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# Biological control of spider mite, *Tetranychus urticae* Koch on rose *Vis-à-vis* leaf quality

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**Abstract**
The spider mite, *Tetranychus urticae* Koch damages rose plants grown in polyhouses. This pest is being managed by spraying several chemicals; however in such plots the plants continue to appear unhealthy. In plots where spider mite is managed by releasing the predatory mite, *Neoseiulus longispinosus* (Evans) the plants look healthier. The apparent difference in quality of the leaves in plots where the predators were released at different predator to prey ratios was monitored by estimating the leaf chlorophyll content. The results revealed that the chlorophyll content of rose leaves was higher in the plots where predators were released compared to pesticides sprayed plots of both bottom and middle canopy leaves.

**Keywords:** Rose, chlorophyll, spider mite, predators

## 1. Introduction
Karnataka is a pioneering state in cultivation of commercial flowers. The floriculture industry in the state enjoys several natural and infrastructural advantages. The state ranks first in terms of production and export of cut flowers in the country [10]. The five flowers, namely, rose, chrysanthemum, carnation, tulip and lily account for 70-75 per cent of the world trade. The international trade of cut flowers was US $ 4.22 billion during 2008, compared with US $ 4.32 billion during 2007 [1]. The export of cut flowers from India during 1995-96 was about Rs. 601.41 million [7]. The potential of world market for all floricultural products has been estimated to be US $ 50 billion with a 15 per cent annual growth rate. In view of a number of features in favour of India, namely varied agro-climate, skilled manpower, proximity to consuming markets, Government of India has identified floriculture, with cut flowers as an extreme focus segment for boosting export potential of the country. The Expert Group of the Planning Commission has proposed an annual export target of Rs.100 crores for cut flowers.
Cut flowers are generally grown in polyhouses. Temperature, humidity, ventilation of air is controlled by the equipments fixed in the polyhouse. The modern breeding techniques have helped in obtaining attractive colorful flowers with greater export value. However, such hybrid plants are more susceptible to pests and diseases. Among the pests, two spotted spider mite, *Tetranychus urticae* Koch is the major one both in polyhouses and also under open field conditions [8]. Spider mite populations build up to tremendous numbers and can decimate roses in a very short time under favourable conditions. This pest is being managed by spraying several chemicals; however in such plots the plants continue to appear unhealthy. To know the difference in chlorophyll content, it is essential to estimate the chlorophyll loss due to mite feeding and its recovery after the mite populations are managed.

## 2. Materials and methods
To quantify the chlorophyll loss due to mite feeding and its recovery after the suppression of the spider mites population, the leaf chlorophyll content was estimated separately during June 2011 and compared between predator released plots and plots where spider mites were controlled using synthetic chemicals.
For chlorophyll estimation leaf samples were collected from each treatment, before and at weekly intervals after the release of the predators up to 15 weeks. One gram of leaf samples was taken and incubated overnight in 20ml mixture of DMSO (Dimethyl sulphoxide) and acetone (80 %) at 1: 1 ratio. The supernatant extract (0.5 ml) was taken and diluted with 9.5 ml of DMSO and acetone mixture. Absorbance was recorded using spectrophotometer (Thermo Spectronic Genesys 10μv) at 645 and 663 nm wave lengths. Using the absorbance values total chlorophyll content was estimated using the formulae suggested by Arnon [2].

Total chlorophyll: [20.8 ($A_{645}$) + 8.02 ($A_{663}$) x V/ W] x 1000

[V - Volume of dilution by solvent in ml, and
W - Weight of leaves in grams,
$A_{663}$ and $A_{645}$ – Absorbance values at 663 and 645 nm, respectively].

The chlorophyll content was compared with the corresponding week's total spider mite population.

## 3. Results and Discussion

### 3.1 Chlorophyll content in rose leaves where spider mites were managed by using the predator, *N. longispinosus*

#### 3.1.1 Chlorophyll content in middle canopy leaves of rose plants

Before release of predators, the total chlorophyll (mg/g) was 3.54, 3.36, 3.80, 3.19, 3.78, 3.33, 3.45 and 3.51 mg/ g of rose leaves in T1, T2, T3, T4, T5, T6, T7 and T8 (in plots where the pesticides were used) treatments, respectively (Table 1 & Fig. 1). One week after release of predators the total chlorophyll was 3.59, 3.53, 3.42, 3.56, 3.52, 3.85, 3.40 and 3.25 mg/g of rose leaves, respectively.

