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MA Pawar
Department of Entomology, Mahatma Phule Krishi Vidyapith, Rahuri, Maharashtra, India

CS Patil
Department of Entomology, Mahatma Phule Krishi Vidyapith, Rahuri, Maharashtra, India

SK Singh
Department of Entomology, Mahatma Phule Krishi Vidyapith, Rahuri, Maharashtra, India

Correspondence
MA Pawar
Department of Entomology, Mahatma Phule Krishi Vidyapith, Rahuri, Maharashtra, India

Relative toxicity of imidacloprid to *Aphis gossypii* Glover and *Amrasca biguttula biguttula* Ishida infesting okra

MA Pawar and CS Patil

Abstract
Investigations were carried out to evaluate the sensitivity of neonicotinoids to *Aphis gossypii* and *Amrasca biguttula biguttula* under laboratory condition at PGI, MPKV, Rahuri during the year 2012-13. Evaluated insecticides differed in their persistence and index of persistence against both insects. The persistence of insecticides was assessed by exposing known number of aphids and jassids to pretreated leaves of okra. It was revealed that recommended dose of imidacloprid (25 g a.i/ha) persisted for 21 days against both aphids and jassids. However dimethoate, a conventional insecticide persisted for 11 days.

Keywords: *Aphis gossypii, Amrasca biguttula biguttula,* imidacloprid, relative toxicity

Introduction
Okra is cultivated throughout India over an area of 5.30 lakh hectares with a total annual production of 63.50 lakh metric tonnes, [2]. In Maharashtra bhendi is grown over 19000 ha with total annual production of 224 thousand metric tonnes providing a continuous and good source of income to the farmers.

Okra growers frequently complain yield losses due to insect pests. The important pests affecting the yield of okra are jassid (*Amrasca biguttula biguttula* Ishida), aphid (*Aphis gossypii* Glover), whitefly (*Bemisia tabaci* Genn,), mite (*Tetranychus* spp.) and shoot and fruit borer (*Earias vittella* Fab). The aphid (*Aphis gossypii* Glover) and jassid (*Amrasca biguttula biguttula* Ishida) infest okra right from the early seedling stage to last fruit harvest. Presently broad range of systemic and contact insecticides and biopesticides are recommended for the control of okra pests. However, short picking interval of okra fruits cause residue hazards to the consumers when conventional pesticides are used repeatedly, besides killing natural enemies and eventual development of resistance [3].

Imidacloprid belonging to neonicotinoids have been used in a big way against sucking pests. Development of resistance in sucking pests to imidacloprid has already been documented in different crops [4, 5, 11, 14]. Recently, farmers have started claiming the reduced efficacy of imidacloprid against aphids and jassids. Therefore, it was felt necessary to evaluate the performance of these insecticides against *A. gossypii* and *A. biguttula biguttula*.

Materials and Methods
Okra plants were raised in glass house following all recommended agronomic practices. The plants 21 days old were used for assessing the effect of insecticides on aphids and jassids. The insecticides were diluted with distilled water to make desired concentrations used for foliar application. The experiment was conducted in a completely randomized block design with three replications at the glass house of department of Entomology M. P. K. V. Rahuri. The insecticides included in the study were imidacloprid 17.8 SL, imidacloprid 70 WG, thiamethoxam 25 WG and dimethoate 30 EC. Untreated check was maintained by spraying with distilled water. The mortality of aphids and jassids on treated leaf were recorded at 1, 3, 5, 7, 9, 11, 13, 15, 17, 21, and 25 days after spray till zero per cent mortality observed for each treatment.

A. gossypii
Insecticide treated leaves from the glasshouse raised plants were sampled and brought to the laboratory. One leaf bit of 10 cm diameter was placed inside a petriplate lined with filter paper

and moist cotton swab at the bottom. The laboratory conditioned 10 apterous adult aphids were carefully transferred to the leaves inside petriplate with a soft camel hair brush and dish was covered with white muslin cloth. Petriplates were maintained at 26±1 ^{0}C and 75 per cent humidity. Observations were recorded on mortality of aphids at 24 h intervals and the experiment was continued till no mortality was observed.

