment has been worked out to evaluate the effect of some new insecticides along with the conventional insecticides against the two most dreaded pest of groundnut i.e. leaf miner and Bihar hairy caterpillar. An attempt has also been

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made to study the effect of different insecticidal treatments on the yield of groundnut thereby assessing the benefit: cost ratio.

MATERIAL AND METHODS

The field experiment was conducted at the Institute of Agriculture (Palli Siksha Bhavana) farm, Visva-Bharati, West Bengal, during pre-summer season of 2016. This farm is situated at $23^0$39′ North latitude and $87^0$42′ East longitude and 58.90m above the main sea level. The soil of the experimental site was sandy loam in texture with high percent of sand and low percent of clay and dry sub-humid and subtropical climate. The soil was acidic in nature with pH range 5.1- 6.1. The weather conditions during the period of investigation is characterized by the temperature range of maximum 35.31-42.32^{0}C and minimum20.19-26.42^{0}C and maximum RH 42.42-87.14%, rainfall 0.04-7.22 mm and sunshine hour 4.1 to 9.64 hr during crop growth period. The experiment was laid out in Randomized Block Design (RBD) with eight treatments including control and each treatment was replicated three times. The control plot was sprayed with water. The experimental plot was 4m x 3m size and the crop was grown on a row spacing of 30cm. Attempts were made to evaluate the effect of different insecticidal treatments on leaf miner (*Aproaerema modicella*) and bihar hairy caterpillar (S*pilosoma obliqua*) of groundnut. Ten plants were selected randomly from each plot for taking the observation of insect pest viz. leaf miner and bihar hairy caterpillar (S*pilosoma obliqua*). Incidence of leaf miner *A. modicella* and bihar hairy caterpillar S*pilosoma obliqua*were assessed in terms of larvae present on 10 plants in each plot. The spraying on crop for testing efficacy of different pesticide formulations was initiated with the incidence of the pest. Spraying with insecticides were done using knapsack sprayer after the incidence of the two pests respectively. The different insecticidal treatments comprised of Imidacloprid 17.8% SL, Diafenthiuron 50%WP, Diflubenzuron 25%WP, Acephate 50% + imidacloprid 1.8% SP, Lambda Cyhalothrin 5% EC, Quinalphos 25% EC and Chlorpyriphos 20% EC. The population of leaf miner and bihar hairy caterpillar (S*pilosoma obliqua*) were recorded before and 3, 7, and 10 days after treatment imposition. Data thus obtain were analyzed in computer by using OPSTAT & SPSS package. Transformations of insect data were made where necessary. Population reduction over control was worked by a procedure as laid by out by Henderson –Tilton's formula.The data on yield was also recorded and benefit cost ration thereby calculated.

RESULT AND DISCUSSION

Evaluation of some synthetic insecticide against the pests of groundnut

The experiment was done to evaluate a group of synthetic insecticides against the important insect-pests infesting groundnut mainly caterpillar Caterpillar and Leaf miner. The different insecticides evaluated were Imidacloprid 17.8% SL, Diafenthiuron 50%WP, Diflubenzuron 25%WP, Acephate 50% + imidacloprid 1.8% SP, Lambda Cyhalothrin 5% EC, Quinalphos 25% EC and Chlorpyriphos 20% EC. An untreated control was maintained as check. The treatment Chlorpyriphos 20% EC was treated as farmers recommended practice which was also evaluated against all the above mentioned insecticides.

Effect of different insecticidal treatments on leaf miner (Aproaerema modicella)

The results of this investigation as depicted in Table 1 and 2 revealed that among the seven insecticides tested, all the insecticides have registered fairly high level of larval mortality except the untreated check. The highest efficacy was observed in spraying with both Acephate 50% + imidacloprid 1.8% SP (@1000g/ha) and Quinalphos 25%EC (@1250ml/ha) which were also at par with each other. Both insecticides gave 85% reduction in leaf miner population after 10 day of spraying. The next order of efficacy were recorded as Chlorpyriphos 20% EC (@ 1000ml/ha) >Lambda Cyhalothrin 5% EC (@300ml/ha), Diflubenzuron 25%WP(@ 300g/ha), and Diafenthiuron 50%WP (@600g/ha), which ultimately provided an overall efficacy of 83%, 82%, 81%, and 47% reduction in population leaf miner respectively. Analysis of variance also showed that the interaction between and days after spraying also very significant. This observation suggested that the efficacy of different pesticide molecule differ with that of duration of exposure after spraying. A significant reduction in population was noticed at 3 DAT in all the treatments as compared to the untreated check. The efficacy of imidacloprid was found effective against leaf miner on groundnut which was in agreement with the findings of Ramesh Babu *et al*. (2002). He suggested that population ranged from 1.25 to 4.00 per 5 plants in imidacloprid treatments, 3.75 and 3.00 per 5 plants in the standards dimethoate and methyl-o-demeton treatment respectively. Imidacloprid at 150, 200 and 250 ml/ha recorded significantly lower larval population at 7, 14 and 21 DAT and were superior to the other treatments. Similar result was also reported by A. Pavviya and N. Muthukrishnan (2016).