Among the different treatments, the highest level of total chlorophyll (4.46 mg/g) was recorded 12 weeks after predator release in 1:25 predator-prey ratio. In 1:50 predator-prey ratio the maximum chlorophyll content was 4.30 mg/g 13 weeks after predator release. It was maximum of 4.17 mg/g after eleven weeks in 1:100 predator-prey ratios. In the treatments where predators were released at 1:200 and 1:400 predator-prey ratios, the high amount (4.09 and 4.40 mg/g, respectively) of chlorophyll was recorded 12 weeks after predator release. In 1:600 predator-prey ratio chlorophyll recorded was maximum of 4.06 mg/g 13 weeks after predator release. In control plots the chlorophyll content recorded was maximum of 4.21 mg/g 13 weeks after predator release. In pesticides used plots the chlorophyll content was relatively low (2.87 mg/g) 13 weeks after the start of the study compared to other treatments.

#### 3.1.2 Chlorophyll content in rose leaves in bottom canopy

At the time of release of predators, the chlorophyll content was 3.43, 3.70, 3.03, 3.14, 3.10, 3.71, 3.60 and 3.27 mg/ g of leaf in T1, T2, T3, T4, T5, T6, T7 and T8 (in plots where the pesticides were used) treatments, respectively (Table 2 & Fig. 2). One week after the release of predators the chlorophyll was 3.74, 3.31, 3.47, 3.69, 3.48, 3.85, 3.40 and 3.25 mg/g of leaf, respectively. In all the treatments the chlorophyll fluctuated during different weeks of observation. Chlorophyll was high (4.55 mg/g) in plants on which predators were released at 1:25 predator-prey ratio compared to all other treatments, 12 weeks after predator release. The lowest amount of chlorophyll (2.78 mg/g) was recorded in plants from plots where pesticides were applied, 13 weeks after the start of study. In plants on which predators were released at 1:50, 1:400 and 1: 600 predator-prey ratios the total chlorophyll was high (4.39, 3.84 and 4.18 mg/g of leaf, respectively) 13 weeks after predator release. In plants in other treatments like 1:100 predator-prey ratio and predator free plots the total chlorophyll (4.35 and 4.17 mg/g of rose leaves, respectively) was maximum 12 weeks after predator release.

The amount of chlorophyll estimated during successive weeks after predator release recorded an increasing trend. This was mainly due to plants recovery from mite injury, consequent to elimination of the spider mites by the phytoseiids. Thus in predator released plots significantly higher amount of chlorophyll was recorded compared to pesticides sprayed plots since there was no complete elimination of spider mites in the plots where the pesticides were used to manage the spider mite (Figure 1&2), whereas in predator released plots the *T. urticae* population was found eliminated completely.

Studies have been carried out by several workers on the nature of damage and extent of loss caused by *T. urticae* in different crops. *T. urticae* injures individual leaf cells, causing the reduction of total chlorophyll content and net photosynthetic rate of leaves [6], [9]. Such leaf cell and tissue injury alters carbon allocation patterns of plant organs [11], often causing deformity of plants [3] and reduce the yield potential of the plants. Due to feeding by two spotted spider mite, *T. urticae* on apple and peach [4], cucumber [9], and tomato [5] total chlorophyll content was found reduced. Similarly in the present study, the total chlorophyll recorded before predator release was less due to feeding damage by the spider mites. Once the spider mites population was reduced by the predators, the chlorophyll content improved during subsequent weeks as the plants recovered from spider mite damage.

