The Bioscan 9(3): 977-980, 2014
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

# EVALUATION OF INSECTICIDES AGAINST SUCKING INSECT PESTS INFESTING *BT* COTTON BG- II

**T. M. BHARPODA*, N. B. PATEL, R. K. THUMAR, N. A. BHATT, L. V. GHETIYA, H. C. PATEL AND P. K. BORAD**
Department of Agricultural Entomology, B. A. College of Agriculture, Anand Agricultural University
Anand - 388 110 (Gujarat)
e-mail: tmbharpoda@yahoo.com

**KEYWORDS**
Insecticides
*BT* cotton
Sucking insect pests
Natural enemies

**Received on :**
15.11.2013

**Accepted on :**
30.07.2014

***Corresponding author**

**ABSTRACT**
Nine synthetic insecticides were evaluated against sucking insect pests *viz.,* leaf hopper (*Amrasca biguttula biguttula* Ishida), whitefly (*Bemisia tabaci* Gennadius), thrips (*Thrips tabaci* Lindemann) and aphid (*Aphis gossypii* Glover) in cotton variety RCH-2 *Bt* (BG-II) during three consecutive years *i.e.* 2009-10, 2010-11 and 2012-13. Among the different insecticides, imidacloprid 17.8 SL @ 0.008% (7.50 aphid and 1.47 whitefly/ leaf), thiamethoxam 25 WG @ 0.0125% (1.22 leaf hopper/ leaf) and diafenthiuron 50 WP @ 0.05% (1.43 thrips/ leaf) found more effective and safer to the natural enemies *viz.*, *Chrysoperla carnea* (adult), spiders and coccinellids (grubs and adult). Highest seed cotton yield (30.81 q/ha) was harvested from crop treated with imidacloprid followed by clothianidin (27.34 q/ha), difenthiuron (26.93 q/ha), thiamethoxam (26.01 q/ha) and acetamiprid (25.68 q/ha). The highest Insecticidal Cost Benefit Ratio (1: 16.54) was registered in imidacloprid followed by acetamiprid (11.06), acephate (10.38), thiamethoxam (7.05) and difenthiuron (6.13).

## INTRODUCTION

Cotton is one of the most commercially important fiber crops in the world. Due to its economic important known as "white gold" of India. In India, cotton is cultivated in 119.78 lakh hectare with a production of 365.00 lakh bale of seed cotton. In Gujarat, cotton is cultivated in about 24.97 lakh hectare with the production of 93.00 lakh bales and productivity of 633 kg per hectare during 2012-13 (Anon., 2013). Nearly 130 species of insect pests occur on Indian cotton with a dozen of these arthropods requiring their management for realizing better cotton yields. Existing species associations among insect pests seem to avoid competition among them as well as to match with the phenology of cotton growth. Sucking pests viz., aphids (*Aphis gossypii* Glover), leaf hopper (*Amrasca biguttula biguttula* Ishida), whiteflies (*Bemisia tabaci* Gennadius) and thrips, (*Thrips tabaci* Lindeman) are deleterious to the cotton crop growth and development (Vennila *et al.*, 2000). The estimated loss due to sucking pest's complex was up to 21.20 per cent (Dhawan *et al.,* 1988). Now-a-days, numbers of new molecules are introduced in the market and those are not only effective but also cost effective and less toxic to the existing natural enemies of the pests. Therefore, the present investigation was conducted to evaluate the efficacy of different insecticides against sucking insect pests infesting *Bt* cotton.

## MATERIALS AND METHODS

The experiment was laid out in a Randomized Block Design with three replications having plot size of 6.0 x 3.6 m consecutively for three years (2009-12) at Anand Agricultural University, Anand. *Bt* cotton variety RCH-2 (BG-II) was raised at 90 x 60 cm. Recommended agronomical practices except plant protection were followed for raising the crop. First spray application of respective insecticides (Table 1) was given on the appearance of the pests and subsequently two sprays were given at 15 days interval using manually operated knapsack sprayer having duromist nozzle with slight runoff stage.

