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Ramesh M Maradi
Department of Agricultural Entomology, Department of Agronomy and Department of Horticulture, College of Agriculture, Shivamogga, University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka, India

Rajashekharappa K
Department of Agricultural Entomology, Department of Agronomy and Department of Horticulture, College of Agriculture, Shivamogga, University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka, India

MJ Susheelkumar
Department of Agricultural Entomology, Department of Agronomy and Department of Horticulture, College of Agriculture, Shivamogga, University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka, India

Shivanna B K
Department of Agricultural Entomology, Department of Agronomy and Department of Horticulture, College of Agriculture, Shivamogga, University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka, India

Veeranna HK
Department of Agricultural Entomology, Department of Agronomy and Department of Horticulture, College of Agriculture, Shivamogga, University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka, India

Corresponding Author:
Ramesh M Maradi
Department of Agricultural Entomology, Department of Agronomy and Department of Horticulture, College of Agriculture, Shivamogga, University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka, India

Evaluation of bio-efficacy of different insecticides against aphids, *Aphis craccivora* in yard long bean, *Vigna unguiculata* subsp. *Sesquipedalis*

Ramesh M Maradi, Rajashekharappa K, MJ Susheelkumar, Shivanna B K, Veeranna HK and Nagarajappa Adivappar

Abstract
Yard long bean, *Vigna unguiculata* subsp. *Sesquipedalis* is infested with many sucking pest *viz.*, aphids, jassids, bugs, thrips and mites. Among the different sucking pests reported on yard long bean, aphids, *Aphis craccivora* are the major pest causing severe yield loss under field condition. Observations on the population counts of aphids were recorded one day before spraying and three, seven, ten and fifteen day after spraying on five randomly selected plants on three leaves from top, middle and bottom in each plot. Among the insecticides tested, the highest per cent reduction of aphids was recorded in the treatments imidacloprid 17.5 SL (86.89%) followed by acetamiprid 20 SP (84.50%), acephate 75 SP (79.29%) and diafenthiuron 50 EC (76.81%). However, least per cent reduction of aphid population was observed in azadirachtin 10,000 ppm (55.97 per cent) treated plot when compared to untreated control. Thus, it is concluded that all the studied insecticides proved effective against the aphids but the toxicity studies of the insecticides were observed from maximum to minimum in the following order, Imidacloprid > Acetamaprid > Acephate > Diafenthiuron > Spiromecifen > Fenazaquin > Chlorfenapyr > Azadirachtin.

Keywords: Aphids, *Aphis craccivora*, *Vigna unguiculata*

Introduction
Yard long bean, *Vigna unguiculata* sub spp. *sesquipedalis* is a delicious fresh vegetable belonging to the family Fabaceae. It is also known by other names like asparagus bean, sting bean, long podded cowpea, snake bean and body bean [9]. The yard long bean was originated probably in the Middle West Africa or Southern China. In India, Kerala contributes a major share, accounting for nearly 90 per cent in terms of both area and production followed by Karnataka and Tamil Nadu. The area of yard long beans in India is about 18,560–20,160 ha [12]. It is a highly nutritive vegetable containing a good amount of digestible protein both in pods (23.5 - 26.3%) and in leaves [2]. It can be used as fodder, vegetable, green legume as well as green manure crop.
During the cultivation, the farmer faces various problems in pest management [11]. The important constraints for lowering yield and poor quality of yard long bean is incidence of insect pests. The major insect pests which severely damage yard long bean during all growth stages are the bean aphid, *A. craccivora*, leaf hopper, *Emposca terminalis Distanct*, thrips, *Megalurothrips usitatus* and red spider mites, *Tetranychus urticae*. Among these, *A. craccivora* was the major one and it has been reported as a cosmopolitan species causing direct and indirect (as vectors) damage to the cultivated crops [3]. About 150 species of insect pests are known to attack beans in India, of which about 25 species are reported to be serious [14]. The yield loss in yard long bean due to aphids is reported to be about 12-30 per cent [4]. Reports on incidence of insect pests and their management techniques for the yard long beans in its major growing areas of India are limited. Review of literature revealed that in our state, no work has been conducted on the insect pests of the yard long bean. The present study was, therefore, undertaken to know the incidence of aphids and their level of infestation under different conditions on yard long bean.

Materials and methods
Efficacy of selected insecticides against Aphids
A field experiment was conducted to evaluate the efficacy of newer molecules of insecticides *viz.*, acetamiprid 20 SP, imidacloprid 17.5 SL, chlorfenapyr 10 EC, diafenthiuron 50 EC,

spiromesifen 22.9 SC, fenazaquin 10 EC, azadirachtin 10000 ppm and acephate75 SP against aphids under natural field condition during 2018-2019 at Agricultural and Horticultural Research Station (AHRS), Bhavikere, UAHS, Shivamogga, Karnataka. Arka Mangala variety of yard long bean was sown with a spacing of 120 cm x 30 cm in a gross plot size of 660 m^2 area. The crop was raised as per package of practices except plant protection measures against sucking pests. The field experiment was laid out in randomized block design (RCBD) with nine treatments and three replications comprising of different newer molecules of insecticides along with an untreated control (Table 1).

