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Comparative bio-efficacy of newer insecticides and bio-pesticides against leafhopper, *Empoasca kerri* Pruthi of groundnut in semi-arid region of India

Sunil Gocher, Sarfraz Ahmad and Rohit K Nayak

Abstract
In an investigation carried out during *Kharif* 2018, bio-efficacy of nine insecticides and bio-pesticides (including control) were tested against major sucking pest Leafhopper, *Empoasca kerri* Pruthi of groundnut at S.K.N. College of Agriculture, Jobner (Rajasthan). On the basis of mean per cent reduction in leafhopper population the treatment of imidacloprid 17.8SL (84.31%) was found most effective, followed by thiamethoxam 25WG (81.66%) and acetamiprid 20SP (80%) and were also statistically at par with each other in their efficacy. Bio-pesticides *Metarhizium anisopliae* 1.15 WP (33.56%) and NSKE (Neem Seed Kernel Extract) (49.68%) were proved least effective, however both were differed significantly with each other. The descending order of effectiveness of treatments were as imidacloprid > thiamethoxam > acetamiprid > methyl demeton > fipronil > acephate > NSKE > *Metarhizium anisopliae*. The highest pod yield was obtained from the plot treated with insecticide imidacloprid (27.16 qha^{-1}) followed by thiamethoxam (26.58 qha^{-1}) and acetamiprid (26.11 qha^{-1}) and were statistically at par with each other.

Keywords: Bio-efficacy, bio-pesticide, groundnut, leafhopper, newer insecticide

Introduction

Groundnut, *Arachis hypogaea* L. is an important oil seed and legume crop belongs to family Fabaceae. It is also known as peanut, earthnut, monkey nut and “king of oil seeds”. The seeds contain 47-53 per cent oil, 18 per cent carbohydrate, 26 mg calcium, 401 mg phosphorus, 2.1 mg iron and vitamins like thiamine (B1) 1.14 mg, riboflavin (B2) 0.13 mg, niacin 17.2 mg per 100 gram of kernel. Groundnut is prominent source of dietary protein, lipids and can supply about 5.6 calories per gram and also provides cash income (Padgham *et al*. 1990) [9]. In India it is mainly grown in the Southern and Western states, Gujarat, Andhra Pradesh, Tamil Nadu, Rajasthan, Karnataka, Maharashtra and Madhya Pradesh, together occupying about 90 per cent of groundnut area. Total cultivated area of groundnut in India is 49.70 lakh hectares with an annual production of 71.00 lakh tonnes and productivity of 1429 kg/ha (Anonymous, 2017) [2]. In Rajasthan groundnut is cultivated in 5.56 lakh hectares area with the production of 11.40 lakh tonnes annually and productivity is 2051 kg/ha (Anonymous, 2016-17) [3].

As many as 52 species of insects and two species of mites have been recorded infecting the groundnut crop in India (Singh *et al*. 1990) [12]. The sucking insect pests *viz*., leafhoppers, *E. kerri*, aphid, *A. craccivora*, whiteflies, *B. tabaci and* thrips, *T. dorsalis* are most important (David and Ramamurthy, 2015) [4]. They suck the sap from tender parts of the plants, as a result plants wilted and dry up. Most of the species of sucking insects are also known to be vectors of diseases of groundnut. The critical vegetative stage *viz*., pegging, pod formation and pod development in groundnut play an important role in production of the crop. The damage done by aphid, leafhopper and thrips at these stages showed maximum reduction in potential yield of the crop. Therefore, the crop should be protected at proper stage from these pests (Singh and Singh, 1991) [11]. Insecticides are used widely to control the insect pests of groundnut because of easy adoption, effectiveness and immediate control. But their indiscriminate and irrational use creates resurgence, resistance and residual problems. Hence in the present study efficacy of some new insecticides and bio-pesticides were evaluated against the damage caused by leafhopper and estimated their effects on the pod yield of groundnut.

Materials and Methods

In the season *Kharif* 2018, the investigation was carried out at S.K.N. College of Agriculture, Jobner (S.K.N. Agriculture University, Jobner). Total nine treatments were used including untreated control (Table 1). Field layout was carried out in simple Randomized Block Design (RBD) with three replications. Groundnut variety RG-382 recommended for the region was used in the experiment. The plot size was 2.4 x 3.0 square meter with row to row distance of 40 cm and plant to plant distance 15 cm.

