Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2019; 7(3): 97-99

Received: 23-03-2019
Accepted: 28-04-2019

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Evaluation of root dip treatment and foliar spray of insecticides against aphid, *Uroleucon compositae* (Theobald) infesting gaillardia (Var. Lorenziana)

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Abstract
A field investigation was carried out on evaluation of root dip treatment (Main plot) and foliar spray (Sub plot) of insecticides against aphid, *Uroleucon compositae* (Theobald) infesting ornamental crop Gaillardia (var. Lorenziana) were carried out in split plot design at Agronomy farm, B. A. College of agriculture, Anand Agricultural University, Anand, Gujarat during 2014-17. Among the individual as well as the different combination of root dip treatments and foliar sprays, thiamethoxam 25 WG 0.0125% (5 g/ 10 litre of water)and foliar spray of dimethioate 30 EC 0.03% (10 ml/ 10 litre of water) were found effective and economical in reducing the population of aphid, *U. compositae* with higher flower yield in Gaillardia.

Keywords: Root dip, insecticides, gaillardia, *Uroleucon compositae*

1. Introduction
Gaillardia (Var. Lorenziana) grown for its profuse flowers and the same are used for making garlands in religious ceremony and for making flower beds and herbaceous flower border. As a cut flower, it is very useful for the lasting qualities. The blanket flower plant suffers from aphid, thrips, leaf miner and spider mites [1-3]. The crop was found to be severely and regularly attacked by aphid *Uroleucon compositae* (Theobald) in Gujarat [3-5]. The aphid attacked plants fail to produce healthy and quality flowers. To harvest quality flowers, it is necessary to check the incidence of aphids in Gaillardia crop. Neonicotinoids are found effective against sucking pests infesting field and vegetable crops. This group of insecticides may be found more effective against this pest if it applied as root dip method in combination with foliar spray. The information on transplanting of seedling through root dip treatment of insecticidesin combination with foliar spray in ornamental crop is scanty. Therefore, present investigation was carried out to evaluate efficacy of neonicotinoid insecticides as a root dip and other synthetic insecticides as a foliar spray to manage aphid, *U compositae* on Gaillardia.

2. Materials and methods
To find out effective and economic insecticide against aphid, *U. compositae* in festing gaillardia were carried out at agronomy farm, B. A. College of agriculture, Anand Agricultural University, Anand Gujarat during the year 2014-17. Gaillardia seedlings were raised by following standard agronomical practices and transplanted in the second week of November in Split Plot Design. The main and sub plot sizes were 18.0 x 2.0 m and 3.6 x 2.0 m, respectively. Each treatment was replicated four times. For the root dip treatment, ten liter solution of respective insecticide was prepared and required 45-60 days old healthy seedlings were dipped for 2 hrs before transplanting [6, 7]. The observations on aphid population were recorded at weekly interval. For the purpose, 10 plants were selected randomly and the observations on number of aphids were recorded on 10 cm twigs of 5 randomly selected plants. The first foliar application of respective insecticide was applied at sufficient population of the pest and second at 15 days of first spray. Picking-wise yield of flowers were recorded.

3. Results and Discussion
Root dip (thiamethoxam 25 WG 0.0125% and imidacloprid 70 WG 0.014%), foliar spray (dimethoate 30 EC 0.03%, acephate 75 SP 0.075%, flonicamid 50 WG 0.015% and diafenthiuron 50 WP 0.05%) alone and all combinations of root dip treatment with foliar spray

were found significantly superior in reducing the aphid incidence on gaillardia to control in first, second and third year of experimentation as well as in pooled over years results.

Imidacloprid 0.014% and thiamethoxam 0.0125% as root dip were equally effective against aphid on gaillardia during first year of study. Foliar spray of flonicamid 0.015%, acephate 0.075% and dimethoate 0.03% were at par with each other in their effectiveness in reducing the aphid populations on gaillardia and significantly more effective than diafenthiuron 0.05%. The lowest aphid population was recorded in plots having root dip with imidacloprid0.014% and foliar application of flonicamid 0.015% and it was at par with acephate 0.075 % and dimethoate 0.03% as well as root dip with thiamethoxam 0.0125% and foliar application of dimethoate 0.03%.

During second year, root dip treatment of thiamethoxam remained superior over the imidacloprid in controlling aphid on gaillardia. Among the foliar application, dimethioate was significantly superior to all evaluated insecticides except flonicamid. Root dip treatment with thiamethoxam coupled with dimethioate as foliar spray was found effective by recording the lowest population of aphid followed by foliar application of flonicamid and acephate.