**Table 1:** Chlorophyll content (mg/g) of middle canopy rose leaves v/s spider mite control using phytoseiids at different release ratios (Predator: Prey)

| Predator release ratios (Predator: prey) | BRP | Weeks after predator release | | | | | | | | | | | | | Overall mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | |
| 1:25 | 3.54 | 3.59 | 3.35 | 2.76 | 2.91 | 3.26 | 3.62 | 3.39 | 3.19 | 2.53 | 2.76 | 3.49 | 4.46 | 3.83 | 3.34 |
| 1:50 | 3.36 | 3.53 | 3.53 | 3.23 | 3.16 | 3.37 | 3.26 | 3.84 | 3.08 | 2.89 | 2.84 | 3.80 | 3.96 | 4.30 | 3.44 |
| 1:100 | 3.80 | 3.42 | 2.76 | 2.82 | 2.80 | 2.74 | 3.68 | 3.29 | 2.66 | 2.66 | 2.38 | 4.17 | 3.59 | 3.84 | 3.19 |
| 1:200 | 3.19 | 3.56 | 3.75 | 2.81 | 2.74 | 3.08 | 3.53 | 2.59 | 2.47 | 2.18 | 2.64 | 3.75 | 4.09 | 3.93 | 3.16 |
| 1:400 | 3.78 | 3.52 | 3.29 | 2.92 | 2.62 | 2.50 | 3.23 | 2.58 | 2.54 | 2.12 | 2.35 | 3.29 | 4.40 | 3.63 | 3.05 |
| 1:600 | 3.33 | 3.85 | 3.23 | 2.49 | 2.66 | 2.44 | 2.28 | 2.10 | 2.44 | 2.21 | 2.13 | 3.56 | 4.05 | 4.06 | 2.92 |
| Control | 3.45 | 3.40 | 3.59 | 2.31 | 1.92 | 1.89 | 2.49 | 2.06 | 2.36 | 2.09 | 2.44 | 3.50 | 3.66 | 4.21 | 2.81 |
| General* | 3.51 | 3.25 | 3.11 | 2.71 | 2.74 | 2.88 | 2.69 | 1.90 | 2.36 | 2.47 | 2.56 | 2.65 | 3.06 | 2.87 | 2.77 |
| 'F' test | * | * | * | * | * | * | * | * | * | * | * | * | * | * | - |
| S.Em.± | 0.01 | 0.01 | 0.02 | 0.001 | 0.02 | 0.03 | 0.09 | 0.05 | 0.007 | 0.01 | 0.014 | 0.01 | 0.04 | 0.017 | - |
| C.D. at P=0.05 | 0.21 | 0.18 | 0.25 | 0.05 | 0.27 | 0.32 | 0.54 | 0.40 | 0.15 | 0.25 | 0.21 | 0.21 | 0.38 | 0.23 | - |

Control: No release of predators
* Managed by spraying pesticides
* Significant at P=0.05

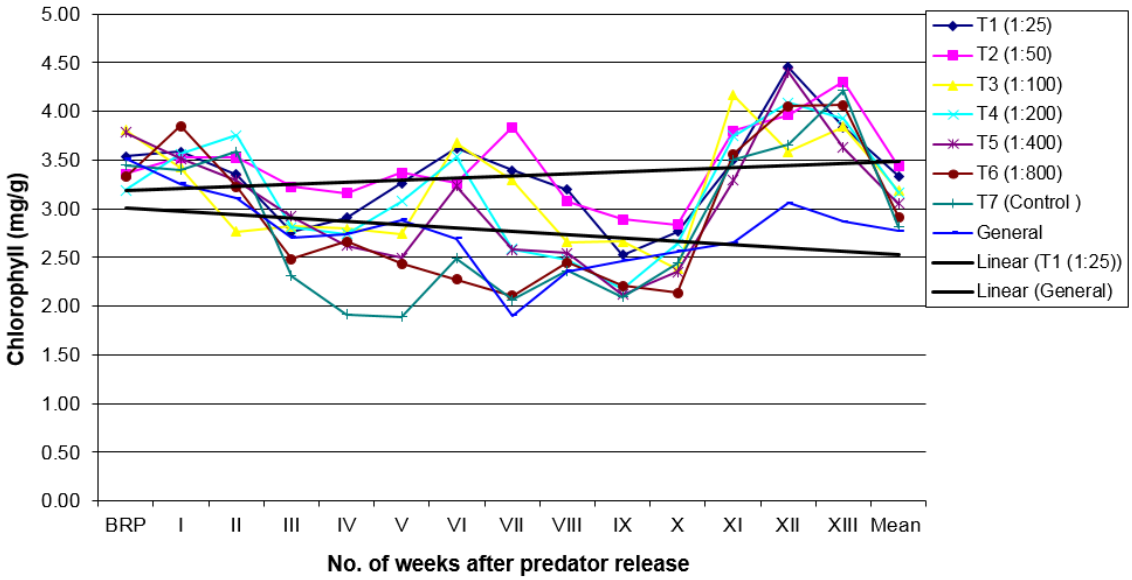


**Fig. 1. Chlorophyll content of rose leaves of middle canopy vis-à-vis spider mite control using predator at different release ratios**