Table 1: Details of treatments used

S. No	Insecticides/ bio-pesticides	Formulation	Concentration
1.	Imidachloprid	17.8 SL	0.005%
2.	Thiamethoxam	25 WG	0.005%
3.	Acephate	75 SP	0.05%
4.	Fipronil	5 SC	0.01%
5.	Acetamiprid	20 SP	0.004%
6.	NSKE*	-	5.00%
7.	*Metarhizium anisopliae*	1.15 WP	1 gm/ l
8.	Methyl demeton	25EC	0.025%
9.	Untreated Check	-	-
*NSKE- Neem seed kernel extract			

Foliar sprays of insecticides and bio-pesticides were applied in two intervals. The first spray was done at economic threshold level on 66 days after sowing while second spray applied on 20th day after first spray when population of leafhopper rebuilt. In each spray, 600 liters per hectare solution of insecticides and bio-pesticides were used. The population of leafhopper on groundnut crop was recorded early in morning hours on three leaves per plant from five randomly selected and tagged plants in each plot. The mean per cent reduction in the population of leafhopper obtained one day before and one, three, seven and ten days after spray. The formula proposed by Abbott's (1925) [1] was used to calculate the per cent reduction in the leafhopper population.

$$\text{Per cent population reduction} = \frac{\{X_1 - X_2\}}{X_1} \times 100$$

Where,

X_1= live number in control

X_2= live number in treatment

X_1- X_2 = Number of killed by the treatment

The data were statistically analyzed by transforming the percentage data into angular transformation values (Gomez and Gomez, 1976) [5]. The pod yield per plot were taken and converted into quintal per hectare and yield data were statistically analyzed.

Results and Discussion

The mean data on per cent population reduction of leafhopper in two successive sprays and pooled mean along with pod yield are represented in table 2. A comparative efficacy at one, three, seven and ten days after both the sprays of different insecticides and bio-pesticides against leafhopper population on groundnut are shown in the figure-1.

Percent population reduction of leafhopper (*Empoasca kerri* Pruthi)

All the insecticidal treatments were found significantly superior over the untreated control in leafhopper population however, considerable difference were existed among them**.** On the basis of mean per cent reduction in leafhopper population in two successive sprays the treatment of imidacloprid 17.8SL (84.31%) was found most effective, followed by thiamethoxam 25WG (81.66%) and acetamiprid 20SP (80%) and were also statistically at par with each other in their efficacy. The next effective treatments were methyl demeton 25EC (73.15%), followed by fipronil 5SC (70.67%) and acephate 75SP (68.67%) which falls under moderately effective group and were differed significantly to each other. Bio-pesticides *Metarhizium anisopliae* 1.15 WP (33.56%) and NSKE (49.68%) were proved least effective, however both were differed significantly with each other in their efficacy. The descending order of effectiveness of treatments were as imidacloprid >thiamethoxam > acetamiprid > methyl demeton > fipronil > acephate > NSKE > *Metarhizium anisopliae*.

The present findings are fully agreement with that of Yadav *et al*., (2015) [14] reported that the imidacloprid (0.005%) and thiamethoxam (0.005%) were most effective, acephate (0.037%) as moderately effective while NSKE (5.0%) and *Metarhizium anisopliae* ($2x10^7$ spores l^{-1}) least effective for controlling sucking insect pests of clusterbean. The results are further conformity with those of Mutkule *et al.*, (2018) [7], Nigude *et al*., (2018) [8] and Kolhe *et al*., (2016) [6] whose result shows that imidacloprid 17.8 SL was most effective for controlling of sucking insect pests on groundnut while Pawar *et al*., (2016) [10] reported similar results in okra.

Effect of newer insecticides and bio-pesticides on pod yield of groundnut

The pod yields in all the treated plots were significantly higher over untreated control (18.26 q ha^{-1}). The maximum pod yield was obtained from the plots treated with imidacloprid (27.16 q ha^{-1}), followed by thiamethoxam (26.58 q ha^{-1}) and acetamiprid (26.11 q ha^{-1}), respectively and were statistically at par with each other. The higher pod yield was also obtained in the treatment of methyl demeton, followed by fipronil and acephate with pod yield of 24.82, 24.18 and 23.92 q ha^{-1}, respectively and formed a non-significant group of moderately effective insecticides. The minimum pod yield of 19.28 and 21.14 q ha^{-1} was obtained in plots treated with *M. anisopliae* and NSKE, however both were differed significantly with each other. The descending order of pod yield of treatments was imidacloprid > thiamethoxam > acetamiprid > methyl demeton > fipronil > acephate > NSKE > *Metarhizium anisopliae*.

