

Evaluation of biorationals in management of chrysanthemum aphid, *Macrosiphoniella sanbornii* (Gillette)

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ABSTRACT

Nymphs and adults of chrysanthemum aphid *Macrosiphoniella sanbornii* (Gillette) colonize on under-surface of leaves, apical shoots, buds and flowers. They suck sap resulting in devitalization of affected parts. In order to find out the relative efficacy of different biorationals/insecticides like azadirachtin @ 5 ml/l, karanj oil @ 2 ml/l, *Verticillium* @ 5 g/l, *Verticillium* @ 5 g/l followed by azadirachtin @ 5 ml/l, *Verticillium* @ 5 g/l followed by karanj oil @ 2 ml and imidacloprid @ 0.4 ml/l two sprays at ten days interval were applied. Field experiment was conducted at Floriculture Research Station, Rajendranagar, Hyderabad. The insecticides were evaluated on the basis of reduction in population over control at 1, 3, 5, 7 and 10 days after spraying (DAS). Among treatments imidacloprid was the most effective treatment in reducing aphid population by 92.31 per cent which was a significant reduction over untreated control as compared to the other treatments. The next effective treatments were *Verticillium* followed by azadirachtin (68.54%), two sprays of azadirachtin (68.49%) and *Verticillium* followed by karanj oil (67.34%) which were all significantly different from each other. Two sprays of *Verticillium* were found to significantly reduce aphid population over control but was least effective (64.66%) in comparison to rest of the treatments.

Keywords: Efficacy; biorationals; chrysanthemum; aphid; spray

INTRODUCTION

Chrysanthemum belongs to the family Asteraceae and is native to northern hemisphere chiefly Europe and Asia. Mostly the species in the lineage of present day cultivars are from China and the country is credited for having domesticated and hybridized the flowers for improvement.

In India chrysanthemums are grown for cut flowers, loose flowers, as potted plants and as border plants in the garden. In north India various hues of red, yellow, white and purple colour chrysanthemums are grown in abundance for decorating the landscape either in the ground or in pots. But in southern India mostly the yellow colour flowers are

preferred and grown as loose flowers for trade. Profitable production of chrysanthemum is constrained by several factors the most important being damage caused by insect pests such as aphids, caterpillars, mites, whiteflies, thrips and leafminer. Among these pests chrysanthemum aphid (*Macrosiphoniella sanbornii* Gillette) causes direct damage through feeding and indirectly by sooty mold formation (Agrios 1988). To control aphid damage insecticides are being used in large quantities indiscriminately adding to environmental pollution as well as cost of production. It was therefore necessary to devise pest management strategies to manage chrysanthemum aphid which would not only be economically feasible but also ecologically sound through biorationals.

MATERIAL and METHODS

An experiment was conducted in simple RBD with biorationals for their bio-efficacy against *Macrosiphoniella sanbornii* (Gillette) during Kharif 2013-14 at Floriculture Research Station, Agricultural Research Institute, Rajendranagar, Hyderabad.

One month old nursery-grown silper cuttings were transplanted in the 2 x 2 m plots in a manner to accommodate 36 plants in each plot with seven treatments and three replications on 8 August 2013. The insecticides used along with other details are given in Table 1. All the recommended agronomic practices were followed. Treatments used for bioefficacy studies against the aphids were T₁: Azadirachtin 10000 ppm (5 ml/l), T₂: Karanj oil 20000 ppm (2 ml/l), T₃: *Verticillium lecanii* (5 g/l), T₄: *Verticillium* followed by azadirachtin (5 g/l and 5 ml/l), T₅: *Verticillium* followed by karanj oil (5 g/l and 2 ml/l), T₆: Imidacloprid 17.8 SL (0.4 ml/l) and T₇: Untreated control. The same treatments of T₁, T₂, T₃ and T₆ were applied twice at ten days interval and one application of T₄ and T₅ was followed by another after ten days interval.

In all the treatments two sprays were given during the course of investigations. First spray was done on 15 December when pest incidence was noticed and second 10 days after first spray on 26 December. The spray was done with knapsack sprayer during evening hours to minimize drift of insecticides on neighboring plots. The plants in each treatment were covered with respective spray fluid thoroughly.

RESULTS and DISCUSSION

Two sprays were given during the cropping period at an interval of ten days when the crop recorded maximum load of aphids. The pre-treatment data were recorded one day prior to spraying and the post-treatment data at one, three, five, seven and ten days after each spray and the efficacy of insecticidal treatments was determined in terms of per cent

reduction in the insect population over untreated control in each treatment, cumulative reduction of aphids due to each spray and combined effect of the two sprays was worked out.

