

## SOME STUDIES ON THE INTEGRATION OF CHEMICAL CONTROL WITH BIOLOGICAL CONTROL FOR COTTON INSECT PEST MANAGEMENT

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The studies were carried out by laying out replicated trial in Research Area of the Department of Agri. Entomology, University of Agriculture, Faisalabad to determine the feasibility of integrating chemical control with biological control for the management of cotton insect pests. The results showed that integration of bio control agents such as *Chrysoperla carnea* and *Trichogramma chilonis* individually as well as jointly with insecticides proved as effective as chemical control using recommended insecticides against sucking insect pests and spotted bollworms. The integrated control proved economical as it reduced the number of insecticide sprays from 8 in the chemical control to 2 in the integrated control treatments.

**Keywords:** Integration, *Chrysoperla*, *Trichogramma*, *chilonis*, biological, chemical control

### INTRODUCTION

In Pakistan, cotton crop is attacked by a variety of insect pests, out of which jassid, *Amrasca devastans*; whitefly, *Bemisia tabaci*; thrips, *Thrips tabaci*; spotted bollworm, *Earias spp.*, pink bollworm, *Pectinophora gossypiella* and American bollworm, *Helicoverpa armigera*, are the most important. According to Ahmed (1999) due to bollworm infestation, the crop losses is sometime as high as 45%. Sucking insect pests have been reported to cause seed cotton loss to tune of 4.6% (Satpute *et al.*, 1988)

For the control of insect pests of cotton, insecticides are mainly relied upon. For this purpose huge amount of pesticide worth billion of rupees is imported in the country, out of which 70%, is used on cotton alone. The heavy use of pesticides, besides, creating problems of health hazards, and environmental pollution has also resulted in the development of insect resistance to insecticides (Ahmad and Khan, 1991; Sorejani, 1998), and elimination of natural biological control agents (Hamburg and Guest, 1997), consequently, upsetting the natural balance of these insect pests. The use of insecticides is increasing day by day. The average number of sprays applied by farmers for cotton pest control was 3 in 1987 which went up to 6 in 1998 and now stands around 8 in the Punjab province of Pakistan. With such a heavy spraying schedule, the pest control is still not satisfactory.

The integrated control has been advised by many workers in the past (Ahmad and Khan, 1991) but no practical steps have been taken to provide empirical evidence of the usefulness of integrated control for the management of insect pests of cotton.

The main objective of present study was to find out the feasibility of integrating *Chrysoperla carnea* and *Trichogramma chilonis* with chemical insecticides.

### MATERIAL AND METHODS

The study was carried out during the year 2004 by laying out experiment in the Research Area of Department of Agri. Entomology, University of Agriculture, Faisalabad. There were in all five treatments which were replicated four time following RCBD. The detail of the treatments is as under

- T<sub>1</sub>= Chemical control:- 8 sprays;** S<sub>1</sub>-acetameprid, S<sub>2</sub>-deltamethrin, S<sub>3</sub>-cypermethrin, S<sub>4</sub>-acetameprid, S<sub>5</sub>-imidacloprid, S<sub>6</sub>-spinosad, S<sub>7</sub>-deltamethrin, S<sub>8</sub>-spinosad.
- T<sub>2</sub>= *Trichogramma chilonis* + two insecticide sprays:-** R<sub>1</sub>S<sub>0</sub>, R<sub>2</sub> S<sub>1</sub>-imidacloprid, R<sub>3</sub> S<sub>0</sub>, R<sub>4</sub> S<sub>0</sub>, R<sub>5</sub> S<sub>2</sub>-spinosad, R<sub>6</sub> S<sub>0</sub>, R<sub>7</sub> S<sub>0</sub>, R<sub>8</sub> S<sub>0</sub>.
- T<sub>3</sub>= *Chrysoperla carnea* + two insecticide sprays:-** R<sub>1</sub> S<sub>0</sub>, R<sub>2</sub> S<sub>1</sub> imidacloprid, R<sub>3</sub> S<sub>0</sub>, R<sub>4</sub> S<sub>0</sub>, R<sub>5</sub> S<sub>2</sub>-spinosad, R<sub>6</sub> S<sub>0</sub>, R<sub>7</sub> S<sub>0</sub>, R<sub>8</sub> S<sub>0</sub>.
- T<sub>4</sub>= *Chrysoperla carnea* + *Trichogramma chilonis* + 2 insecticide sprays** R<sub>1</sub> S<sub>0</sub>, R<sub>2</sub> S<sub>1</sub>-imidacloprid, R<sub>3</sub> S<sub>0</sub>, R<sub>4</sub> S<sub>0</sub>, R<sub>5</sub> S<sub>2</sub>-spinosad, R<sub>6</sub> S<sub>0</sub>, R<sub>7</sub> S<sub>0</sub>, R<sub>8</sub> S<sub>0</sub>)
- T<sub>5</sub>= Control:** No treatment  
S = Spray of Insecticides  
R = Release of biological control agents