A. biguttula biguttula

Treated leaves from the glasshouse were brought to the laboratory. Large glass test tubes with wide mouth were used for this purpose. Aspirator was made out of them by using rubber cork & inserting two plastic tubes, one end of a tube was covered with cotton cloth. The treated leaves were dropped in each tube with a moist cotton swab at bottom of leaf and sucking apparatus was fitted to the tube. Ten jassids were sucked in each tube from the plants in the field. Tube was covered with muslin cloth. All the tubes were kept in BOD incubator which was maintained at 26±1 ^{0}C and 75 per cent humidity. Observations were recorded at 24 h interval and experiment was continued till no mortality was observed.

The corrected mortality was calculated using Abbott's formula [1]. The corrected mortality data were used for computing PT index [10] expressing persistent toxicity of insecticides. The persistent toxicity of each insecticide was determined in terms of persistent toxicity [8] and PT_{50} were worked out. Based on that, the order of relative persistence (ORP) was determined for various insecticides.

Results and Discussion

A. gossypii

It could be seen from Table 1 and Fig 1 that imidacloprid 17.8 SL 30 g a.i./ha was highly toxic to *A. gossypii* with cent per cent mortality a DAT. There was a gradual decline in mortality of aphids with advancement of time but the effect of imidacloprid 17.8 SL persisted for 17, 21, 25 days at 20, 25 and 30 g a.i./ha, respectively. While it was 21 days for imidacloprid 70 WG @ 25 g a.i./ha, 21 days for thiamethoxam 25 WG @ 25 g a.i./ha and 11 days for dimethoate 30 EC @ 200 g a.i./ha.

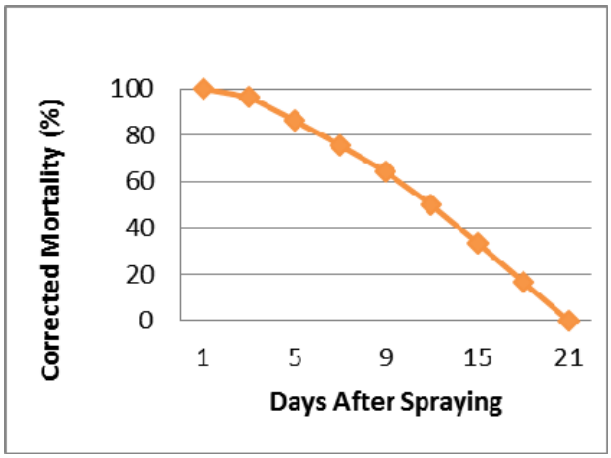
The order of relative toxicity (ORT) of the insecticides based on the persistent toxicity index was: imidacloprid 17.8 SL @ 30 g a.i./ha > imidacloprid 70 WG @ 25 g a.i./ha > imidacloprid 17.8 SL @ 25 g a.i./ha > thiamethoxam 25 WG @ 25 g a.i./ha > imidacloprid 17.8 SL @ 20 g a.i./ha > dimethoate 30 EC @ 200 g a.i./ha.

Persistence of the insecticides as evaluated from PT_{50} values reveal that imidacloprid 17.8 SL @ 30 g a.i./ha recorded highest persistent toxicity to *A. gossypii* PT_{50} value of 14.39 days (Fig. 5). It was followed by imidacloprid 70 WG @ 25 g a.i./ha (13.67 days), imidacloprid 17.8 SL @ 25 g a.i./ha (12.42 days). Dimethoate 30 EC @ 200 g a.i./ha recorded PT_{50} value of 5.12 days. On comparison of PT_{50} values, it revealed that imidacloprid 17.8 SL @ 30 g a.i./ha, imidacloprid 70 WG @ 25 g a.i./ha, imidacloprid 17.8 SL @ 25 g a.i./ha, thiamethoxam 25 WG @ 25 g a.i./ha and imidacloprid 17.8 SL @ 20 g a.i./ha were 2.81, 2.67, 2.43, 2.37 and 2.17 times more toxic, respectively to *A. gossypii* than dimethoate 30 EC @ 200 g a.i./ha.