**Table 2:** Chlorophyll content (mg/g) of bottom canopy rose leaves v/s spider mite control using phytoseiids at different release ratios

| Predator release ratios (Predator: prey) | BRP | Weeks after predator release | | | | | | | | | | | | | Overall mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | |
| 1:25 | 3.43 | 3.74 | 3.61 | 3.10 | 3.11 | 3.36 | 2.93 | 2.85 | 2.78 | 3.15 | 2.66 | 3.57 | 4.55 | 3.89 | 3.34 |
| 1:50 | 3.70 | 3.31 | 3.27 | 3.33 | 3.33 | 2.99 | 3.21 | 3.01 | 2.95 | 2.33 | 2.74 | 3.70 | 4.33 | 4.39 | 3.33 |
| 1:100 | 3.03 | 3.47 | 3.33 | 3.11 | 3.03 | 3.47 | 3.63 | 3.17 | 3.06 | 2.59 | 2.69 | 3.59 | 4.35 | 4.18 | 3.34 |
| 1:200 | 3.14 | 3.69 | 3.56 | 3.13 | 2.77 | 3.16 | 3.34 | 2.89 | 2.86 | 2.37 | 2.26 | 3.58 | 3.54 | 4.02 | 3.17 |
| 1:400 | 3.10 | 3.48 | 3.32 | 2.74 | 2.92 | 2.65 | 3.33 | 2.49 | 2.49 | 2.31 | 2.39 | 3.51 | 3.77 | 3.84 | 3.02 |
| 1:600 | 3.71 | 3.85 | 3.44 | 2.83 | 2.29 | 2.31 | 2.71 | 2.09 | 2.10 | 1.93 | 2.36 | 3.71 | 4.15 | 4.18 | 2.98 |
| Control | 3.60 | 3.40 | 3.50 | 2.04 | 1.97 | 1.93 | 2.48 | 1.99 | 2.00 | 2.00 | 2.59 | 3.68 | 4.17 | 3.83 | 2.80 |
| General* | 3.27 | 3.25 | 3.02 | 2.49 | 2.88 | 2.95 | 2.51 | 2.43 | 2.46 | 1.60 | 2.01 | 2.13 | 2.69 | 2.78 | 2.60 |
| 'F' test | * | * | * | * | * | * | * | * | * | * | * | * | * | * | - |
| S.Em.± | 0.01 | 0.03 | 0.012 | 0.02 | 0.03 | 0.026 | 0.001 | 0.013 | 0.03 | 0.01 | 0.006 | 0.033 | 0.018 | 0.02 | - |
| C.D. at P=0.05 | 0.19 | 0.32 | 0.19 | 0.28 | 0.33 | 0.28 | 0.17 | 0.21 | 0.30 | 0.22 | 0.14 | 0.15 | 0.24 | 0.25 | - |

Control: No release of predators
* Managed by spraying pesticides
* Significant at P=0.05