#### Release of *Chrysoperla carnea* larvae

The egg sheets of *Chrysoperla carnea* were obtained from the Rearing Lab of Agri. Entomology Deptt. A single egg sheet contained 2000-2500 eggs. The *Chrysoperla carnea* were released at the rate of 2500 eggs per treatment at 15 days interval. The egg sheets were kept at 27±2°C and 60-65%, RH, for two days. When the colour of egg changed from white to grey, these sheets were cut into small pieces or rings having 20-25 eggs and attached to the lower surface of the leaves.

### Release of *Trichogramma chilonis* cards

The cards of *Trichogramma chilonis* were prepared in the laboratory of Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad. The cards were used at the rate of 300 eggs per treatment by attaching them to the lower surface of leaves before parasitoid emergence.

In the chemical control treatment, six insecticides viz , cypermethrin 10 EC @ 330 ml per acre, deltamethrin 2.5 EC @ 250 ml per acre , imidachloprid 200 SL @ 250 ml per acre, acetameprid 20SP @ 250 ml per acre, thiamethoxon 25 WP@ 24 gm per acre and spinosad 240 SC @ 80 ml were applied in 8 sprays at 12 days interval. The acetameprid and spinosad were applied twice as S<sub>1</sub> and S<sub>4</sub> and S<sub>6</sub> and S<sub>8</sub>, respectively.

### Data collection

Five plants, selected at random from the two middle rows, were observed in each treatment for recording the pest population. Tagging was done on all the selected plants to avoid repetition. The data were recorded on weekly basis. For bollworm infestation, the data were collected weekly from flowers, buds, squares and bolls, starting from 20<sup>th</sup> June and ending on 20<sup>th</sup> October. These data were converted into percentage infestation for bollworm at the end. The data were analyzed, statistically.

### RESULTS

The population of whitefly, jassid and thrips, and spotted bollworm infestation recorded at weekly interval are given in Table-1 and presented graphically in figures 1-4.

The whitefly population in treatments, T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub> and T<sub>5</sub> ranged from 1.73 to 3.05, 0.45 to 3.25, 0.35 to 3.25 and 0.73 to 4.73 and averaged 1.85, 2.14, 2.09, 2.36 and 3.63 respectively. The jassid population per leaf in the respective treatments ranged from 0.08 to 0.95, 0.33 to 3.13, 0.07 to 1.23, 0.35 to 0.98 and 0.41 to 5.87 and averaged 0.60, 1.78, 0.69, 0.53 and 3.42, respectively.

Similarly, the thrips population in the aforesaid treatments ranged from 0.03 to 3.8, 0.16 to 2.80, 0.09 to 4.35, 0.05 to 2.88 and 0.13 to 3.33 and averaged 1.71, 1.5, 2.15, 1.67 and 2.2 respectively.

The data given in the Table showed that overall average population of sucking insects, whitefly, jassid and thrips was statistically similar in T<sub>1</sub>(Chemical control), T<sub>2</sub> (*Trichogramma chilonis* + Chemical control), T<sub>3</sub> (*Chrysoperla carnea* + Chemical control) and T<sub>4</sub> (*Trichogramma chilonis* + *Chrysoperla carnea* + Chemical control) but differed significantly from T<sub>5</sub>

(Control). The spotted bollworm population in the respective treatments ranged from 0.03 to 2.09, 0.03 to 2.05, 0.17 to 2.23, 0.33 to 1.35, 0.23 to 5.45 and averaged 1.06, 1.17, 0.99, 0.94 and 2.93.

Spotted bollworm infestation in T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> was statistically similar but differed significantly from T<sub>5</sub> control plot.