Table 1: Details of the insecticides tested against sucking pest of yard long bean

Treatments	Chemicals	Dosage (ml or gm per lit)	Trade name
T1	Acetamiprid 20 SP	0.3 g/l	Pride
T2	Imidacloprid 17.8 SL	0.5 ml/l	Confider
T3	Chlorfenapyr 10 EC	1.0 ml/l	Interprid
T4	Diafenthiuron 50 WP	1.0 g/l	Peagasus
T5	Spiromesifen 22.9 SC	0.50 ml/l	Oberon
T6	Fenazaquin 10 EC	2.0 ml/l	Magister
T7	Azadirachtin 10000 ppm	2.0 ml/l	Neembicidine
T8	Acephate 75 SP	1.5 gm/l	Acetaf
T9	Untreated control	-	-

Sampling procedure: The adults and nymphs of aphids were counted from three leaves *i.e*., one each from top, middle and bottom canopy of five randomly selected plants. Total number of aphids from each plant was estimated and the population was expressed in terms of mean number of aphids per leaf.

Recording observation: Two sprays of insecticides were given at 15 days interval during the study period. The first spray was initiated when the crop was uniformly infected with single pest. The data on the population of aphids were recorded at one day before spraying and 1, 3, 5 and 7 days after each spraying.

Per cent reduction over control was also worked out using the following formula.

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

Statistical analysis: For statistical analysis of data SPSS software and WASP softwares were used and for average data, square root transformation, for per centage data arc sine transformation were used.

Results and Discussion

First spray

There was no significant difference among the treatments with respect to number of aphids per leaf before imposition of treatments. The mean population varied from 38.11 to 39.12 aphids per leaf, respectively (Table 2)

One day after spraying the aphid population varied from 9.09 to 28.76 among different treatments; while it was 39.01 aphids per leaf in the untreated control. All the treatments were significantly superior over control in reducing the aphid population. The treatment with imidacloprid 17.8 SL was found to be significantly superior in reducing the aphid population from 38.27 to 9.09 per leaf. However, it was on par with acetamiprid 20 SP (11.85 aphids per leaf). The next best treatments were acephate 75 SP (13.53 aphid per leaf), diafenthiuron 50 EC (16.28 aphid per leaf), spiromecifen 22.9 SC (20.43 aphid per leaf), fenazaquin10 EC (22.35 aphid per leaf) and chlorfenapyr 10 EC (25.83 aphid per leaf). Azadirachtin 10,000 ppm was found to be least effective and recorded 28.76 aphids per leaf (Table 2).

The observations on three days after spraying revealed that, the lowest population of aphids were recorded in imidacloprid 17.8 SL (7.10 per leaf) followed by acetamiprid 20 SP (8.12 per leaf) which were on par with each other. The next best treatments in the order of control of aphid population were acephate 75 SP (9.31 aphids per leaf) and diafenthiuron 50 WP (10.51 aphids per leaf). On the contrary, the highest population of aphids was recorded in the untreated control (40.25 per leaf) compare to other treatments (Table 2).

At five days after treatment, imidacloprid 17.8 treated plots were superior to other treatments in reducing aphid population. This was on par with treatments acetamiprid 20 SP followed by acephate 75 SP, diafenthiuron 50 EC, spiromecifen 22.9 SC, fenazaquin10 EC and chlorfenapyr 10 EC treated plots which recorded 7.50, 8.66, 11.17, 12.15 and 14.20 per leaf respectively. In azadirachtin, 10,000 ppm treated plots, 16.62 aphids per leaf were recorded, which was higher than that observed in all other treatments but significantly lower than that of control.

A similar trend was observed on seven days after spraying. The data recorded revealed that imidacloprid 17.8 was most effective and recorded significantly less aphid population of 2.15 per leaf. Acetamiprid 20 SP was on par with imidacloprid 17.8 which recorded 3.10 aphid per leaf respectively. The azadirachtin 10,000 ppm recorded significantly higher population of 11.52 per leaf. Whereas, un treated plot registered the highest population of 41.57 aphids per leaf (Table 2).

Second spray

When the aphid population on different treatments started to retained up in different treatment second spray was taken up at 15 days after first spray. The data pertaining to the efficacy of insecticides after second spray is presented in the Table 3.