Efficacy of different biorational insecticides against chrysanthemum aphid after first spray (Table 2)

The population of aphids in pre-count in all the treatments ranged between 74.5 and 81.2 on an average/plant and was on par with each other. Consequent on imposition of different treatments there was a decline in the aphid population which resulted in differential rate of decrease in different combinations. One day after spray showed that imidacloprid-treated plots recorded highest reduction over control (97.20%). The next effective treatment was karanj oil with 60.53 per cent mortality of aphids. The least population reduction was observed in azadirachtin-treated plots (52.96%) which was on par with three *Verticillium* treatments of 47.09, 47.50 and 47.86 per cent respectively.

Similar trend was observed three days after spray where imidacloprid was the most effective and most superior treatment which recorded 99.04 per cent population reduction over control followed by *Verticillium* treatment which were on par with each other ranging between 72.74 and 75.88 per cent and the least mortality in aphid population was in case of karanj oil (66.98%) that was on par with azadirachtin (69.23%). Five days after spraying imidacloprid recorded the highest population reduction (91.32%) and next better treatment was azadirachtin with 79.99 per cent mortality which was on par with verticillium (T₃) treatment which gave 77.80 per cent mortality. Three *Verticillium*-treated plots recorded similar per cent reduction over control and three of them were on par with each other. Karanj oil (66.98%) recorded least per cent reduction over control.

After seven days of first insecticidal spray per cent field efficacy was highest in plots treated with

Table 1. Insecticides applied against chrysanthemum aphid, *M. sanbornii* for evaluation of relative efficacy

Common name	Trade name	Formulation	Dosage	Source
Azadirachtin	Nivaar	10000 ppm 1% EC	5 ml/l	Shri Disha Biotech Pvt Ltd, Hyderabad
Karanj oil	Karanj oil	20000 ppm	2 ml/l	IICT, Hyderabad
<i>Verticillium lecanii</i>	Vertifire-L	1.15% WP	5 g/l	International Panaacea Ltd, New Delhi
Imidacloprid	Confidor	17.8 SL	0.4 ml/l	Bayer Crop Science Ltd, Bombay

Table 2. Efficacy of different biorational insecticides against chrysanthemum aphid, *M sanbornii* during Kharif 2013-14

T	Pre-count	Mean number of aphids/plant (DAS)					Per cent reduction in aphid population over control (DAS)					Cumulative efficacy
		1	3	5	7	10	1	3	5	7	10	
After first spray												
T ₁	78.2 (62.17)	38.13	24.81	16.81	23.74	31.58	52.96 (46.70) ^a	69.23 (56.31) ^a	79.99 (63.43) ^c	72.15 (58.12) ^c	65.43 (53.99) ^b	67.95 (55.52) ^c
T ₂	74.5 (59.67)	30.48	25.37	21.23	25.47	35.13	60.53 (51.08) ^b	66.98 (54.93) ^a	73.49 (59.01) ^a	68.63 (55.94) ^b	59.63 (50.56) ^a	65.85 (54.24) ^{ab}
T ₃	76.4 (60.94)	36.15	21.48	18.23	32.30	37.01	54.36 (47.50) ^a	72.74 (58.53) ^b	77.80 (61.84) ^{bc}	61.22 (51.49) ^a	58.53 (49.91) ^a	64.93 (53.69) ^a
T ₄	79.1 (62.80)	38.02	19.68	20.06	31.07	36.17	53.64 (47.09) ^a	75.88 (60.59) ^b	76.40 (60.94) ^b	63.97 (53.12) ^a	60.85 (51.27) ^a	66.15 (54.42) ^b
T ₅	78.3 (62.24)	36.54	21.03	19.43	32.08	36.43	54.98 (47.86) ^a	73.96 (59.32) ^b	76.91 (61.28) ^b	62.46 (52.20) ^a	60.17 (50.81) ^a	65.69 (54.15) ^{ab}
T ₆	81.2 (63.30)	2.36	0.80	7.57	13.55	20.53	97.20 (80.37) ^c	99.04 (84.38) ^c	91.32 (72.87) ^d	84.69 (66.97) ^d	78.35 (62.27) ^c	90.12 (71.68) ^d
T ₇	76.2 (60.80)	79.00	78.60	81.90	83.08	89.02	-	-	-	-	-	-
CD _{0.05}	4.12						1.43	2	1.69	1.98	1.45	0.654
SE±0.69							0.46	0.65	0.55	0.64	0.47	0.297
After second spray												
T ₁	30.33 (33.42)	14.21	9.18	5.82	8.40	10.78	53.19 (46.83) ^a	70.14 (56.88) ^{bc}	81.51 (64.54) ^c	73.66 (59.12) ^b	66.67 (54.74) ^c	69.03 (56.19) ^b
T ₂	33.00 (35.06)	13.14	11.22	8.35	9.80	13.34	60.22 (50.90) ^b	66.46 (54.61) ^a	75.62 (60.42) ^a	71.76 (57.90) ^b	62.09 (52.00) ^b	67.23 (55.08) ^b
T ₃	34.27 (35.83)	15.52	9.46	7.80	14.29	16.08	54.75 (47.73) ^a	72.77 (58.55) ^{de}	78.07 (62.08) ^b	60.35 (50.97) ^a	56.00 (48.45) ^a	64.39 (53.36) ^a
T ₄	36.58 (37.22)	16.66	10.42	6.40	8.92	12.34	54.50 (47.58) ^a	71.90 (57.99) ^{cd}	83.14 (65.76) ^c	76.81 (61.21) ^c	68.36 (55.78) ^c	70.94 (57.38) ^c
T ₅	33.49 (35.36)	13.44	10.55	8.01	10.02	11.57	59.90 (50.72) ^b	68.92 (56.12) ^{ab}	76.96 (61.32) ^{ab}	71.55 (57.77) ^b	67.60 (55.31) ^c	68.98 (56.16) ^{bc}
T ₆	22.18 (28.10)	0.00	0.00	0.95	2.17	3.33	100 (90.00) ^c	100 (90.00) ^f	95.87 (78.28) ^d	90.69 (72.24) ^d	85.92 (67.96) ^d	94.49 (76.44) ^d
T ₇	89.21 (89.21)	89.30	90.40	92.62	93.82	95.14	-	-	-	-	-	-
CD _{0.05}	1.70						1.28	1.51	1.21	1.85	1.58	1.138
SE±0.55							0.41	0.49	0.39	0.6	0.51	0.517

