SEASONAL INCIDENCE OF MITE AND INFUENCE OF PESTICIDAL APPLICATION ON ORCHID FLOWER PRODUCTION

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Abstract: Investigations were carried out in 2010 to determine the influence of abiotic factors on the incidence of the two spotted spider mite; *Tetranychus urticae* Koch and to determine the influence of pesticides on orchid flower production. Initially, in January, the mite population was very low (1.0 mite/10 cm^2 leaf area). The population gradually increased and peaked to 22.98 mites/10 cm^2 leaf area in the first fortnight of May along with the rise in temperature and sunshine. Then, the population declined to a low level of 3.43 mites/10 cm^2 leaf area in the first fortnight of December. Maximum and minimum temperatures had a significant positive correlation and sunshine had a non-significant positive correlation, whereas relative humidity and rainfall had a non-significant negative correlation with the mite population. Infestation of the two spotted spider mite was more severe in untreated conditions in comparison to the treated ones. The difference was due to various abiotic factors and natural pest infestation occurrence which drastically affected the flower quality and yield. In unprotected conditions, the number of flower spikes/plant (1.90±0.44 spikes), number of flowers/spike (7.35±1.04 flowers), spike length (42.59±5.69 cm), flower spike diameter (5.26±0.66 mm), and flower size (6.27±0.86 cm) was very low. In protected conditions, flower quality and yield were superior than in unprotected conditions *i.e.* number of flower spike/plant (2.92±0.57 spikes), number of flowers/spike (11.78±1.16 flowers), spike length (57.59±7.35 cm), diameter of flower spikes (9.09±1.01 mm), and flower size (6.73±1.16 cm).

Key words: flower yield, orchids, seasonal occurrence, *Tetranychus urticae*

INTRODUCTION

Orchids are fascinating and beautiful flowers. They exhibit a wide range of diversity. Orchids belong to Orchidaceae, the largest floriculture family recognized as the most important entrepreneur (as orchid genetic resource, cut flower, potted plant, bouquet, and many other value added products) in the international floriculture trade (Kuehnle 2007). Worldwide, there are about 30,000 species of orchids of 800 genera. India accounts for nearly 7 per cent of the genetic diversity of the world's orchids, contributing 1,300 species under 184 genera (Satish Kumar and Manilal 1994). About 800 species are found in the north eastern region of the country (Nagaraju *et al*. 2006). The hills in northeastern India are the richest phyto-geographical habitat for these orchids in India because of the prevailing climatic conditions. Among various categories of orchids in the Orchidaceae family, *Cymbidium* is only the orchid which produces flowers that considered in the top ten cut-flower categories of the international market. Orchids get infested with various kinds of insect pests like scale insects, mites, thrips, aphids, black weevils, lepidopteran caterpillars, grasshoppers, mealybugs, slugs and snails (Pritchard 1959; Batchelor 1982). Amongst these, the two spotted spider mite, *Tetranychus urticae* Koch, is a serious pest of *Cymbidium* 'Winter Beach Sea Green'. *T. urticae* is found on the ventral surface of leaves, flower buds, and flowers. Apart from *Cymbidium*, the mite also feeds on other ornamental plants and vegetable crops in both greenhouse/polyhouse and field conditions due to the changing agricultural scenario (Naher *et al*. 2008; Natarajan 2001). Tuttle and Baker (1968) first reported this species of mite in the USA. This mite occurs throughout the year on the *Cymbidium* orchid and causes moderate to severe damage in different seasons. With the ongoing expansion of orchid cultivation in India, it is imperative to develop ecologically based pest management practices that will optimize the quality and production of flowers while reducing pest management costs and impacts. The aims are to have systematic studies on: the population dynamics of *T. urticae,* and on the influence of pesticides in local orchid farms. Hence, the present experiments were conducted as follow-up observations of the *Cymbidium* orchid. The observations were done to quantify the population dynamics of the mite as well as the effect of pesticidal applications on flower production, in terms of various plant parameters.