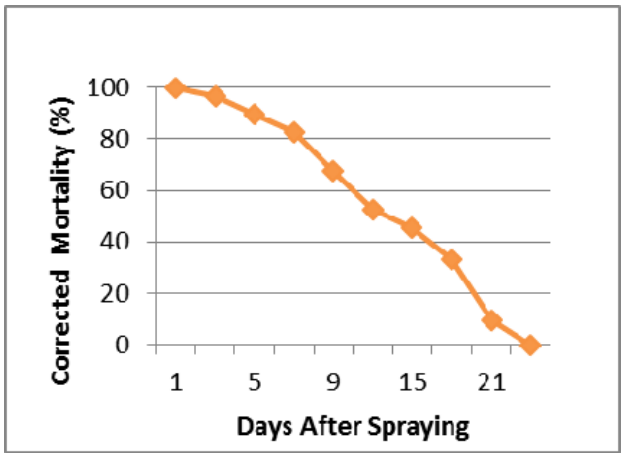
A. biguttula biguttula

The data (Table 2 and Fig 2) indicated that imidacloprid 17.8 SL @ 30 g a.i./ha was highly toxic to *A. biguttula biguttula* with cent per cent mortality upto 3 DAT. There was a gradual reduction in mortality of *A. biguttula biguttula* with the advancement of time but the effect of imidacloprid persisted since 17, 21, 25 days at 20, 25 and 30 g a.i./ha, respectively. It was 21 days for imidacloprid 70 WG @ 25 g a.i./ha, and thiamethoxam 25 WG @ 25 g a.i./ha and 11 days for dimethoate 30 EC @ 200 g a.i./ha.

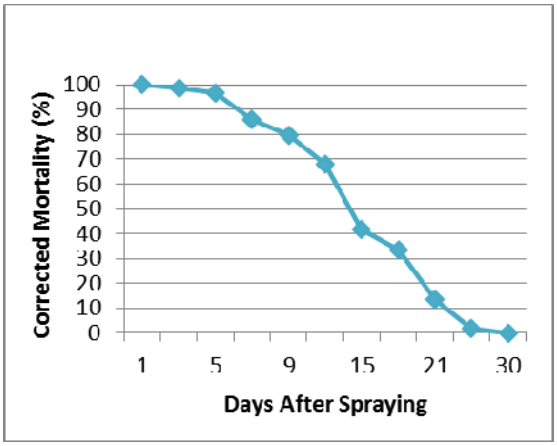
The order of relative toxicity (ORT) of the insecticides based on the persistent toxicity index was: imidacloprid 17.8 SL @ 30 g a.i./ha > imidacloprid 70 WG @ 25 g a.i./ha > imidacloprid 17.8 SL @ 25 g a.i./ha > thiamethoxam 25 WG @ 25 g a.i./ha > imidacloprid 17.8 SL @ 20 g a.i./ha > dimethoate 30 EC @ 200 g a.i./ha.