Root dip treatments (thiamethoxam and imidacloprid) significantly differed to each other, whereas all the foliar application of insecticides significantly superior over the control during third year of study. Root dip treatment with thiamethoxam coupled with dimethioate as foliar spray was found effective against aphid and recorded lowest aphid population.

The pooled of three years data revealed that root dip treatment of thiamethoxam and imidacloprid remained at par in controlling the aphid on gaillardia. Root dip (thiamethoxam and imidacloprid) coupled with dimethioate, acepahate and diafenthiuron as well as foliar application alone were found equally effective against aphids on gaillardia. For management of the population of chili thrips, dipping roots of the chili seedlings in imidacloprid 17.8 SL @ 10 ml /10 litre water or thiamethoxam 25 WG @ 10 g /10 litre water for two hours before transplanting (Anon., 2014) which shore up the present result. Dimethoate proved superior in suppressing the pest in past on other host crop of *U. composite* [8]. Similarly, dimethoate insecticides were found highly effective against *U. compositae* infesting gaillardia crop in present study. According to Gajbhiye [6] imidacloprid was found to translocate from seeds through seed treatment and root through root dipping and finally reach to the leaves. The translocated residues persisted for 45 days after transplanting of tomato. Thiamethoxam 0.005 % and acetamiprid 0.004% proved best by recording maximum per cent decline in safflower aphid, *U. compositae* population and providing the highest seed yield of 1087 kg/ha and 952 kg/ha, respectively [9].

Higher flower yield was recorded in root dip treatment of thiamethoxam with foliar spray of dimethioate which was at par with flonicamid during first, second and third year. Over all pooled over years indicated that the root dip treatment of thiamethoxam coupled with foliar spray of dimethioate recorded higher flower yield (8.16 q/ha) followed by flonicamid (7.86). The yield of safflower increased in dimethoate treated plots [10]. Higher flower yield was recorded in root dip treatment of thiamethoxam with foliar spray of dimethioate which was at par with flonicamid during first, second and third year. Out of four systemic insecticides *viz.*, dimethoate, monocrotophos, imidacloprid, and carbofuran applied as seedling root dip method against whitefly, *Bemisia tabaci* Genn on Brinjal, imidacloprid proved most effective and recorded the lowest population (6.67 and 6.00 adults/3 leaves) of whitefly after 30 days of transplanting [11].

The maximum ICBR (1:4.62) was in root dip treatment of thiamethoxam coupled with foliar spray of dimethioate followed by root dip treatment of imidacloprid coupled with foliar spray of dimethioate.

Table 1: Effect of root dip and foliar spray on incidence of aphid, activity of natural enemies and yield of gaillardia

Treatments	**No. of aphids/10 cm twig**								**Flower yield (q/ha) (Pooled of 3 years)**	
	First year		**Second year**		**Third year**		**Pooled**			
Root dip treatment										
Thiamethoxam 25 WG, 0.0125%	*4.36(18.51)		1.99(3.46)		1.75(2.56)		2.70(6.79)		6.69	
Imidacloprid 70 WG, 0.014%	4.25(17.56)		2.28(4.70)		2.07(3.78)		2.87(7.74)		4.94	
Control (Water dipping)	6.55(42.40)		3.18(9.61)		2.61(6.31)		4.11(15.39)		3.60	
S. Em. +	0.04		0.01		0.01		0.28		0.32	
C.D. at 5%	0.13		0.04		0.03		1.09		1.24	
Foliar Spray										
Dimethoate 30 EC, 0.03%	4.34 (18.34)		2.19 (4.30)		1.84 (2.89)		2.79 (7.28)		6.51	
Acephate 75 SP, 0.075%	4.30 (17.99)		2.35 (5.02)		1.99 (3.46)		2.88 (7.79)		4.99	
Flonicamid 50 WG, 0.03%	4.23 (17.39)		2.22 (4.43)		1.91 (3.15)		2.79 (7.28)		5.92	
Diafenthiuron 50 WP, 0.05%	4.48 (19.57)		2.59 (6.21)		2.21 (4.38)		3.09 (9.05)		4.66	
Control	7.91 (65.07)		3.06 (8.86)		2.76 (7.12)		4.58 (20.48)		3.31	
S. Em. +	0.05		0.02		0.01		0.42		0.12	
C.D. at 5%	0.14		0.05		0.03		NS		0.34	
Interactions	**S. Em. +**	**C.D. at 5%**	**S. Em. +**	**C.D. at 5%**	**S. Em. +**	**C.D. at 5%**	**S. Em. +**	**C.D. at 5%**	**S. Em. +**	**C.D. at 5%**
(Main) R	-	-	-	-	-	-	0.28	1.09	0.32	1.24
(Sub) F	-	-	-	-	-	-	0.42	NS	0.12	0.34
P	-	-	-	-	-	-	0.56	NS	-	-
Y	-	-	-	-	-	-	0.013	0.04	0.06	0.17
Y x R	-	-	-	-	-	-	0.02	0.07	0.10	0.30
R x F	0.19	0.53	0.07	0.18	0.04	0.11	0.13	NS	0.21	NS
Y x F	-	-	-	-	-	-	0.03	0.09	0.21	NS
Y x R x F	-	-	-	-	-	-	0.06	0.15	0.36	NS
P	0.09	0.24	0.03	0.08	0.02	0.05	0.56	NS	-	-