Figures in parentheses are arc sine transformed values

DAS: Days after spraying. T: Treatment, T₁: Azadirachtin 10000 ppm (5 ml/l), T₂: Karanj oil 20000 ppm (2 ml/l), T₃: *Verticillium lecanii* (5 g/l), T₄: *Verticillium* followed by azadirachtin (5 g/l and 5 ml/l), T₅: *Verticillium* followed by karanj oil (5 g/l and 2 ml/l), T₆: Imidacloprid 17.8 SL (0.4 ml/l) and T₇: Untreated control

imidacloprid (84.69%) followed by azadirachtin (72.15%) and karanj oil (68.63%) and *Verticillium*-treated plots showed least reduction over control. Ten days after first spray imidacloprid remained the most effective treatment which recorded 78.35 per cent aphid population reduction and was superior to all other treatments followed by azadirachtin with 65.43 per cent reduction. The *Verticillium*-treated plots showed least reduction of aphids over control which was on par with two other *Verticillium*-treated and karanj oil-treated plots in terms of their efficacy.

Data after first spray revealed that imidacloprid was found to be significantly superior to other treatments reducing aphid population to an extent of 90.12 per cent followed by azadirachtin (67.95%). The least population reduction was observed in *Verticillium*-treated plots ranging between 64 and 66 per cent. The three *Verticillium* treatments and karanj oil were on par with one another with respect to reduction in aphid population.

Efficacy of different biorational insecticides against chrysanthemum aphid after second application (Table 2)

One day after second spray imidacloprid was the most effective treatment and was found significantly superior over all other treatments in reducing the aphid population (100%). The other promising treatment was karanj oil with 50.90 per cent reduction of aphid population over control. At three days after insecticidal application all the treatments were found significantly superior over control and imidacloprid spray continued to show extremely good result with 100 per cent aphid population reduction over control followed by *Verticillium* (72.77%) and azadirachtin (71.90%) which were on par with each other. Karanj oil was found to be least effective causing 66.46 per cent reduction.

Five days after second spray imidacloprid was most effective with 95.87 per cent reduction followed by azadirachtin treatments which were on par with each other. Karanj oil treatment was found to be least effective and was on par with *Verticillium* in its efficacy. Same trend continued seven days after second spray also with imidacloprid recording 90.69 per cent reduction of aphid population and was significantly superior to the remaining treatments. Azadirachtin (T_4) was next effective treatment with 76.81 per cent mortality followed by azadirachtin (T_1), karanj oil (T_2) and karanj oil (T_5) with 73.66, 71.76

and 71.55 per cent reduction over control respectively. The least per cent reduction over control was observed in *Verticillium*-treated plots (60.35%). Ten days after second spray again indicated imidacloprid as the best with highest population reduction of 85.92 per cent and significantly superior to all other treatments. Azadirachtin (T_4), karanj oil (T_5) and azadirachtin (T_1) recorded 68.36, 67.60 and 66.67 per cent reduction over control. *Verticillium* treatment was found to be least effective which recorded 56 per cent reduction over control.

