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Studies on Population Dynamics and Management of Whitefly, *Trialeurodes vaporariorum* on Chrysanthemum under Polyhouse Conditions

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ABSTRACT

Population dynamics of whitefly (*Trialeurodes vaporariorum*) and its management through use of synthetic insecticides in chrysanthemum variety 'Aris' was studied at Hi-Tech Horticulture Unit of Dr. Rajendra Prasad Central Agricultural University, Pusa during *rabi* 2017-18. During early plant stage of chrysanthemum was recorded with population of 4.72 whitefly per three leaves and reached peak population of 67.26 whitefly per three leaves in the 49th SMW of December 2018. Thereafter, whitefly population decreased continuously to 22.66 per three leaves by the end of cropping season. The maximum temperature (r = -0.521), minimum temperature (r= -0.66) and evening relative humidity @ 14.00 hrs (r = -0.051) had a negative correlation with whitefly population while relative humidity in morning @ 7.00 hrs (r=0.358) had a positive correlation. The weather parameters were found to contribute around 53.80% impact on population of whitefly when acted together (R^2 =0.5380). The maximum reduction of whitefly population over control was recorded in imidaclorprid @ 20 g a.i./ha (59.80 and 63.43%) followed by profenophos @ 500 g a.i./ha (54.24 and 57.04%) and buprofezin @ 10 g a.i./ha (51.91 and 54.41%) during first and second sprays, respectively. The maximum increased yield of 3.00 q/ha and cost-benefit ratio of 1:8.57 was recorded in imidacloprid @ 20 g a.i./ha followed by profenophos @ 500 g a.i./ha (2.70 q/ha and 1:7.11) and buprofezin @ 10 g a.i. /ha (2.33 q/ha and 1:6.50), respectively. Among botonicals, neem oil 5% (55.69%), neem oil 2% (51.74%) and NSKE 5% (48.77%) were found as superior treatments with higher per cent reduction over control after third spray.

Keywords *Trialeurodes vaporariorum*, Chrysanthemum, Population dynamics, Botanicals, Synthetic insecticides.

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INTRODUCTION

The flowers symbolize beauty, purity, honesty and divinity. With the changing life style and increased urban affluence, floriculture has assumed a definite commercial status in India. So the demand for fresh flowers is on the increase, more and more area is being brought under floriculture, ornamental trees and shrubs. This has led to the establishment of export oriented commercial floriculture projects where high-quality flowers are grown under protected polyhouse conditions. India is the second largest flower producer just after China. In India, major cut flowers of commercial importance are rose, chrysanthemum, gladiolus, tuberose, carnation, gerbera, lily and marigold grown under Hi-tech floriculture for export and domestic markets. The Andhra Pradesh, Karnataka, Maharashtra, Telangana and Madhya Pradesh are the major chrysanthemum producing states in India, both in terms of area and production.

Chrysanthemum (*Dendranthema grandiflora* Borkh) is one of the most beautiful flowering plant extolled to as Queen of the East. It is also known as "Autumn flower". Chrysanthemum (*Chryos*-golden, *anthos*-flower) ranks second to rose among top ten cut flowers in the world trade of flower crops preferred particularly for its range of shapes and size of flower, brilliant color tones and long-lasting shelf life of flower (Brahma 2002). In India it has been recognized as one among the five commercially important flower crops (Janakiram *et al*. 2006).

Among the various factors affecting production and quality of flowers, infestation by insect pests is one of the important factors which reduce the produce quality as well as quantity. The uniform environmental condition in polyhouse favors the multiplication of sucking insect pests around the year. The most commonly associated insect pests with chrysanthemum are whitefly, aphid, mites, leafminer. Among insect pests, whitefly is one of the serious pests of chrysanthemum. Whiteflies are small, often inconspicuous insects' that are globally distributed as agricultural pests of both greenhouse and field crops. Although > 1,500 species of whiteflies exist, only a few causes serious economic loss. The greenhouse whitefly, (*Trialeurodes vaporariorum* (Westwood) and the Tobacco whitefly, *Bemisia tabaci* (Gennadius) (Hemiptera, Aleyrodidae), represent the two most widely studied and pestiferous species. Whiteflies (Homoptera : Aleyrodidae) are sap sucking pest and cause major threat to chrysanthemum crop under polyhouse conditions. The affected plant parts may wilt, turn yellow, shed leaves and display reduced growth rates if infestation is severe. Hence, it is imperative to know about the insect pests which damage these plants and methods to combat the same (Butani 1974).