R x P	0.09	0.25	0.03	0.08	0.02	0.05	0.55	NS	-	-
F x P	0.15	0.41	0.05	0.14	0.03	0.08	0.47	NS	-	-
R x F x P	0.33	NS	0.11	0.32	0.07	0.19	0.15	NS	-	-
Y x P	-	-	-	-	-	-	0.03	0.09	-	-
Y x R x P	-	-	-	-	-	-	0.09	0.26	-	-
Y x F x P	-	-	-	-	-	-	0.12	0.33	-	-
Y x R x F x P	-	-	-	-	-	-	0.21	0.57	-	-
C. V. %	13.09		9.24		6.23		12.76		14.14	
* The figures in parenthesis are retransformed values, those outsides are $\sqrt{X+0.5}$ transformed values										

Table 2: Economics of different treatments evaluated against aphid on gaillardia

Treatments	Total cost of treatments including labour charges (Rs/ha)	Yield (q/ha)	Net gain over control (q/ha)	Realization Over control (Rs/ha)	ICBR
1	**4**	**5**	**6**	**8**	**9**
Thiamethoxam 25 WG, 0.0125% + Dimethoate 30 EC, 0.03%	2735	8.16	6.32	12640	1: 4.62
Thiamethoxam 25 WG, 0.0125% +Acephate 75 SP, 0.075%	3310	6.31	4.47	8940	1: 2.70
Thiamethoxam 25 WG, 0.0125% +Flonicamid 50 WP, 0.03%	5310	7.86	6.02	12040	1: 2.26
Thiamethoxam 25 WG, 0.0125% +Diafenthiuron 50 WP, 0.05%	6210	6.24	4.40	8800	1: 1.41
Thiamethoxam 25 WG, 0.0125% + Control (water spray)	378	4.89	3.05	6100	1: 16.13
Imidacloprid 70 WG, 0.014% + Dimethoate 30 EC, 0.03%	2635	6.49	4.65	9300	1: 3.52
Imidacloprid 70 WG, 0.014% +Acephate 75 SP, 0.075%	3210	4.94	3.10	6200	1: 1.93
Imidacloprid 70 WG, 0.014% +Flonicamid 50 WP, 0.03%	5210	5.55	3.71	7420	1: 1.42
Imidacloprid 70 WG, 0.014% +Diafenthiuron 50 WP, 0.05%	6110	4.51	2.67	5340	1: 0.87
Imidacloprid 70 WG, 0.014% + Control (water spray)	278	3.20	1.36	2720	1: 9.78
Control (water dipping) + Dimethoate 30 EC, 0.03%	2357	4.86	3.02	6040	1: 2.56
Control (water dipping) +Acephate 75 SP, 0.075%	2932	3.72	1.88	3760	1: 1.28
Control (water dipping) +Flonicamid 50 WP, 0.03%	4932	4.34	2.50	5000	1: 1.01
Control (water dipping) +Diafenthiuron 50 WP, 0.05%	5832	3.22	1.38	2760	1: 0.47
Control (water dipping) + Control (water spray)	-	1.84	-	-	-

4. Conclusion

Among the main plot treatment root dip treatment with thiamethoxam 25 WG 0.0125% (5 g/ 10 litre of water) coupled with sub plot treatment of foliar spray of dimethioate 30 EC 0.03% (10 ml/ 10 litre of water) was found effective and economical against gaillardia aphid which reflected on yield and economics.

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