The overall efficacy of different insecticidal treatments after second round of spraying indicated that all the insecticidal treatments were significantly superior over the control in reducing the aphid population. The overall efficacy of insecticidal treatments against aphid in the descending order of their efficacy was imidacloprid (T_6), azadirachtin (T_4), azadirachtin (T_1), karanj oil (T_5), karanj oil (T_2) and *Verticillium* (T_3) with per cent reduction of aphid population over control being 94.49, 70.94, 69.03, 68.98, 67.23 and 64.39 respectively. Among the treatments imposed karanj oil-treated plots recorded similar reduction with azadirachtin-treated plots.

Cumulative efficacy of different biorational insecticides against chrysanthemum aphid after two sprays (Table 3)

The overall effect of treatments on aphid population after two applications revealed that imidacloprid was found significantly superior to the rest of treatments with 92.31 per cent mortality. The next effective treatments were *Verticillium* followed by azadirachtin (68.54%), two sprays of alone azadirachtin (68.49%) and *Verticillium* followed by karanj oil (67.34%). Two consecutive sprays of karanj oil (66.54%) and *Verticillium* followed by karanj oil (67.34%) were found to be on par with each other.

Among all the treatments imidacloprid proved to be the best treatment while *Verticillium* alone (64.66%) was least effective against the aphids. *Verticillium* followed by azadirachtin and *Verticillium* followed by karanj oil were found to be more effective than two consecutive sprays of *Verticillium* at ten days interval.

Several studies have shown that imidacloprid 200 SL/17.8 SL @ 25 g ai/ha/0.005 per cent concentration was very effective in reducing aphid populations particularly cotton aphid (Preetha et al

Table 3. Cumulative efficacy of different biorational insecticides against chrysanthemum aphid, *M sanbornii* during Kharif 2013-14

T	Mean percentage reduction over control after		Cumulative mean
	First spray	Second spray	
T ₁	67.95 (55.52) ^c	69.03 (56.19) ^{bc}	68.49 (55.86) ^c
T ₂	65.85 (54.24) ^{ab}	67.23 (55.08) ^b	66.54 (54.66) ^b
T ₃	64.93 (53.69) ^a	64.39 (53.36) ^a	64.66 (53.53) ^a
T ₄	66.15 (54.42) ^b	70.94 (57.38) ^c	68.54 (55.89) ^d
T ₅	65.69 (54.15) ^{ab}	68.98 (56.16) ^{bc}	67.34 (55.15) ^{bc}
T ₆	90.12 (71.68) ^d	94.49 (76.44) ^d	92.31 (73.90) ^e
T ₇	-	-	-
CD _{0.05}	0.654	1.138	0.886
SE _±	0.297	0.517	0.402

Figures in parentheses are arc sine transformed values

T: Treatment, T₁: Azadirachtin 10000 ppm (5 ml/l), T₂: Karanj oil 20000 ppm (2 ml/l), T₃: *Verticillium lecanii* (5 g/l), T₄: *Verticillium* followed by azadirachtin (5 g/l and 5 ml/l), T₅: *Verticillium* followed by karanj oil (5 g/l and 2 ml/l), T₆: Imidacloprid 17.8 SL (0.4 ml/l) and T₇: Untreated control

2012). This was once again proved in the present study where out of all the insecticides tested imidacloprid 17.8 SL @ 0.4 ml/l gave 92.31 per cent reduction in aphid population in chrysanthemum after two continuous sprays. However biorational options like azadirachtin, karanj oil and *Verticillium* were able to cause nearly 70 per cent mortality of aphids over control. *Verticillium lecanii* @ 5 g/l followed by either azadirachtin @ 5 ml/l or karanj oil @ 2 ml/l was found to work more effectively in reducing aphid population as compared to two consecutive sprays of *Verticillium* alone. Several reports exist on the efficiency of azadirachtin/neem oil, karanj oil and *Verticillium* as independent sprays accounting for more than 50 per cent control of aphid populations (Kathiriya and Bharpoda 2010, Kumar et al. 2007, Sopp et al 1990).

Sabir et al (2012) found that integrated treatments were more effective than individual treatments in the management of key insect pests of chrysanthemum as evidenced by the efficacy of combination of agricultural spray oil and azadirachtin. The present study shows that *Verticillium* followed by azadirachtin/karanj oil was effective in reducing aphid population by 68.54 and 67.34 per cent. Hence the above results are promising alternative to the usage of chemical insecticide alone as the fungus and botanical pesticide combination may be effectively used along

with natural control agents like parasitoids and predators to keep the aphid population under check.

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