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MATERIALS AND METHODS

Studies on the seasonal incidence of the two spotted spider mite, *T. urticae* and the influence of pesticidal applications on orchid flower production were carried out from January to December 2010, on five-year-old potted plants of *Cymbidium* 'Winter Beach Sea Green' under greenhouse/polyhouse conditions. The location of the experimental site was 27°20'N and 88°40'E at the National Research Centre for Orchids (ICAR), Pakyong, Sikkim, India. Two separate experiments were conducted in which the weather conditions and agronomical practices were the same. Both experiments were replicated three times. Five plants were selected and tagged as a unit of observation in each replication. In the first experiment, the host plants were allowed to undergo natural pest infestation. No plant protection measures were applied to control the pest during the study period. The second experiment was conducted in 2010. In the second experiment, three pesticidal applications with neem oil (azadirachtin) 0.03 EC (5 ml/lit.) and bifenthrin (Talstar) 10 EC (0.25%) were applied alternatively at fifteen day intervals during the higher mite incidence months of April till June. The higher mite incidence was due to favorable abiotic factors. The mite population was observed and recorded from a 10 cm^2 leaf area of each selected and tagged leaf of the potted plants. A hand lens (10x) was used to help see more closely. The observations and recordings were done at fortnightly intervals during the study period. Simultaneously, the weather data on maximum and minimum temperature (C°), percent of relative humidity, sunshine (hrs), and rainfall (mm) were also collected from the centre's meteorological observatory. The data on the mite population used in the analysis and correlation coefficient was worked out with above ecological parameters. The separate observations on various flower parameters, like total number of flower spikes/plant, number of flowers/spike, spike length and diameter, and flower size were also recorded in both the protected and unprotected experiments to make explicit the data on flower quality and production.

RESULTS AND DISCUSSION

The results of our present investigations on the impact of abiotic factors on the seasonal incidence of the two spotted spider mite, *T. urticae,* are presented in table 1. It was observed that the two spotted spider mite, *T. urticae,* persisted on orchid (*Cymbidium* 'Winter Beach Sea Green') throughout the year under polyhouse/greenhouse conditions. Initially, during the January-February time period, mite populations were very low (1.0–4.10 mites/10 cm^2 leaf area). The populations subsequently increased and reached a maximum of 22.98 mites/10 cm^2 leaf area, during the first fortnight (18th standard meteorological week) of May. Similar results were reported by Karmakar and Dey (2006). The present findings are also in agreement with Mashue *et al.* (1998) who showed that high tempera-

Table 1. Seasonal incidence of the two spotted spider mite, *T. urticae,* on orchids, in relation to weather parameters during 2010

Month	Interval	Std. Met. weeks	Temperature [C°]		Relative humidity [%]	Rainfall [mm]	Sunshine [hrs]	Population/ 10 cm^2 leaf area
			maximum	minimum				
January	1st fortnight	1	15.96	6.39	65.45	0.00	8.07	1.00*
	2nd fortnight	3	16.86	7.28	56.20	0.00	8.10	4.10
February	1st fortnight	5	16.65	7.48	68.33	170.25	8.16	1.25
	2nd fortnight	7	17.00	9.84	71.29	97.42	7.86	3.25
March	1st fortnight	9	19.90	12.15	66.29	124.30	8.34	6.50
	2nd fortnight	11	21.62	14.31	65.01	129.45	7.12	12.38
April	1st fortnight	13	23.94	14.77	58.27	68.55	9.53	20.86
	2nd fortnight	15	23.25	15.58	77.51	120.40	8.80	20.80
May	1st fortnight	18	23.60	16.43	76.17	71.66	9.01	22.98
	2nd fortnight	20	23.36	16.76	79.07	107.95	8.18	21.00
June	1st fortnight	22	24.02	18.11	69.15	85.90	8.57	21.13
	2nd fortnight	24	24.33	18.80	71.25	152.70	8.04	14.30
July	1st fortnight	26	23.75	19.21	94.23	435.00	7.83	3.52
	2nd fortnight	28	24.02	19.00	92.42	144.50	10.23	7.65
August	1st fortnight	31	25.05	19.31	81.16	122.39	8.26	7.26
	2nd fortnight	33	22.49	19.63	92.86	226.44	7.01	4.72
September	1st fortnight	35	21.93	19.81	94.04	204.15	5.75	4.75
	2nd fortnight	37	22.78	18.25	89.65	51.70	11.81	10.63
October	1st fortnight	40	22.97	16.77	83.73	36.47	15.15	14.15
	2nd fortnight	42	21.58	14.89	83.45	18.92	7.67	9.10
November	1st fortnight	44	20.15	12.43	78.75	1.00	7.65	6.67
	2nd fortnight	46	17.63	11.70	84.46	1.00	6.95	5.32
December	1st fortnight	48	17.94	8.29	68.82	170.00	7.62	3.43
	2nd fortnight	50	15.59	6.38	71.55	0.00	7.81	0.00