The observations on population of sucking insect pests (aphid, leafhopper, whitefly and thrips) were made on three leaves, each selected randomly on 3 plants from top, middle and bottom canopy. The sucking insect pest's population was recorded before as well as 5, 10 and 15 days after each spray. Observations on population of natural enemies [*Chrysoperla carnea* (adults), spiders and coccinellids (grubs and adults)] per plant were also recorded before as well as 5, 10 and 15 days after each spray (Bharpoda *et al.*, 2000). Seed cotton yield was recorded picking-wise from each plot. The data thus obtained for sucking insect pests and natural enemies were analyzed by adopting square root transformation before statistical analysis following Gomez and Gomez (1984) to test the significance of treatment effects. The economics of each synthetic insecticide was calculated.

## RESULTS AND DISCUSSION

### Efficacy of synthetic insecticides against sucking insect pests

### Aphid

The data on population of aphid pooled over periods, sprays and years (Table 1) revealed that imidacloprid 17.8 SL @

**Table 1: Impact of different insecticides on sucking insect pests of *Bt* cotton (pooled over three periods, sprays and years)**

| Sr. No. | Treatments | No. per leaf Aphids | Jassid | Whitefly | Thrips |
|---|---|---|---|---|---|
| 1 | Acephate 75 WP @ 0.075% | 3.95$^{d}$(15.10) | 1.91 e(3.15) | 1.81 cd(2.78) | 1.93 e(3.22) |
| 2 | Acetamiprid 20 SP @ 0.01% | 3.23$^{b}$(9.93) | 1.89 de(3.07) | 1.56 b(1.95) | 1.83 d(2.85) |
| 3 | Carbosulfan 25 EC @ 0.025% | 4.15$^{d}$(16.72) | 2.33 f(4.93) | 2.22 e(4.45) | 2.45 h(5.50) |
| 4 | Clothianidin 50 WDG @ 0.025% | 3.49$^{c}$(11.68) | 1.77 c(2.63) | 1.77 c(2.63) | 1.58 c(2.00) |
| 5 | Fipronil 5 EC @ 0.1% | 4.14$^{d}$(16.64) | 2.36 f(5.07) | 2.22 e(4.44) | 2.34 g(4.98) |
| 6 | Thiamethoxam 25 WG @ 0.0125% | 3.55$^{c}$(12.10) | 1.31 a(1.22) | 1.85 cd(2.90) | 2.02 f(3.58) |
| 7 | Thiacloprid 48 SC @ 0.024% | 3.51$^{c}$(11.82) | 1.83 cd(2.85) | 1.88 d(3.04) | 1.95 ef(3.30) |
| 8 | Imidacloprid 17.8 SL @ 0.008% | 2.83$^{a}$(7.51) | 1.41 b(1.49) | 1.40 a(1.47) | 1.50 b(1.75) |
| 9 | Diafenthiuron 50 WP @ 0.05% | 3.03$^{ab}$(8.68) | 1.47 b(1.66) | 1.47 ab(1.67) | 1.39 a(1.43) |
| 10 | Control | 5.17$^{e}$(26.23) | 2.67 g(6.63) | 2.61 f(6.33) | 2.75 i(7.06) |
| | Mean | 3.70(13.19) | 1.90(3.11) | 1.88(3.04) | 1.97(3.38) |