Mutkule *et al.*, (2018) [7] reported that for the suppression of leafhopper and thrips on groundnut the treatment of imidacloprid (0.003%) was most effective, followed by thiamethoxam (0.005%). Highest pod yield was recorded with the treatment of imidacloprid (18. 50 q ha^{-1}), followed by quinalphos (18.15 q ha^{-1}) and thiamethoxam (16.25 q ha^{-1}). The present findings are in partially corroborate with those of Sutaria *et al*., (2010) [13] who observed that plot treated with thiamethoxam gave the maximum soybean yield (1889 kg ha^{-1}) followed by acetamiprid (1852 kg ha^{-1}) and imidacloprid (1815 kg ha^{-1}) against jassid population.

Conclusion

Among the various insect pests attacking the groundnut in various seasons from sowing to harvesting, the leafhopper (*Empoasca kerri* Pruthi) is one of the important sucking pest and are responsible for reducing the grain yield. The comparative bio-efficacy of newer insecticides and bio-pesticides tested against the population reduction of leaf hopper and the effect on pod yield of groundnut. Imidacloprid, thiamethoxam and acetamiprid were proved most effective while, bio-pesticides, *Metarhizium anisopliae* and NSKE were least effective against leafhopper on groundnut. The Maximum pod yield (27.16 q ha^{-1}) of groundnut was obtained in the treatment imidacloprid followed by thiamethoxam (26.58 q ha^{-1}) and acetamiprid (26.11 q ha^{-1}). The present investigation will help to choose the effective insecticide or bio-pesticide for proper management of sucking pest and getting high return on groundnut cultivation.

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Table 2: Bio-efficacy of different insecticides and bio-pesticides against leafhopper, *Empoasca kerri* Pruthi on groundnut

S. No.	Insecticides or Bio-pesticides	Per cent reduction days after spray											Mean Yield (q ha^{-1})
		First Spray					Second Spray					Pooled Mean	
		One	Three	Seven	Ten	Mean	One	Three	Seven	Ten	Mean		
1.	Imidacloprid 17.8 SL	89.14 (70.77)*	94.23 (76.14)	89.00 (71.09)	74.45 (59.90)	86.71 (68.65)	83.76 (66.28)	88.36 (70.94)	82.00 (65.13)	73.50 (59.06)	81.91 (64.92)	84.31 (67.03)	27.16
2.	Thiamethoxam 25 WG	86.22 (68.54)	90.82 (72.69)	85.33 (67.71)	72.16 (58.41)	83.63 (66.40)	81.58 (64.68)	86.18 (68.69)	79.75 (63.38)	71.25 (57.58)	79.69 (63.31)	81.66 (64.94)	26.58
3.	Acephate 75 SP	71.46 (57.77)	77.42 (61..99)	72.37 (58.44)	54.78 (47.80)	69.01 (56.20)	70.15 (57.02)	74.50 (59.92)	68.45 (55.85)	60.22 (50.90)	68.33 (55.77)	68.67 (56.00)	23.92
4.	Fipronil 5 SC	73.37 (59.00)	80.24 (63.95)	74.46 (60.20)	56.48 (48.74)	71.14 (57.53)	72.37 (58.45)	76.96 (61.45)	70.12 (56.91)	61.32 (51.55)	70.19 (56.92)	70.67 (57.28)	24.18
5.	Acetamiprid 20 SP	85.53 (67.96)	87.94 (69.90)	84.10 (66.70)	70.42 (57.09)	82.00 (65.09)	79.44 (63.26)	84.00 (66.50)	78.56 (62.70)	70.00 (56.80)	78.00 (62.05)	80.00 (63.52)	26.11
6.	NSKE	55.28 (48.08)	61.12 (51.46)	59.22 (50.31)	40.54 (39.54)	54.04 (47.32)	42.78 (40.85)	54.37 (47.51)	45.66 (42.50)	38.48 (38.32)	45.32 (42.31)	49.68 (44.82)	21.14
7.	*Metarhizium anisopliae* 1.15 WP	35.43 (36.56)	40.45 (39.49)	43.76 (41.41)	29.20 (32.70)	37.21 (37.58)	24.98 (29.96)	30.88 (33.75)	36.23 (37.00)	27.57 (31.65)	29.92 (33.13)	33.56 (35.39)	19.78
8.	Methyl demeton 25 EC	75.44 (60.43)	84.38 (66.74)	77.18 (61.61)	58.32 (49.80)	73.83 (59.25)	75.28 (60.22)	79.30 (63.16)	72.28 (58.24)	63.00 (52.56)	72.47 (58.38)	73.15 (58.86)	24.82
9.	Untreated	00.00 (00.00)	00.00 (00.00)	00.00 (00.00)	00.00 (00.00)	00.00 (00.00)	00.00 (00.00)	00.00 (00.00)	00.00 (00.00)	00.00 (00.00)	00.00 (00.00)	00.00 (00.00)	18.26
S. Em ±		1.08	1.40	1.63	1.34	1.26	1.47	1.30	1.21	1.24	1.36	1.34	0.43
CD (p=0.05)		3.29	4.24	4.96	4.06	3.81	4.45	3.94	3.66	3.77	4.13	4.05	1.30
*Figures in parentheses are angular transformation values													