Effect of different insecticidal treatment on bihar hairy caterpillar (Spilosoma obliqua)-Table-3 represents the efficacy of different synthetic insecticides against Bihar Hairy Caterpillar of groundnut. All the chemical formulations tested were found significantly effective as compared to untreated control. Highest efficacy was observed in the treatments with Diflubenzuron 25%WP and Lambda Cyhalothrin 5% EC. The efficacy observed in spraying with both Diflubenzuron 25%WP(@ 300 g/ha) and Lambda Cyhalothrin 5% EC (@300ml/ha) was 1.43 and 1.13 reduction in mean population of bihar hairy caterpillar at 10 days after spraying. Both the treatments were at par with each other and gave 88% mortality of Bihar hairy caterpillar larval population over control (Table-4). The next order percent population reduction were recorded as Chlorpyriphos 20% EC (@ 1000 ml/ha) >Quinalphos 25%EC (@1250ml/ha)> Acephate 50% + imidacloprid 1.8% SP (@1000g/ha) and Imidacloprid 17.8% SL (@ 125ml/hawhich provided overall efficacy of 84%, 81%, 80% and 71% respectively. Analysis of variance also showed that the interaction between treatment and days after spraying also very significant. Diflubenzuron may safely be included in the pest management programme of *S. obliqua* was the agreement with the findings of Dev Narayan (2004). Gupta and Yadav (2009) studied the effect of biorational insecticides in combination with other agrochemicals (fungicide, Plant growth regulator PGR) for the control of first instar larvae of *Spilarctia*

obliqua. The last instar larvae of *S. obliqua* on leaves of til (*Sesamum indicum*) treated with diflubenzuron (Dimilin 25 WP) at different concentrations (0.015, 0.03, 0.06, 0.125, 0.25, 0.5 and 1.0%) resulted in various morphogenetic deformities and weight losses among the larvae. The overall effect of the test compound was assessed on the basis of inhibition of adult emergence, which was more than 50% even at 0.06% concentration.

Effect of Different Treatment on Yield

The different insecticidal treatments found to have a significant effect on yield of groundnut (table-5). The maximum yield 15.33q/ha was obtained from the treatment with Acephate 50% + imidacloprid 1.8% SP (@1000g/ha) whereas, minimum yield 7.41q/ha was recorded from untreated check plots or non pesticidal plot. The next order yields which were provided by different indecticidal treatment were as Quinalphos 25%EC (@1250ml/ha) (T6) < Chlorpyriphos 20% EC (@ 1000ml/ha) (T7) < Diafenthiuron 50%WP (@600g/ha) (T2) < Lambda Cyhalothrin 5% EC (@300ml/ha) (T5) < Imidacloprid 17.8% SL (@ 125ml/ha (T1) and Diflubenzuron 25%WP(@ 300g/ha) which ultimately provided 9.3, 11.32, 12.41, 12.68, 13.27 and 14.36q/ha respectively.

Economics of Insecticidal Application

The economics of insecticidal application is presented in (Table-6). Thetotal cost of cultivation was obtained similar in all the plots except the difference in the cost of the plant protection chemicals. The cost of plant protection measures was maximum in Diflubenzuron 25% WP followed by Quinalphos 25% EC. Whereas, the highest benefit: cost ratio (1.14:1) as well as profit was obtained from Acephate 50% +Imidacloprid 1.8 SP. The least benefit: cost ratio (0.47:1) was obtained from Quinalphos 25% EC.