### DISCUSSION

The overall average population of *Bemisia tabaci* in different treatments showed that chemical control gave maximum reduction as compared to other treatments but it did not differ significantly from T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub>. All the 4 treatments were, however, significantly better than control.

Jassid population in the control treatment (3.42) was significantly higher than other four treatments. (0.60-1.61/leaf) did not differ significantly from one another. Similarly in case of thrips, the average population was significantly higher in the control (T<sub>5</sub>) than the other four treatments in which jassid population was statistically at par. In case of spotted bollworm the overall average population was significantly higher in the control than the other treatments, where overall average infestation ranged from 0.94-2.93 %.

The overall results lead to the conclusion that application of 8 sprays for the chemical control did not do better than the other treatments where inundative release of *Chrysoperla carnea* and *Trichogramma chilonis* were made and were supported each with 2 sprays of pesticides.

Verma *et al.* (1988) reported that *Trichogramma chilonis*, was the most common egg parasitoid of *Earias spp.* with a percentage parasitism of 30% during September–October. Whereas the results of the present study showed that release of *Trichogramma chilonis* reduced insecticide sprayings from 8 to 2 only. Ahmad *et al.* (1996) observed that *Trichogramma chilonis* releases against cotton bollworms along with P.B. ropes (Pheromones) checked the bollworms infestation although pheromone and parasitoid treatments alone were effective. However they emphasized that combination of pheromone and parasitoids could be used more effectively against bollworms of cotton.

Similar studies on the integration of biological control agents *Chrysoperla carnea* with insecticides like amitraz, chloropyrifos, chlorfamaniphos carried out in Sudan, revealed in a significant reduction in whitefly population without harming the predators (Madina *et al.* 2001). Paswal and Williams (1998) and Patel *et al.*, (1999) also obtained satisfactory control of cotton pests by integrating biological control agents with chemical insecticides.

Table 1. Mean per week population of insect pests of cotton in different treatments during the period from June to October, 2004.

Weeks	<i>Bemisia tabaci</i>					<i>Amrasaca devastans</i>					<i>Thrips tabaci</i>					<i>Earlas spp.</i>				
	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	1.65	1.63	2.20	0.75	1.27	0.62	0.38	0.74	0.46	0.41	1.29	0.73	0.09	0.05	1.65	0	0	0	0	0
2	0.47	1.56	0.64	0.72	2.7	0.36	0.98	0.07	0.58	2.18	1.55	2.03	1.78	1.31	3.30	0.71	0.80	0.75	0.53	0.90
3	1.70	3.22	2.15	4.65	3.70	0.68	1.98	1.23	0.79	2.85	3.28	1.59	4.35	1.50	1.8	0.85	2.05	1.02	0.81	1.4
4	1.85	0.45	2.10	4.72	3.30	0.74	1.27	0.67	0.95	4.16	2.05	2.8	1.3	2.08	2.55	1.7	1.38	2.23	1.2	2.22
5	1.18	1.32	0.35	2.45	3.20	0.39	0.51	0.22	0.36	2.7	0.79	1.8	2.4	2.85	2.5	0.54	0.61	0.43	0.78	3.22
6	1.95	2.73	2.15	1.68	2.90	0.95	1.86	0.32	0.88	3.18	1.82	1.28	2.3	2.38	2.88	2.09	1.58	0.74	1.05	4.23
7	0.30	1.750	2.36	2.48	3.65	0.09	0.70	0.97	0.37	4.3	0.95	2.80	3.78	2.88	2.78	0.8	0.81	1.45	1.12	3.78
8	2.73	2.85	2.76	3.48	3.38	0.81	1.8	0.90	0.7	3.9	3.8	2.457	3.475	2.65	2.55	1.93	1.57	2.07	1.27	4.23
9	1.41	1.65	1.48	2.05	2.85	0.26	0.33	0.39	0.67	4.9	1.83	1.53	1.93	1.95	2.65	0.33	0.89	0.77	1.32	4.4
10	3.00	3.18	2.40	2.30	4.00	0.923	1.68	0.99	0.98	5.88	1.9	2.33	1.32	2.78	2.05	2.03	1.95	1.85	1.35	6.05
11	2.60	1.30	2.40	1.92	3.98	0.73	1.03	0.58	0.35	5.82	1.20	2.5	2.04	1.53	2.09	1.48	1.9	0.85	1.25	5.45
12	1.72	1.90	2.22	2.02	4.90	0.40	0.74	0.89	0.52	3.73	1.5	1.40	2.29	0.722	2.87	0.77	0.99	0.34	0.63	1.27
13	2.55	3.25	2.68	2.20	4.38	0.94	3.13	0.90	0.86	2.17	0.64	0.97	2.42	0.17	1.31	0.68	0.95	0.17	0.33	0.76
14	3.05	2.95	3.25	1.55	5.60	0.70	1.57	0.95	0.85	1.82	0.03	0.15	0.64	0.26	0.13	0.031	0.038	0.23	0.61	0.28
Average	1.85	2.14	2.09	2.36	3.63	0.60	1.78	0.69	0.53	3.42	1.71	1.5	2.15	1.67	2.20	1.06	1.17	0.99	0.94	2.93