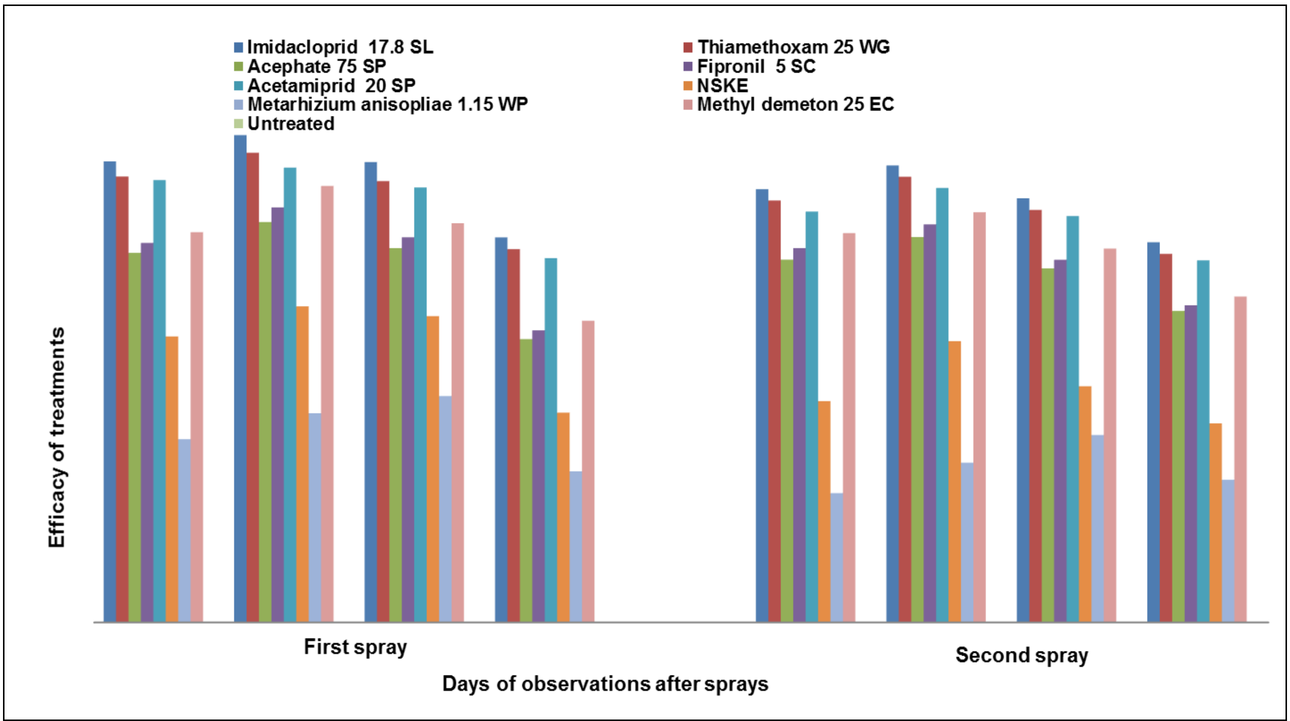

Fig 1: comparative efficacy at one, three, seven and ten days after spray of different insecticides and bio-pesticides against leafhopper population on groundnut

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