At one day after spraying population of aphids ranged from 8.55 to 25.31 per leaf. Imidacloprid 17.8 SL was retained superiority in reduction of aphid population from 18.85 to 8.55 per leaf followed by acetamaprid 20 SP of 9.65 aphids per leaf which was on with imidacloprid 17.8 SL. Whereas, acephate 75 SP, diafenthiuron 50 EC recorded 14.01 and 15.90 aphids per leaf respectively. In untreated control aphid population increased from 44.15 to 44.32 per leaf at one day after spraying.

The mean number of aphids recorded at three days after spraying indicated that imidacloprid 17.8 and acetamiprid 20 SP are on par with each other and significantly reduce the aphid population of 6.70 and 7.30 per leaf, respectively. Azadirachtin 10,000 ppm recorded highest aphid population of 21.78 per leaf compared to other treatment included in the

study.

The data recorded on five days after spraying showed the aphid population ranged from 4.87 to 17.10 per leaf. All the treatments were significantly superior over control in reducing aphid population. The lowest number of 4.87 aphids per leaf was observed in plots treated with imidacloprid 17.8 SL and emerged as the significantly superior treatment. However, it was on par with acetamiprid 20 SP recorded aphid populations of 5.74 per leaf, respectively (Table 3).

It was recorded that the aphid population at seven days after spraying varied from 2.40 to 13.85 per leaf and 49.87 in the untreated control. The imidacloprid 17.8 SL was found to be superior over rest of the treatments. The treatment with azadirachtin 10,000 ppm was least effective in controlling the aphid population of 13.85 per leaf (Table 3).

Per cent reduction over untreated control: The results of experiment revealed that among the different treatments, highest per cent reduction of 86.49 per cent was recorded in imidacloprid 17.8 SL treated plot followed by acetamaprid 20 SP (84.50 per cent), acephate 75 SP (79.29 per cent), diafenthiuron 50 EC (6.81 per cent), spiromecifen 22.9 SC (67.09 per cent), fenazaquin 10 EC (64.30 per cent) and chlorfenapyr 10 EC (60.11 per cent). Least control of population was observed in azadirachtin 10,000 ppm (55.97 per cent) when compared to untreated control (Table 3).

The present findings are in agreement with Jarande and Dethe [5] and John palumbo *et al.* [6] who reported that imidacloprid and acetamiprid proved most effective in reducing aphid population in cow pea. Patil *et al.* [8] and Prasad *et al.* [10] who reported that the imidacloprid 17.8 SL was found to be superior by recording least number of aphids in pigeon pea.

Misra [7] revealed that imidacloprid and acetamipride proved significantly superior in controlling aphids on okra. Abhijit and Chatterjee [1]. Evaluated the efficacy of chloro-neonicotinoid as a foliar application against aphids. Imidacloprid 17.8 SL was found superior against aphids among other treatments. Siddartha *et al.* [13] found that, the synthetic active ingredients, imidacloprid was the most effective in reducing the aphid (*Aphis gossypii*) populations on Okra.

Table 2: Efficacy of different insecticides against aphids, *Aphis craccivora* during *Kharif* 2018-19 (first spray)

S. No.	Treatments	Dosage (g or ml per ltr.)	Mean no. of aphids per leaf						Per cent reduction over control
			1DBS	1DAS	3DAS	5DAS	7DAS	Mean	
1	Acetamiprid 20 SP	0.3g/ ltr	38.67 (6.21)	11.85 (3.43)^{f}	8.12 (2.84)^{e}	5.94 (2.43)^{e}	3.10 (1.75)^{e}	7.25	82.09
2	Imidacloprid 17.8 SL	0.5ml/ltr	38.27 (6.18)	9.09 (3.01)^{f}	7.10 (2.63)^{e}	5.22 (2.26)^{e}	2.15 (1.43)^{e}	5.89	85.45
3	Chlorfenapyr 10 EC	1.5ml/ltr	38.93 (6.23)	25.83 (5.07)^{bc}	17.67 (4.19)^{bc}	14.20 (3.74)^{bc}	10.46 (3.20)^{bc}	17.04	57.03
4	Diafenthiuron 50 WP	1.5g/ltr	39.01 (6.24)	16.28 (4.02)^{de}	10.51 (3.21)^{d}	8.66 (2.90)^{de}	6.10 (2.46)^{d}	10.30	74.56
5	Spiromesifen 22.9 SC	0.5ml/ltr	38.17 (6.17)	20.43 (4.51)^{cd}	15.88 (3.96)^{cd}	11.17 (3.32)^{cd}	8.10 (2.84)^{bcd}	13.87	65.70
6	Fenazaquin 10 EC	2.0ml/ltr	38.11 (6.17)	22.35 (4.72)^{cd}	16.02 (4.00)^{cd}	12.15 (3.48)^{cd}	9.45 (3.07)^{bcd}	14.99	62.98
7	Azadirachtin 10,000 ppm	2.0ml/ltr	38.67 (6.21)	28.76 (5.36)^{b}	19.86 (4.44)^{b}	16.62 (4.06)^{b}	11.52 (3.38)^{b}	19.17	52.66
8	Acephate 75 SP	1.5g/ltr	39.12 (6.25)	13.53 (3.66)^{e}	9.31 (3.02)^{de}	7.50 (2.71)^{de}	5.33 (2.29)^{d}	8.90	78.02
9	Control	-	38.90 (6.23)	39.01 (6.24)^{a}	40.25 (6.33)^{a}	41.19 (6.41)^{a}	41.57 (6.43)^{a}	40.50	-
	SEM±	-	NS	1.21	1.35	1.32	1.22	-	-
	CD (P=0.05)	-	NS	3.63	4.05	3.96	3.66	-	-
	CV (%)	-	8.10	8.03	9.92	10.76	10.01	-	-