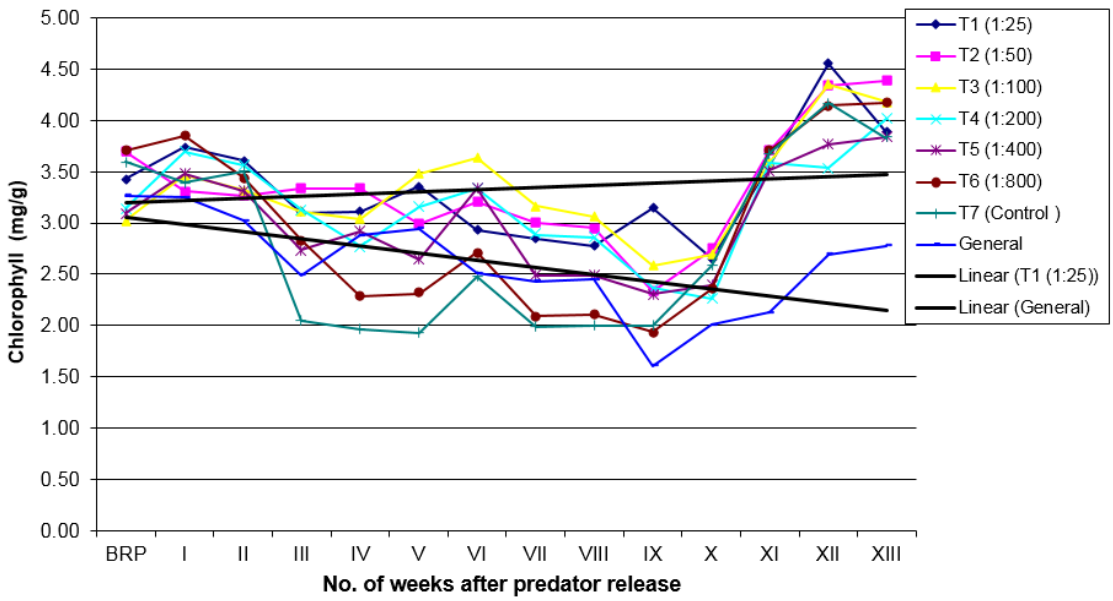


**Fig. 2. Chlorophyll content of rose leaves of bottom canopy vis-à-vis spider mite control using predator at different release ratios**

## 4. Conclusion

The chlorophyll content (mg/g) estimated from both rose and carnation plants where predators were released for suppressing the spider mite population and also from the plants where pesticides were sprayed to manage *T. urticae* population, revealed that the chlorophyll content of rose and carnation leaves was higher in the plots where predators were released compared to pesticides sprayed plots.

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## 6. References

1. Anonymous. Floriculture Crops 2008 Summary. United States Department of Agriculture, National Agricultural Statistics Service, 2009: Sp Cr 6-1.
2. Arnon di. Copper enzymes in isolated chloroplasts, Polyphenoloxidase in *Beta vulgaris*. Plant Physiol. 1949; 24(1):1-15.
3. Avery DJ, Briggs JB. The etiology and development of damage in young fruit trees infested with fruit tree red spider mite, *Panonychus ulmi* (Koch). Ann. Appl. Biol. 1968; 61: 227-228.
4. Campbell RJ, Mobley KN, Marini RP. Growing conditions influence mite damage on apple and peach leaves. Hort. Science, 1990; 25(4):445-448.
5. Jayasinghe GJ. Studies on ecology and biological control of the two spotted spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae) infesting tomato. Ph. D. Thesis, Department of Entomology, University of Agricultural Sciences, Bangalore, 2008, 95-120.
6. Latrou G, Cook CM, Stamou G, Lanaras T. Chlorophyll fluorescence and leaf chlorophyll content of bean leaves injured by spider mites (Acari: Tetranychidae). Exp. Appl. Acarol. 1995; 19:581-591.
7. Narendra KD. Cut flower production in Asia**.** RAP Publication.1998; 14:85.
8. Onkarappa, S. Management of two spotted spider mite, *Tetranychus urticae* Koch. (Acari: Tetranychidae) on rose. Ph.D Thesis, Department of Entomology, University of Agricultural Sciences, Bangalore. 1999, 1-3.
9. Park YL, Lee JH. Leaf cell and tissue damage of cucumber caused by two spotted spider mite (Acari: Tetranychidae). J. Econ. Entomol. 2002; 95:952–957.
10. Prasanna D, Srinivasa Gowda MV, Devaraj M. Hi-tech floriculture in Karnataka – yet to take –off? Retrieved online on 25-09-2009. 2008; www.commodityindia.com.
11. Wyman JA., Oatman ER, Voth V. Effects of varying two spotted spider mite infestation levels on strawberry yield. J. Econ. Entomol. 1979; 72: 747-753.