| ANOVA | S. Em. ± | CD at 5% | S. Em. ± | CD at 5% | S. Em. ± | CD at 5% | S. Em. ± | CD at 5% |
|---|---|---|---|---|---|---|---|---|
| Treatment (T) | 0.08 | - | 0.03 | - | 0.03 | - | 0.03 | - |
| Period (P) | 0.06 | 0.16 | 0.03 | 0.11 | 0.05 | NS | 0.03 | 0.01 |
| Spray (S) | - | - | 0.03 | NS | 0.04 | NS | 0.01 | 0.04 |
| Year (Y) | 0.06 | NS | 0.01 | 0.04 | 0.02 | 0.05 | 0.01 | 0.04 |
| T x P | 0.10 | NS | 0.04 | 0.12 | 0.04 | NS | 0.06 | NS |
| T x S | - | - | 0.04 | NS | 0.06 | NS | 0.04 | NS |
| T x Y | 0.18 | NS | 0.04 | NS | 0.06 | NS | 0.04 | NS |
| P x S | - | - | 0.02 | 0.06 | 0.04 | 0.13 | 0.03 | 0.09 |
| P x Y | 0.18 | NS | 0.02 | 0.06 | 0.26 | 0.72 | 0.03 | 0.09 |
| S x Y | - | - | 0.02 | 0.06 | 0.03 | 0.09 | 0.02 | NS |
| T x P x S | - | - | 0.07 | 0.22 | 0.08 | NS | 0.09 | NS |
| T x P x Y | 0.32 | NS | 0.07 | NS | 0.08 | NS | 0.09 | NS |
| T x S x Y | - | - | 0.07 | NS | 0.10 | NS | 0.08 | NS |
| P x S x Y | - | - | 0.04 | NS | 0.04 | 0.123 | 0.05 | NS |
| T x P x S x Y | - | - | 0.13 | NS | 0.142 | NS | 0.17 | NS |

Note:
1. Figures in parentheses are retransformed values, those outside are $\sqrt{\chi} + 0.5$ transformed values.
2. Treatment means with letter(s) in common are at par by DNMRT at 5% level of significance.
3. NS: Not significant

0.008% and difenthiuron 50 WP @ 0.05% were found most effective chemicals than the rest of the insecticidal treatments. Similarly, Preetha *et al*. (2007) reported that imidacloprid 17.8 SL at the recommended dose of 25 g a.i.ha$^{-1}$ as effective in controlling the population of aphid, *A. gossypii* up to 25 days. Diafenthiuron 50 WP @ 0.05% was found as good as acetamiprid 20 SP @ 0.01%. According to Awasthi *et al*. (2013), the acetamiprid was most toxic to cotton aphid with 82.28 per cent relative toxicity. Clothianidin 50 WDG @ 0.025%, thiacloprid 48 SC @ 0.024% and thiamethoxam 25 WG @ 0.0125% were more or less equally effective and recorded significantly lower population than acephate, fipronil and carbosulfan. Acephate 75 WP @ 0.075%, fipronil 5 EC @ 0.1% and carbosulfan 25 EC @ 0.025% were comparatively less effective and recorded higher population of aphid.

**Leaf hopper**

Thiamethoxam 25 WG @ 0.0125% (1.22 /leaf) was found significantly superior insecticide in reducing the population of leaf hopper than rest of the treatments (Table 1). The next best group of chemicals was imidacloprid 17.8 SL @ 0.008% and difenthiuron 50 WP @ 0.05%, and also recorded significant lower (1.49 and 1.66/ leaf, respectively) population of the pest. The higher effectiveness of thiamethoxam 25 WG @ 0.0125% is strongly supported by Saleem *et al*. (2001) and Srinivasan *et al*. (2004). Razaq *et al*. (2005) also reported diafenthiuron, acetamiprid, imidacloprid and thiamethoxam as more effective insecticides in reducing jassid population below ETL at 7$^{th}$ days post application. Thiacloprid 48 SC @ 0.024% was at par with clothianidin 50 WDG @ 0.025% on one hand while, with acetamiprid 20 SP @ 0.01% on other hand. Significantly higher leaf hopper population was observed in the plots treated with fipronil 5 EC @ 0.1% and carbosulfan 25 EC @ 0.025%.

**Whitefly**

The imidacloprid 17.8 SL @ 0.008% found to be most effective and recorded the lowest (1.47 /leaf) population of whitefly and was at par with difenthiuron 50 WP @ 0.05% (1.67 /leaf). The next best insecticide was acetamiprid 20 SP @ 0.01% which also recorded lower whitefly population *i.e.* 1.95 per leaf than rest of the insecticides. However, it was at par with difenthiuron. Acephate 75 WP @ 0.075% and thiamethoxam 25 WG @ 0.0125% were equally effective and were at par with clothianidin 50 WDG @ 0.025% on one hand while with thiacloprid 48 SC @ 0.024% on other hand. Fipronil 5 EC @ 0.1% and carbosulfan 25 EC @ 0.025% were found more or less equally effective and proved to be less effective group of chemicals under the present investigation. The present investigation are in conformity with the results of Raghuraman and Gupta (2005) who reported that acetamiprid 40 g a. i. / ha and imidacloprid @ 100 g a. i. /ha was proved effective against *B. tabaci* in cotton. Similarly, Kalyan *et al*. (2012) also reported that imidacloprid, acephate and fipronil effectively managed the population of whiteflies.