Table 1 Evaluation of Some Insecticidal Molecules Against Leaf Miner (*Aproarema modicella*) Damaged in Leaf (1ST Spray)

Treatment	Incidence of leaf miner (damaged leaves/plant) observed in different days			
	Pre treatment	3 DAS	7 DAS	10 DAS
Imidacloprid 17.8% SL (0.02% a.i.)	3.00 (9.97)	2.93 (8.89)*	3.10 (10.14)	3.00 (10.04)
Diafenthiuron 50%WP (300g a.i./ha)	2.26 (8.64)	1.66 (7.40)	1.07 (5.93)	1.00 (5.73)
Diflubenzuron 25%WP ()	2.06 (8.25)	1.06 (5.90)	0.77 (5.03)	0.66 (4.65)
Acephate 50% + imidacloprid 1.8% SP(500g a.i./ha)	2.86 (9.73)	1.93 (7.98)	0.86 (5.32)	0.73 (4.90)
Lambda Cyhalothrin 5% EC	2.33 (8.78)	1.33 (6.62)	0.80 (5.13)	0.71 (4.83)
Quinalphos 25%EC	2.67 (9.40)	1.80 (7.71)	0.90 (5.44)	0.70 (4.79)
Chlorpyriphos 20% EC	2.90 (9.80)	1.22 (6.34)	0.75 (4.96)	0.67 (4.69)
Control (Water Spray)	3.66 (11.02)	4.20 (11.82)	5.00 (12.92)	6.10 (14.29)
CD (5%)	NS	3.326	1.509	1.051
Se(d)	-	1.536	0.697	0.485
Se(m)	-	1.086	0.493	0.343
CV	-	25.023	13.020	8.049

*Figures in parentheses are angular transformed values

Table 2 Percent Reduction of Leaf Miner (*Aproarema modicella*) After Spraying of Some Insecticidal Molecules

Treatment	Dose	Pre count insects/10 plant	Population at 10 DAS	Mean population reduction	% population reduction at 10 DAS
Imidacloprid 17.8% SL (0.02% a.i.)	125 ml	3.00 (9.97)	3.00 (10.04)	3.03	39
Diafenthiuron 50%WP (300g a.i./ha)	600 g	2.26 (8.64)	1.00 (5.73)	1.24	47
Diflubenzuron 25%WP ()	300 g	2.06 (8.25)	0.66 (4.65)	0.83	81
Acephate 50% + imidacloprid 1.8% SP(500g a.i./ha)	1000 g	2.86 (9.73)	0.73 (4.90)	1.17	85
Lambda Cyhalothrin 5% EC	300 ml	2.33 (8.78)	0.71 (4.83)	0.94	82
Quinalphos 25%EC	1250 ml	2.67 (9.40)	0.70 (4.79)	0.88	85
Chlorpyriphos 20% EC	1000 ml	2.90 (9.80)	0.67 (4.69)	0.79	83
Control (Water Spray)	-	3.66 (11.02)	6.10 (14.29)	5.1	-

*Figures in parentheses are angular transformed values

Table 3 Evaluation of Some Insecticidal molecules against Bihar Hairy Caterpillar (*Spilosoma obliqua*) Damaged in leaf

Treatment	Incidence of BHC (no.of larva/plant) observed in different days			
	Pre treatment	3 DAS	7 DAS	10 DAS
Imidacloprid 17.8% SL (0.02% a.i.)	7.16 (2.76)	4.33 (2.19)*	3.86 (1.91)	2.86 (1.83)
Diafenthiuron 50%WP (300g a.i./ha)	5.33 (2.41)	3.06 (1.88)	2.33 (1.68)	2.16 (1.63)
Diflubenzuron 25%WP ()	8.66 (3.02)	5.46 (2.44)	1.60 (1.44)	1.43 (1.38)
Acephate 50% + imidacloprid 1.8% SP(500g a.i./ha)	5.86 (2.52)	2.60 (1.76)	2.13 (1.62)	1.60 (1.44)
Lambda Cyhalothrin 5% EC	6.67 (2.67)	2.06 (1.6)	1.66 (1.46)	1.13 (1.27)
Quinalphos 25%EC	4.93 (2.33)	2.20 (1.64)	1.40 (1.37)	1.33 (1.35)
Chlorpyriphos 20% EC	10.03 (3.24)	6.51 (2.64)	3.06 (1.88)	2.28 (1.66)
Control (Water Spray)	8.87 (3.06)	9.25 (3.12)	11.2 (3.42)	12.00 (3.53)
CD (5%)	NS	0.150	0.158	0.063
Se(d)	-	0.069	0.073	0.029
Se(m)	-	0.049	0.052	0.021
CV	-	3.939	4.792	2.023

*Figures in parentheses indicate square root transformed values

Table 4 Percent Reduction of Bihar Hairy Caterpillar (*Spilosoma obliqua*) After Spraying of Some Insecticidal Molecules