MATERIALS AND METHODS

The experiment was carried out in experimental farm (Hi-Tech Horticulture unit at Pusa) of Dr. Rajendra Prasad Central Agricultural University, Pusa, which lies in the district Samastipur. The observations on the population of whitefly were recorded at weekly intervals on five randomly selected plants of chrysanthemum under polyhouse conditions. The population of whitefly was recorded at three leaves (upper third, middle and lower) of tagged plants on both sides of the leaves, with the help of a magnifying glass (10x) in morning hours. The plants were carefully handled to avoid disturbing of the pests and their natural enemies on the crop to get actual population. Field observations were taken in the morning during 6 to 8 am. Meteorological data were also recorded to find out the effect of temperature and humidity on the whitefly population invading chrysanthemum under polyhouse conditions. Correlation of pest population with abiotic factors including temperature (maximum and minimum) and relative humidity (7.00 hrs and 14.00 hrs) was worked out using statistical analysis program.

The synthetic chemical insecticides were sprayed twice during cropping season at 15 days interval and the botanical insecticides were sprayed thrice during the cropping season at 10 days interval immediately after crossing the ETL (10-15 T. vaporariorum /leaf) in separate field experiments. Observations pertaining to population of whitefly were recorded on five randomly selected and tagged plants only on three leaves (upper third, middle and lower) on the both sides of the leaves, with the help of magnifying glass (10x) in morning hours. The observations were recorded one day before first spraying and 3, 7 and 14 days after each spray in the plots where synthetic chemical insecticides were applied. However, the observations were recorded after 3 and 7 days after each spraying in case of botanical insecticides treated plots.

Table 1. Population dynamics of whitefly, *T. vaporariorumon* chrysanthemum in relation to abiotic factors during *rabi* 2018.

Standard meteorological	Temperature (ºC)		Relative humidity (%)		Mean whitefly population/3 leaves
	Max	Min	7.00 hrs	14.00 hrs	
41	35.1	27.0	91	71	4.72
42	35.4	24.8	90	65	7.94
43	35.5	22.8	92	67	11.17
44	31.8	21.5	88	62	22.42
45	32.2	19.3	89	58	36.18
46	33.6	18.7	89	58	41.83
47	29.8	14.4	87	63	52.64
48	28.1	12.6	93	66	65.42
49	28.5	12.5	96	66	67.26
50	29.1	14 .5	94	71	66.94
51	24.6	13.8	96	73	57.66
01	29.6	12.8	97	79	42.54
02	22.2	10.9	95	72	40.62
03	23.6	8.7	93	68	37.66
04	25.2	9.1	95	72	34.12
05	27.0	12.6	94	71	22.66

RESULTS AND DISCUSSION

The experiment on population dynamics of whitefly (*Trialeurodes vaporariorum*) and its management in chrysanthemum variety 'Aris' (Table 1) revealed that the pest activity started in 41th standard meteorological week (SMW) of October 2018 and continued till harvesting of the chrysanthemum crop. i.e 49th SMW of December 2018. It was observed that the whitefly population in the beginning was low (4.72 whitefly/ three leaves) and reached to 67.26 whitefly/three leaves in the 49th SMW of December 2018. Thereafter its population started declining slowly (66.74 to 22.66 whitefly/three leaves). The corresponding weather parameters at peak whitefly population (67.26 whitefly / three leaves) were 28.5, 12.5, 96 and 66 of maximum and minimum temperature (°C), relative humidity (%) at 7.00 and 14.00 hrs, respectively.