*average mite population from 45 leaves; Std. – standard; Met. – meteorological

ture and drought conditions favoured the occurrence of mites. The prevailing high temperature coupled with low humidity was observed to be very advantageous for the rapid multiplication of this species of mite. The mite population declined in an inconsistent manner as the atmospheric relative humidity increased. The lowest level of 3.43 mites/10 cm^2 leaf area was reached during the first fortnight of December. During the second fortnight of December, the mite population was negligible due to very low temperatures. From the correlation studies (Fig. 1), the incidence of *T. urticae* was found to have a significantly positive correlation with maximum and minimum temperature (r = 0.6924 and r = 0.4923), and a non-significant positive correlation with sunshine (r = 0.3351). Relative humidity (r = –0.1002) and rainfall (r = –1109) were negatively correlated with mite population. These results clarify the earlier findings of Rajakumar *et al*. (2005) and Mahato *et al*. (2008). Many other workers have also done extensive research on red spider mites, relating population fluctuations due to abiotic factors on plants other than orchids (Stanyard *et al*. 1997).

Orchid flower production is accomplished based on various parameters viz., total number of flower spikes per plant, number of flowers per spike, spike length and diameter, and size of the flowers. In unprotected conditions, the data on various parameters (Table 2) showed that mite incidence was more severe when there were fluctuations or changes in abiotic factors during particular parts of the year. Such fluctuations or changes resulted in the production of only 1 to 3 flower spikes by most of the plants [average (av.) 1.90 ±0.44 spikes/plant]. The total number of flowers per spike was also much less in unprotected conditions, in comparison to protected conditions. In unprotected conditions, the total number of flowers per spike ranged from 5.0 to 10.0 (av. 7.35±1.04) flowers. Flower spikes length varied from 34.20 to 56.40 cm with an average of 42.59±5.69 cm along with a 6.25 to 8.80 (av. 5.26±0.66) mm flower diameter. There was also a decrease in flower size which ranged from 5.0 to 8.20 cm (av. 6.27±0.86 cm).

In the protected conditions, the mite incidence on treated plants was reduced. The mite incidence disappeared completely after the third pesticidal application. The result was that most of the plants produced 2 to 4 flower spikes, with an average of 2.92±0.57 spikes per plant. The total number of flowers per spike varied from

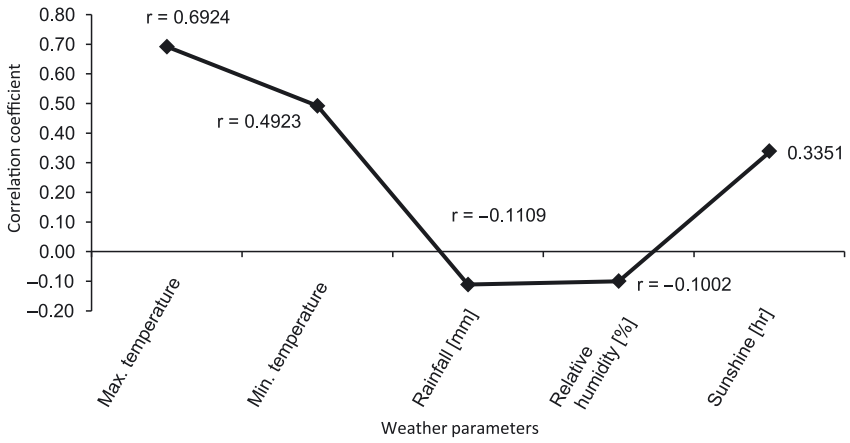

Fig. 1. Correlation coefficient of mite incidence with abiotic factors under polyhouse/greenhouse conditions