Fig. 1. Comparison of mean population of Jassid of different treatments at different weeks

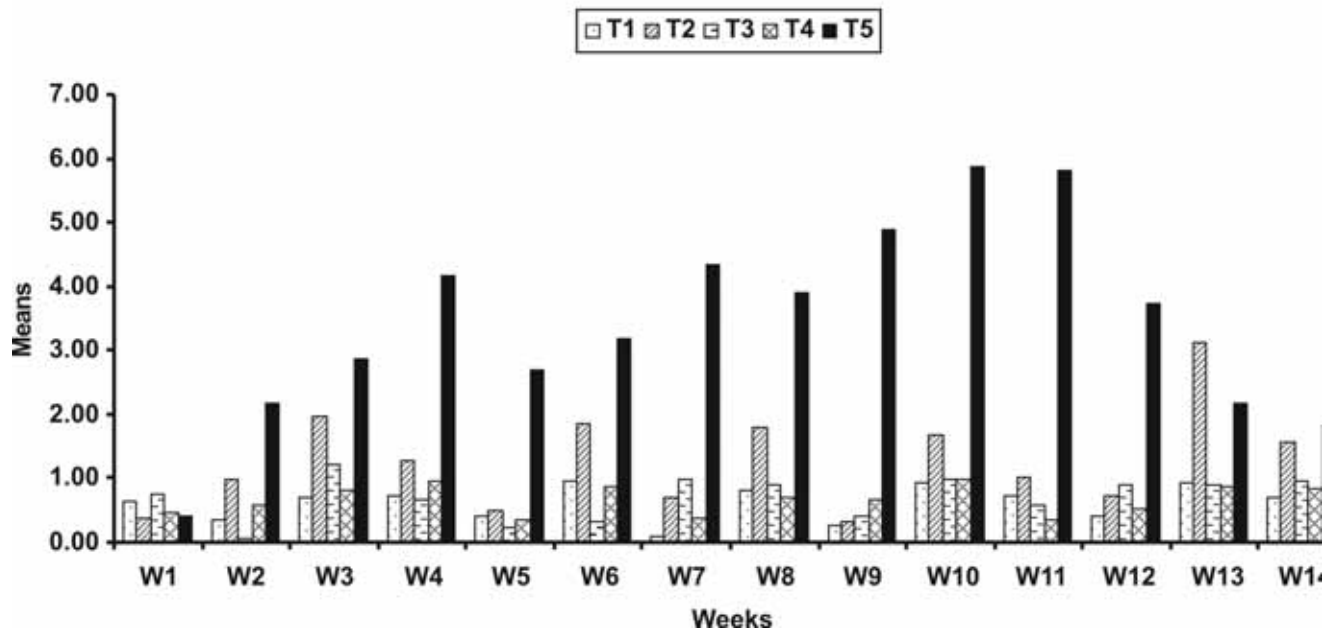


Fig. 2. Comparison of mean population of Spotted bollworm of different treatments at different weeks