Correlation studies summarized in Table 2 indicated that whitefly population had the maximum temperature (r=-0.521), minimum temperature (r=-0.66) and evening relative humidity @ 14.00 hrs (r=-0.051) had a negative correlation with whitefly population while relative humidity in morning @ 7.00 hrs (r=0.358) had a positive correlation. The weather

Table 2. Correlation coefficient and regression equation between weather parameters (X) and mean number of *T. vaporariorum* per three leaves (Y).

Weather parameter	Correlation coefficient (r)
Maximum temperature (ºC) (X_1)	-0.521
Minimum temperature (ºC) (X_2)	-0.66
Relative humidity 7.00 hrs (X_3)	0.358
Relative humidity 14.00 hrs (X_4)	-0.051
Multiple regression equation:	$Y = 16.278 + (X_1) + (-3.047)(X_2) + 2.670(X_3) + (-1.7220)(X_4)$
Coefficient of determination (R^2)	0.538

parameters were found to contribute around 53.80% impact on *Trialeurodes vaporariorum* population when acted together (R^2=0.538). The present findings are in agreement with the results of earlier workers. Gupta *et al.* (1998) reported that minimum temperature and evening relative humidity were significantly correlated with whitefly population in cotton. Reddy (2002) also found a positive correlation of maximum and minimum temperature and morning relative humidity with whitefly population on castor in Andhra Pradesh while evening humidity has shown a negative correlation. Dhaka and Pareek (2008) also observed that maximum temperature had a significant positive effect and evening humidity had a negative effect on whitefly population.

The mean per cent reduction over control in whitefly population by synthetic insecticides after first spray varied among the treatments (Table 3). It was maximum (59.80%) in imidaclorpid treatment @ 20 g a.i./ha closely followed by profenophos @ 500 g a.i./ha (54.24%) and buprofezin @ 10 g a.i./ ha (51.91%). After second spray, the mean per cent reduction was again maximum in imidacloprid treatment @ 20 g a.i./ha (63.43%) closely followed by profenophos @ 500 g a.i./ha (57.04%), buprofezin @ 10 g a.i./ha (54.41%) and thiacloprid @ 20 g a.i./ ha (52.60%). Deltamethrin treatment @ 10 g a.i./ha recorded lowest mean per cent reduction (44.75%) in whitefly population. All the botanical insecticidal treatments were also significantly superior to untreated control in reducing the whitefly population on chrysanthemum (Table 4). The mean per cent reduction over control in whitefly population varied from 30.84 - 47.65% after first spray, from 34.54 to

Table 3. Economy and efficacy of different synthetic insecticides on whitefly population on chrysanthemum during *rabi* 2018.

		1st Spray		2nd Spray				
Insecticide	Dose (g a.i./ha	Whitefly population per three leaves per plant	Mean per-cent reduction over control	Whitefly population per three leaves per plant	Mean per-cent reduction over control	Mean yield (q/ha)	Increased yield over control (q/ha)	Cost-benefit ratio
Profenophos	500	15.50	54.24	26.47	57.04	13.00	2.70	1:7.61
Deltamethrin	10	19.12	43.91	34.05	44.75	11.80	1.50	1:3.81
Imidacloprid	20	13.52	59.80	22.45	63.43	13.30	3.00	1:8.57
Thiacloprid	20	17.90	47.22	29.15	52.6	12.30	2.00	1:5.47
Thiamethoxam	20	17.25	49.18	31.63	48.64	12.15	1.85	1:4.88
Buprofezin	10	16.24	51.91	28.03	54.41	12.63	2.33	1:6.50
Control		34.62	-	62.00	-	10.30	-	-

51.26 % after second spray and 41.84 to 55.69 % after third spray. Neem oil (5%), neem oil (2%) and NSKE (5%) were superior over other insecticidal treatments.