Table 2. Impact of mite incidence on flower production of *Cymbidium* 'Winter Beach Sea Green' under unprotected conditions

Treatment	Different parameters of flower yield				
	No. of flower spike/ plant	No. of flower/spike	spike length [cm]	diameter of flower spike [mm]	flower size [cm]
*P1	2.00	7.40	41.72	5.42	6.10
P2	1.80	6.80	35.44	4.17	5.85
P3	2.07	7.20	43.21	4.76	5.08
P4	2.73	6.40	38.00	5.00	4.92
P5	1.40	8.00	44.12	5.27	6.59
P6	1.20	9.00	52.67	6.32	7.58
P7	2.20	8.13	50.40	6.08	7.16
P8	1.87	5.73	36.96	4.86	5.96
P9	2.13	8.47	44.85	5.81	6.78
P10	1.60	6.40	38.52	4.95	6.70
Range (av.±σ)	1–3 (1.90±0.44)	5–10 (7.35±1.04)	34.20–56.40 (42.59±5.69)	6.25–8.80 (5.26±0.66)	5–8.20 (6.27±0.86)

*P – plots; values are given for an average of 15 plants; σ – standard deviation

Table 3. Impact of mite incidence on flower production of *Cymbidium* 'Winter Beach Sea Green' under protected conditions

Treatment	Different parameters of flower yield				
	No. of flower spike/ plant	No. of flower/spike	spike length [cm]	diameter of flower spike [mm]	flower size [cm]
*P1	2.67	9.87	43.26	8.00	5.60
P2	2.33	12.60	59.00	9.82	7.12
P3	3.60	11.67	51.18	8.73	5.72
P4	2.20	13.00	64.22	10.58	8.05
P5	3.00	10.60	57.33	9.05	6.76
P6	2.40	12.93	65.10	10.67	9.18
P7	3.60	11.52	50.56	8.10	5.63
P8	3.07	10.40	66.45	8.25	6.39
P9	3.73	12.20	58.25	8.20	6.00
P10	2.60	13.00	60.55	9.50	6.85
Range (av.±σ)	2–4 (2.92±0.57)	8–13 (11.78±1.16)	40.10–67.15 (57.59±7.35)	8–11.50 (9.09±1.01)	5.50–10 (6.73±1.16)

*P – plots; values are given for an average of 15 plants; σ – standard deviation

8.0 to 13.0, with an average of 11.78±1.16. The spike length ranged from 40.10 to 67.15 (av. 57.59±7.35) cm, whereas spike diameter ranged from 8.0 to 11.50 mm with a mean diameter of 9.09±1.01 mm. The size of the flowers varied from 5.50 to 10.0 cm with an average of 6.73±1.16 cm (Table 3). A marked difference was observed in flower opening and shape of the flowers in both unprotected and protected conditions. A higher population of mites caused discoloration and uneven petal size. These disfigurations meant that the marketability of the orchids was reduced. There has been no previous work done in this line so far, hence, the results could not be compared and discussed.

CONCLUSION

The results of this study show the influence of different abiotic factors on mite incidence and influence of pesticidal applications on the flower production of the *Cymbidium* orchid. In unprotected conditions, the climatic factors, especially temperature and relative humidity, played a major role in the severity of mite infestation. In unprotected conditions, flower quality and production were significantly affected when compare with these factors under protective conditions, over the season. For obtaining good quality and a higher flower yield of *Cymbidium* 'Winter Beach Sea Green' low temperatures and high relative humidity inside polyhouses/greenhouses must be provided. This may be done by modifying structures or providing extra facilities to avoid a sudden climate changing effect as well as using plant protection measures (pesticidal applications).

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