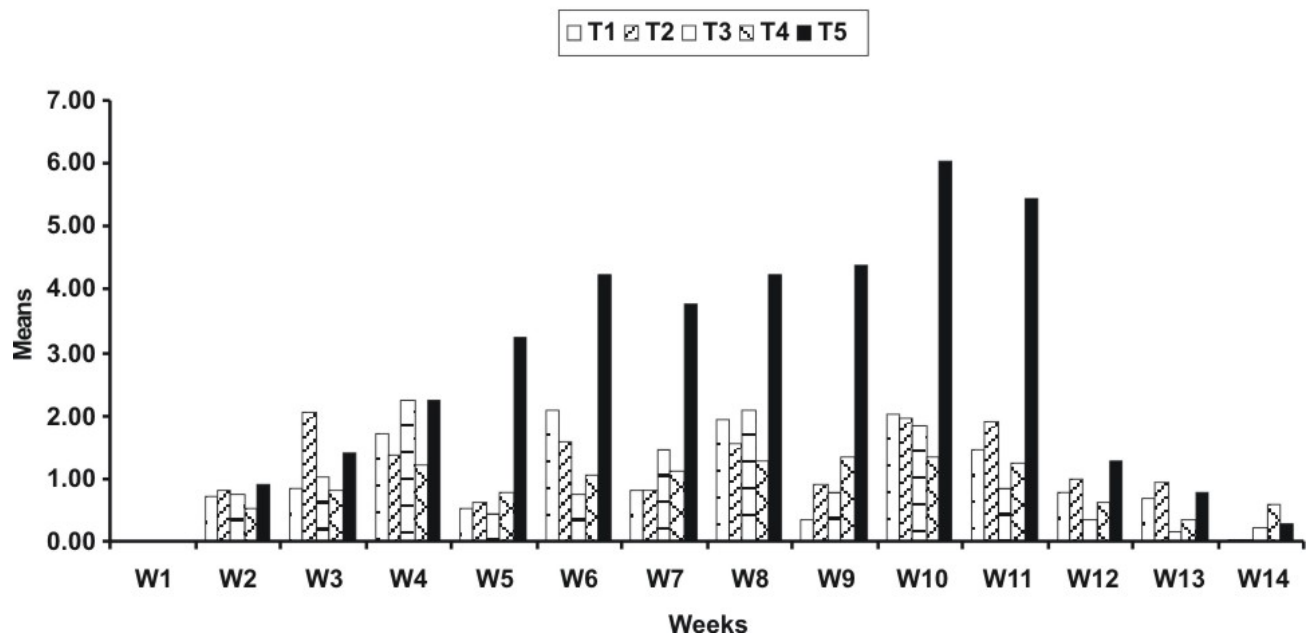


Fig. 3. Comparison of mean population of Thrips of different treatments at different weeks