Treatment	Dose	Pre count insects/10 plant	Population at 10 DAS	Mean population reduction	% population reduction at 10 DAS
Imidacloprid 17.8% SL (0.02% a.i.)	125 ml	7.16 (2.76)	2.86 (1.83)	3.68	71
Diafenthiuron 50%WP (300g a.i./ha)	600 g	5.33 (2.41)	2.16 (1.63)	2.51	70
Diflubenzuron 25% WP ()	300 g	8.66 (3.02)	1.43 (1.38)	2.83	88
Acephate 50% + imidacloprid 1.8% SP(500g a.i./ha)	1000 g	5.86 (2.52)	1.60 (1.44)	2.11	80
Lambda Cyhalothrin 5% EC	300 ml	6.67 (2.67)	1.13 (1.27)	1.61	88
Quinalphos 25%EC	1250 ml	4.93 (2.33)	1.33 (1.35)	1.64	81
Chlorpyriphos 20% EC	1000 ml	10.03 (3.24)	2.28 (1.66)	3.95	84
Control (Water Spray)	-	8.87 (3.06)	12.00 (3.53)	10.81	

*Figures in parentheses are angular transformed values

Table 5 Yield of Groundnut Crop

Treatment	Dose	No. of Pods/Plant	No. of seed/pod	100 kernel weight (g)	Physical Yield Qt/Ha
Imidacloprid 17.8% SL (0.02% a.i.)	125 ml	25.22	1.44	40	13.27
Diafenthiuron 50% WP (300g a.i./ha)	600 g	27.11	1.54	40	12.41
Diflubenzuron 25% WP ()	300 g	26.88	1.62	39.5	14.36
Acephate 50% + imidacloprid 1.8% SP (500g a.i./ha)	1000 g	31.00	1.96	39	15.33
Lambda Cyhalothrin 5% EC	300 ml	26.44	1.35	40	12.68
Quinalphos 25% EC	1250 ml	23.88	1.33	38.5	9.3
Chlorpyriphos 20% EC	1000 ml	25.77	1.39	39	11.32
Control (Water Spray)	-	13.02	0.83	38.5	7.41
CD at 5%					0.168
Se(m)					0.055

*Figures in parentheses are angular transformed values

Table 6 Benefit Cost Ratio of Groundnut

Treatment	Dose formulation (g or ml/ha) (1)	Cost of Chemical/l or kg (₹) (2)	Cost of Chemical/ha (₹) (3)	Cost of Cultivation /ha (₹) (4)	Total Cost (₹) (5=3+4)	Total yield (kg/ha) (6)	Gross Return @ ₹50/kg (7)	Net Returns (₹) (8=7-5)	BC Ratio (9=8/5)
Imidacloprid 17.8% SL	125 ml	2868	717	35700	36417	1502	76000	39583	1.08
Diafenthuron 50% WP	600 g	1250	1500	35700	37225	1421	71050	33825	0.90
Diflubenzuron 25% WP	300 g	3500	2100	35700	37800	1526	76300	38500	1.01
Acephate 50% +Imidacloprid 1.8 SP	1000 g	800	1600	35700	37300	1602	80100	42800	1.14
Lambda cyhalothrin 5% EC	300 ml	450	270	35700	37770	1398	69900	32130	0.80
Quinalphos 25% EC	1250 ml	750	1875	35700	37575	1109	55450	17875	0.47
Chlorpyriphos 20% EC	1000 ml	240	480	35700	36180	1342	67100	30920	0.85
Untreated check	-	-	-	35700	35700	741	37050	1350	0.03

CONCLUSION

The results obtained in the present study thus, clearly indicated that the higher efficacy against leaf miner (*Aproaerema modicella*) was observed in spraying with both Acephate 50% + imidacloprid 1.8% SP (@1000g/ha) and Quinalphos 25%EC (@1250ml/ha). Both insecticides gave 88% reduction in leaf miner population after 10 day of spraying. While highest efficacy against bihar hairy caterpillar (*Spilosoma obliqua*) was observed in the treatments with Diflubenzuron 25%WP and Lambda Cyhalothrin 5% EC. The efficacy observed in spraying with both Diflubenzuron 25%WP (@ 300 g/ha) and Lambda Cyhalothrin 5% EC (@300ml/ha) was 1.43 and 1.13 reduction in mean population. This gave ultimately 88% mortality of Bihar hairy caterpillar larval population over control. Similar results were obtained when yield and benefit-cost ratio were taken into consideration. Based on the above results, it is concluded that the infestation of leaf miner and bihar hairy caterpillar on groundnut is gradually reduced after application of insecticides applied at recommended levels in agricultural system to control the insect pests.

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