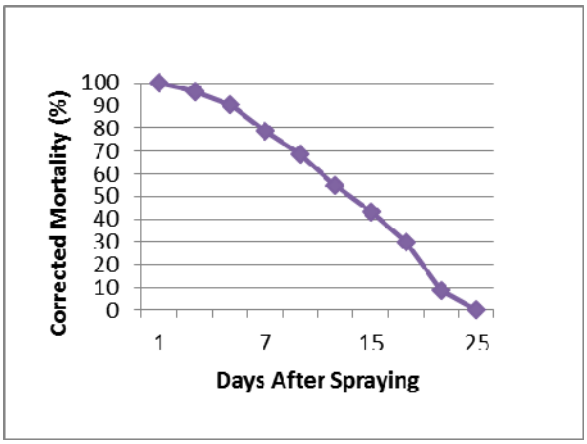
i. Imidacloprid 17.8 SL @ 20g a.i



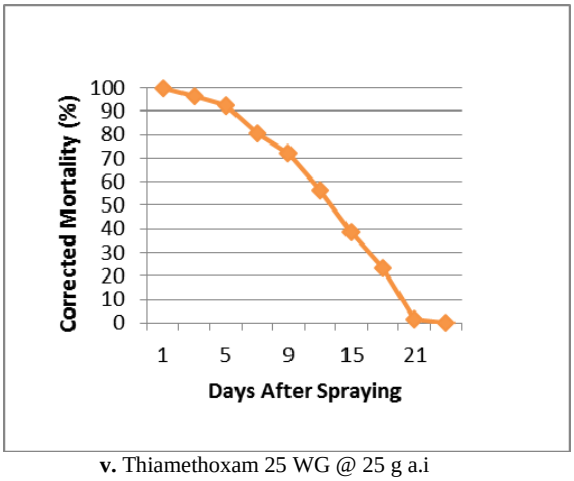
ii. Imidacloprid 17.8 SL @ 25 a.i



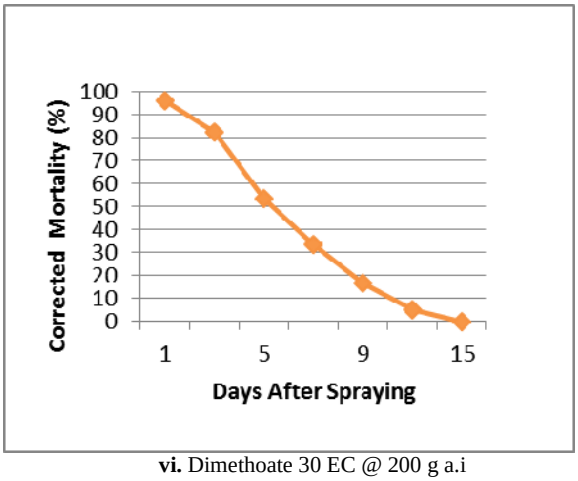
iii. Imidacloprid 17.8 SL @ 30 a.i



iv. Imidacloprid 70 WG @ 25 g a.i