Figures in parentheses are √x + 0.5 transformed values; Means in the columns followed by the same alphabet do not differ significantly by DMRT (P = 0.05); DBS-Day before spray; DAS-Days after spray;

Table 3: Efficacy of different insecticides against aphids, *Aphis craccivora* during *Kharif* 2018-19 (second spray)

S. No.	Treatments	Dosage (g or ml per ltr.)	Mean no. of aphids per leaf						Per cent reduction over control
			1DBS	1DAS	3DAS	5DAS	7DAS	Mean	
1	Acetamiprid 20 SP	0.3g/ ltr	21.84 (4.66)^{cd}	9.65 (3.08)^{e}	7.30 (2.67)^{ef}	5.74 (2.38)^{ef}	2.85 (1.68)^{ef}	6.30	86.70
2	Imidacloprid 17.8 SL	0.5ml/ltr	18.85 (4.33)^{d}	8.55 (2.91)^{e}	6.70 (2.58)^{f}	4.87 (2.18)^{f}	2.40 (1.52)^{f}	5.63	88.11
3	Chlorfenapyr 10 EC	1.5ml/ltr	30.79 (5.54)^{b}	23.31 (4.81)^{bc}	20.45 (4.52)^{bc}	15.98 (3.99)^{bc}	12.41 (3.52)^{dc}	18.03	61.95
4	Diafenthiuron 50 WP	1.5g/ltr	25.59 (5.04)^{bcd}	15.90 (3.97)^{cd}	11.45 (3.36)^{d}	7.98 (2.81)^{de}	4.66 (2.13)^{e}	9.99	78.91
5	Spiromesifen 22.9 SC	0.5ml/ltr	27.79 (5.27)^{bc}	20.12 (4.48)^{bcd}	16.25 (4.02)^{cd}	12.19 (3.48)^{cd}	9.15 (3.10)^{d}	14.42	69.57
6	Fenazaquin 10 EC	2.0ml/ltr	28.14 (5.29)^{bc}	22.41 (4.37)^{bcd}	18.36 (4.28)^{bc}	13.74 (3.69)^{c}	11.10 (3.32)^{cd}	16.40	65.39
7	Azadirachtin 10,000 ppm	2.0ml/ltr	30.88 (5.55)^{b}	25.31 (5.00)^{b}	21.78 (4.65)^{b}	17.10 (4.12)^{d}	13.85 (3.79)^{d}	19.51	58.83

8	Acephate 75 SP	1.5g/ltr	24.30 (4.90)^{bcd}	14.01 (3.72)^{de}	10.30 (3.20)^{de}	6.13 (2.46)^{ef}	3.92 (1.96)^{ef}	8.59	81.87
9	Control	-	44.15 (6.63)^{a}	44.32 (6.69)^{a}	46.95 (6.82)^{a}	48.45 (6.96)^{a}	49.87 (7.04)^{a}	47.39	-
	SEM±	-	1.54	1.76	1.32	1.12	1.09	-	-
	CD (P=0.05)	-	4.63	5.30	3.98	3.38	3.29	-	-
	CV (%)	-	8.41	11.10	9.78	9.47	10.67	-	-

Figures in parentheses are √x + 0.5 transformed values; Means in the columns followed by the same alphabet do not differ significantly by DMRT (P = 0.05); DBS-Day before spray; DAS-Days after spray;

Conclusion

Yard long bean is growing round the year in some parts of Karnataka. Farmers are unaware of loss by aphids. To overcome the loss caused by the aphids imidacloprid 17.8 SL and acetamiprid 20 SP proved to be the most promising insecticides with minimum population of aphids followed by acephate 75 SP and diafenthiuron 50 EC. Results of experiment concluded that all the treatment were found significantly superior over control in reducing the aphid population and toxicity studies of the insecticides was observed from maximum to minimum in the following order, Imidacloprid > Acetamaprid > Acephate > Diafenthiuron > Spiromecifen > Fenazaquin > Chlorfenapyr > Azadirachtin.\

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