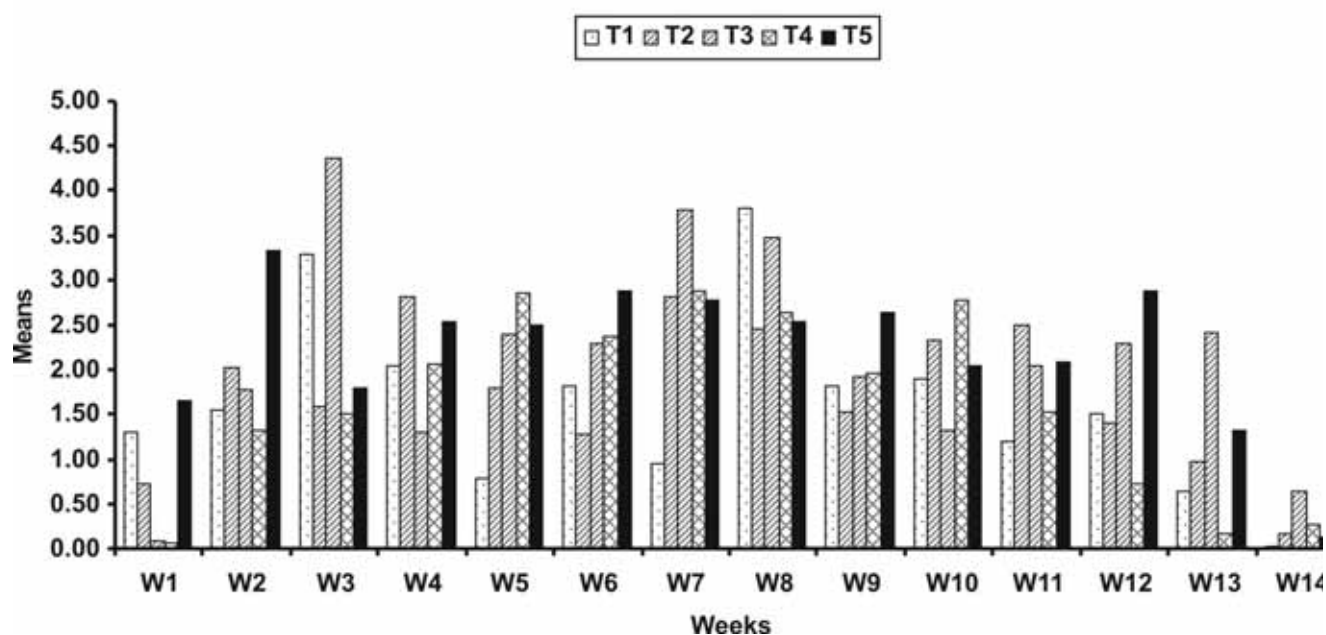
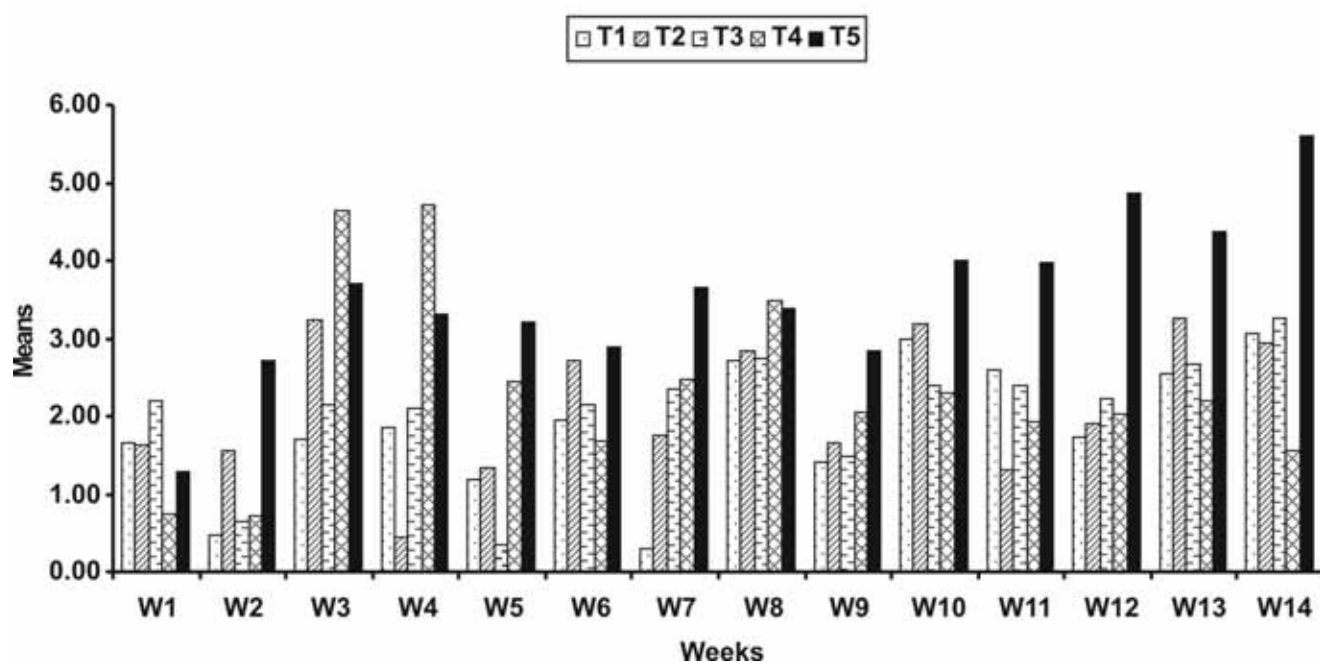


Fig. 4. Comparison of mean population of Whitefly of different treatments at different weeks



The integration of biological control agents with chemical insecticides resulted in reducing the number of insecticides sprayings from 8 to 2. The integration of two methods has proved far more economical than chemical control alone. These findings suggest further in-depth studies to determine the role of individual biological control agents as compared to its integration with chemical insecticides. It is further visualized that there is a great scope for reducing our reliance on pesticide alone for cotton pest control.

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