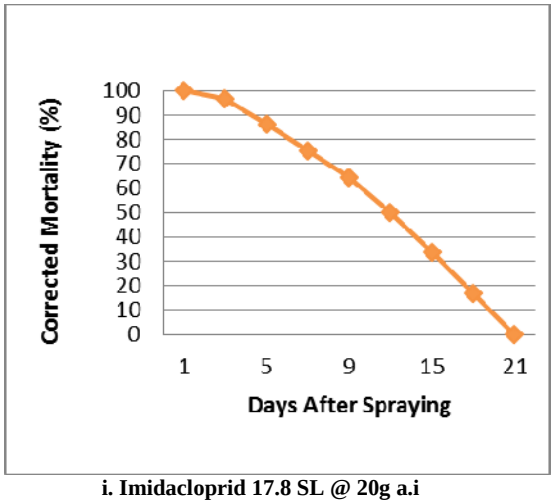


v. Thiamethoxam 25 WG @ 25 g a.i

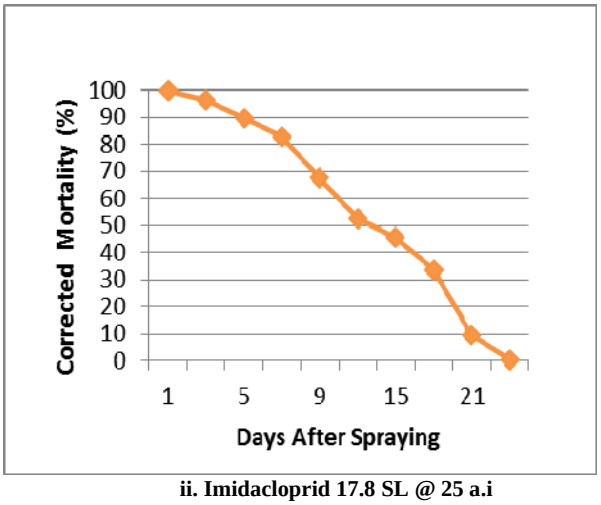


vi. Dimethoate 30 EC @ 200 g a.i

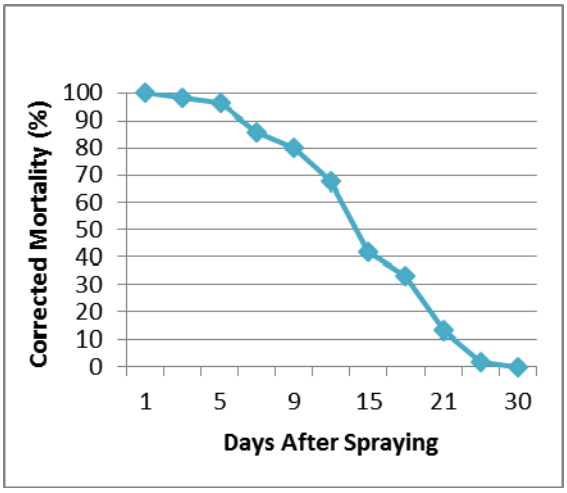
Fig 1: Persistent toxicity of different formulations and dosages of insecticides to aphids, *A. gossypii* on okra