All the synthetic insecticides were significantly superior over untreated control in increasing the yield of chrysanthemum flowers (Table 3). The mean yield varied from 11.80 to 13.33 q/ha in insecticide treated plots. The increase in yield varied from the maximum of 3.00 q/ha in imidacloprid @ 20 g a.i./ha to the minimum of 1.50 q/ha in deltamethrin @ 10 g a.i./ha showing a corresponding increase of 29.12 and 14.56%, respectively. The cost - benefit ratio was found maximum in imidacloprid @ 20 g a.i. /ha (1:8.57) closely followed by profenophos @ 500 g a.i./ha (1:7.11) and buprofezin @ 10 g a.i. /ha (1:6.50). Deltamethin treatment@ 10 g a.i./ha recorded lowest cost benefit ratio (1:3.81). The present findings are in agreement to the reports of Singh and Loknath (2003) who reported that profenophosh was the most effective treatment against *B. tabaci* on brinjal crop. Sangle *et al.* (2017) also reported imidacloprid as most effective insecticide against whitefly in chilli. The observation of Kar (2017) that imidacloprid and thiamethoxam were most effective in reducing whitefly population is also in close confirmation to the present findings.

In botanical insecticides treated plots (Table 4), the mean yield of chrysanthemum flowers varied from 11.53 to 12.32 q/ha. The increase in yield varied from the maximum of 1.67 q/ha in neem oil @ 5% to the minimum of 0.88 q/ha in karanj oil @ 2% showing a corresponding increase of 15.68 and 8.26% in yield of chrysanthemum cut flowers under polyhouse conditions. The cost-benefit ratio was

Table 4. Economy and efficacy of different botanical insecticides on whitefly population on chrysanthemum during *rabi* 2018.

		1st spray		2nd spray		3rd spray				
Insecticide leaves	Dose over	Whitefly popula-tion per three leaves per plant	Mean percent reduc-tion control con-trol	White-fly popu-lation per three leaves per plant	Mean per cent reduc-tion over control	Whitefly popula-tion per three leaves per plant	Mean percent reduction over control	Mean yield (q/ha)	Increa-sed yield over con-trol (q/ha)	Cost benefit ratio
Neem oil	2%	18.45	42.00	25.34	45.57	30.71	51.74	12.13	1.48	1:4.26
Neem oil	5%	16.64	47.65	22.30	51.26	28.20	55.69	12.32	1.67	1:6.32
Karanj oil	2%	21.97	30.84	29.94	34.54	37.05	41.84	11.53	0.88	1:2.66
Karanj oil	5%	20.675	34.87	27.22	40.46	34.56	45.74	11.73	1.08	1:3.61
NSKE	5%	19.4	38.93	26.46	42.14	32.62	48.77	11.90	1.25	1:4.63
YBSE	5%	21	33.90	28.45	37.88	36.06	43.38	11.65	1.00	1:3.31
Control		32.065	–	46.02	–	63.75		10.65	–	–

found maximum in neem oil @ 5 % (1:6.32) closely followed by NSKE @ 5% (1:4.63) and neem oil @ 2 % (1:4.26). These findings are in partial agreement with the results of Gupta (2013) who reported that in brinjal yield was maximum in indoxacarb treated plots than imidacloprid treated plots against shoot and fruit borer (*Leucinodes orbonalis*) but cost - benefit ratio was maximum in imidacloprid treated plots. Patil *et al.* (2003) obtained increased yield in neem seed extract and tobacco decoction treated plots as compared to untreated control plot and cost- benefit ratio was maximum in neem seed karnel extract treatment.

CONCLUSION

Effective management of whitefly in chrysanthemum is only possible after better understanding of insect pest complex and dynamics. Synthetic insecticides viz., imidacloprid @ 20 g a.i. /ha (1:8.57), profenophos @ 500 g a.i/ha and buprofezin @ 10 g a.i. /ha can be recommended for two successive spray at 15 days interval for effective management of whitefly. Botanicals such as neem oil @ 5%, neem oil @ 2 % and NSKE @ 5% are also equally efficient as synthetic insecticides which can be recommended as an alternative them under IPM practices.

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