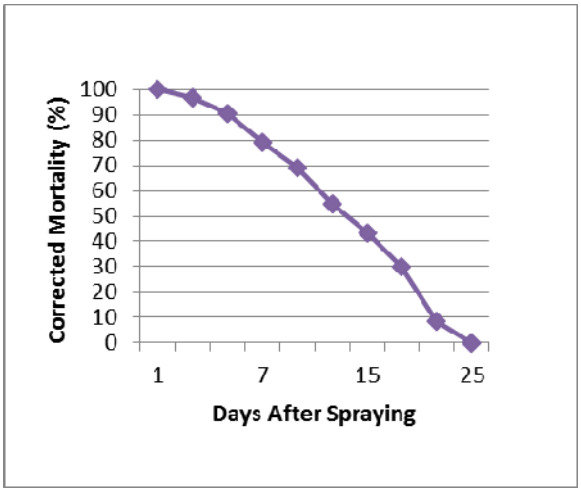
i. Imidacloprid 17.8 SL @ 20g a.i



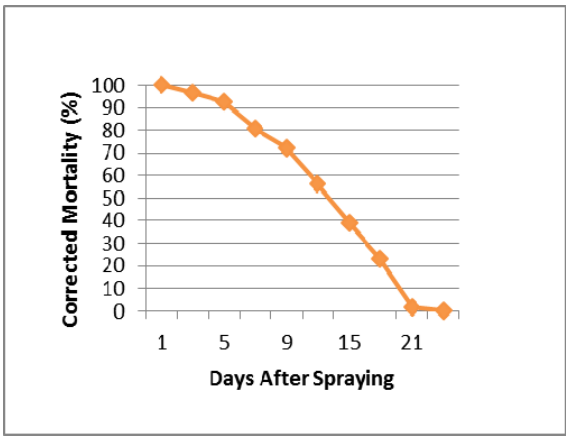
ii. Imidacloprid 17.8 SL @ 25 a.i



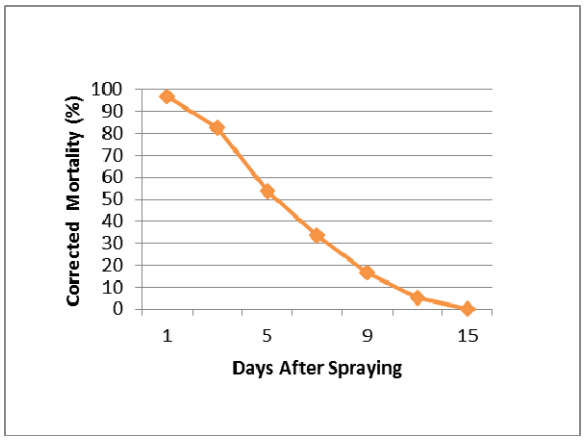
iii. Imidacloprid 17.8 SL @ 30 a.i



iv. Imidacloprid 70 WG @ 25 g a.i



v. Thiamethoxam 25 WG @ 25 g a.i



vi. Dimethoate 30 EC @ 200 g a.i

Fig 2: Persistent toxicity of different formulations and dosages of insecticides to jassids, *A. biguttula biguttula* on okra

Persistence of the insecticides as evaluated from PT_{50} values reveal that imidacloprid 17.8 SL @ 30 g a.i./ha recorded highest persistent toxicity to *A. biguttula biguttula* with PT_{50} value of 14.67 days (Fig. 6). It was followed by imidacloprid 70 WG @ 25 g a.i./ha (14.23 days), thiamethoxam 25 WG @ 25 g a.i./ha (13.47 days) imidacloprid 17.8 SL @ 25 g a.i./ha (12.35 days). On comparison of PT_{50} values, it revealed that imidacloprid 17.8 SL 30 g a.i./ha, imidacloprid 70 WG 25 g a.i./ha, imidacloprid 17.8 SL 25 g a.i./ha, thiamethoxam 25 WG @ 25 g a.i./ha and imidacloprid 17.8 SL 20 g a.i./ha were 2.82, 2.74, 2.38, 2.59 and 2.30 times more toxic, respectively to *A. biguttula biguttula* than dimethoate 30 EC @ 200 g a.i./ha.

The results revealed that the imidacloprid 17.8 SL persisted for 25 days at 30 g a.i/ha, 21 days at 25 g a.i/ha and 17 days at 20 g a.i/ha against *A. gossypii* and 25 days at 30 g a.i/ha, 21 days at 25 g a.i/ha and 17 days at 20 g a.i/ha against *A. biguttula biguttula*. Imidacloprid 70 WG @ 25 g a.i/ha persisted for 21 days against both *A. gossypii and A. biguttula biguttula*. Whereas thiamethoxam 25 WG @ 25 g a.i/ha persisted for 21 days against both *A. gossypii and A. biguttula biguttula*. However dimethoate 30 EC @ 200 g a.i/ha persisted for 11 days against *A. gossypii and A. biguttula biguttula*.

The present findings are in agreement with those of [9] who reported, higher dose of imidacloprid (50 g a.i/ha) showed the longest persistence up to 27 days for aphids and 29 days for jassids. This was followed by the recommended dose of imidacloprid (25 g a.i/ha) and thiamethoxam (25 g a.i/ha) irrespective of insect species.

Similarly [13] observed that imidacloprid 17.8 SL persisted for 29 days @ 50 g a.i./ha and 25 days @ 25 g a.i./ha against aphids and 31 days @ 25 and 50 g a.i./ha against jassids on cotton. Foliar application of imidacloprid persisted for 23 days against aphids in Bhendi [12]. The results are also in agreement with the [6] similar results in cotton and stated that imidacloprid 200 SL foliar spray @ 100 and 150 ml/ha persisted for 22 days against *A. gossypii and A. biguttula biguttula* (Ishida).

The persistent studies on okra revealed that the recommended dose of imidacloprid (25 g a.i/ha) persisted for 21 days against both aphids and jassids. However dimethoate, a conventional organophosphorus insecticide retained persistence for 10 to 12 days only. The prolonged persistence of imidacloprid formulations as observed in the laboratory studies was endorsed in the field evaluation [7].

The results of the present studies revealed that neonicotinoids *viz.* imidacloprid and thiamethoxam were most effective in controlling the aphids and jassids in okra.

Table 1: Persistent toxicity of insecticides to aphids, *A. gossypii* on okra

No.	Treatment	Dose	corrected per cent mortality (Days after treatment)																	
		g a.i gm/ha	1	3	5	7	9	11	15	17	21	25	30	P	T	PT	ORT	PT50 days	RP	ORP
1	Imidacloprid 17.8 SL	20	100	96.55	86.21	75.48	64.36	50.21	33.45	16.72	0.00	0	0.00	17.00	65.37	1111.33	5	11.13	2.17	5
2	Imidacloprid 17.8 SL	25	100	96.55	89.78	82.86	67.78	52.65	45.78	33.34	9.34	0	0.00	21.00	64.23	1348.85	3	12.42	2.43	3
3	Imidacloprid 17.8 SL	30	100	98.66	96.55	85.76	79.86	67.86	41.75	33.33	13.33	1.74	0.00	25.00	61.88	1547.11	1	14.39	2.81	1
4	Imidacloprid 70 WG	25	100	96.55	90.45	78.93	68.89	54.68	43.33	39.48	8.62	0	0.00	21.00	64.55	1355.52	2	13.67	2.67	2
5	Thiamethoxam 25 WG	25	100	96.55	92.34	80.76	78.91	56.34	38.74	23.33	1.67	0	0.00	21.00	63.18	1326.83	4	12.14	2.37	4
6	Dimethoate 30 EC	200	96.55	82.76	53.57	33.54	16.74	5.17	0.00	0.00	0.00	0	0.00	11.00	48.06	528.61	6	5.12	1.00	6

Table 2: Persistent toxicity of insecticides to jassids, *A. biguttula biguttula* on okra

No.	Treatment	Dose	corrected per cent mortality (Days after treatment)																	
		g a.i gm/ha	1	3	5	7	9	11	15	17	21	25	30	P	T	PT	ORT	PT50 days	RP	ORP
1	Imidacloprid 17.8 SL	20	98.33	96.55	86.67	78.57	65.42	50.76	20.69	13.33	0.00	0.00	0.00	17.00	63.79	1084.44	5	11.98	2.30	5
2	Imidacloprid 17.8 SL	25	100.00	96.55	98.00	85.65	78.65	52.67	34.48	26.67	6.67	0.00	0.00	21.00	64.37	1351.79	3	12.35	2.38	3
3	Imidacloprid 17.8 SL	30	100.00	100.00	96.67	80.36	76.67	69.78	41.38	31.33	13.33	1.67	0.00	25.00	61.12	1527.95	1	14.67	2.82	1
4	Imidacloprid 70 WG	25	100.00	96.55	97.00	82.14	75.78	65.37	45.67	23.33	6.34	0.00	0.00	21.00	65.80	1381.77	2	14.23	2.74	2
5	Thiamethoxam 25 WG	25	100.00	98.67	90.00	80.00	75.00	51.34	34.48	28.33	8.33	0.00	0.00	21.00	62.91	1321.04	4	13.47	2.59	4
6	Dimethoate 30 EC	200	96.55	86.67	52.76	34.47	17.38	3.33	0.00	0.00	0.00	0.00	0.00	11.00	48.53	533.79	6	5.2	1.00	6

Conclusion

It appears that imidacloprid is effective against sucking pests infesting okra at the recommended dose of 25 g a.i ha^{-1}. Farmers may be advised to use the imidacloprid at recommended dosage. Considering the harmful effects of imidacloprid on coccinellids and also to avoid continuous selection pressure, excessive reliance on this compound may be avoided. In order to prolong the useful life of this novel insecticide, dimethoate can be used as an alternative which is comparatively less toxic to coccinellids and less persistent in nature.

Acknowledgements

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