**Thrips**

**Table 2: Impact of different insecticides on natural enemies of *Bt* cotton (pooled over three sprays and years)**

| Sr. No. | Treatments | No. per plant | | | |
|---|---|---|---|---|---|
| | | *Chrysoperla carnea* (Adults) | Coccinellids | | Spiders |
| | | | Grub | Adult | |
| 1 | Acephate 75 WP @ 0.075% | 1.24 b(1.04) | 1.56b(1.93) | 1.45b(1.60) | 1.25 cd(1.06) |
| 2 | Acetamiprid 20 SP @ 0.01% | 1.18 b(0.89) | 1.45b(1.60) | 1.39b(1.43) | 1.34 b(1.30) |
| 3 | Carbosulfan 25 EC @ 0.025% | 1.30 b(1.19) | 1.64b(2.19) | 1.42b(1.52) | 1.34 b(1.30) |
| 4 | Clothianidin 50 WDG @ 0.025% | 1.19 b(0.92) | 1.44b(1.57) | 1.38b(1.40) | 1.22 cd(1.14) |
| 5 | Fipronil 5 EC @ 0.1% | 1.22 b(0.99) | 1.47b(1.66) | 1.34b(1.30) | 1.18 d(0.89) |
| 6 | Thiamethoxam 25 WG @ 0.0125% | 1.22 b(0.99) | 1.59b(2.03) | 1.39b(1.43) | 1.24 cd(1.04) |
| 7 | Thiacloprid 48 SC @ 0.024% | 1.20 b(0.94) | 1.59b(2.03) | 1.45b(1.60) | 1.19 cd(0.92) |
| 8 | Imidacloprid 17.8 SL @ 0.008% | 1.22 b(0.99) | 1.57b(1.96) | 1.43b(1.54) | 1.26 c(1.09) |
| 9 | Diafenthiuron 50 WP @ 0.05% | 1.24 b(1.04) | 1.60b(2.06) | 1.44b(1.57) | 1.38 b(1.40) |
| 10 | Control | 1.64 a(2.19) | 1.99a(3.46) | 1.87a(3.00) | 1.67 a(2.29) |
| | Mean | 1.26(1.09) | 1.59(2.03) | 1.46(1.63) | 1.30(1.19) |
| ANOVA | | | | | |
| | | S. Em. ± CD at 5% | S. Em. ± CD at 5% | S. Em. ± CD at 5% | S. Em. ± CD at 5% |
| Treatment (T) | | 0.04 - | 0.04 - | 0.05 - | 0.02 - |
| Spray (S) | | 0.02 NS | 0.02 0.06 | 0.03 0.08 | 0.03 0.12 |
| Year (Y) | | 0.02 0.07 | 0.02 0.06 | 0.03 0.08 | 0.02 0.04 |
| T x S | | 0.08 NS | 0.04 0.11 | 0.05 NS | 0.05 NS |
| T x Y | | 0.04 0.12 | 0.07 NS | 0.09 NS | 0.05 NS |
| S x Y | | 0.08 0.22 | 0.07 0.19 | 0.09 0.26 | 0.03 0.07 |
| T x S x Y | | 0.14 NS | 0.12 NS | 0.16 NS | 0.08 NS |

Note:
1. Figures in parentheses are retransformed values, those outside are $\sqrt{\chi + 0.5}$ transformed values.
2. Treatment means with letter(s) in common are at par by DNMRT at 5% level of significance.
3. NS: Not significant

**Table 3: Impact of diffrent insecticidal treatments on seed cotton yield (Pooled of three years)**

| Sr. No. | Treatments | | Seed cotton yield (Q/ha) | ICBR |
|---|---|---|---|---|
| 1 | Acephate 75 WP @ 0.075 | | 24.21 cde | 1:10.38 |
| 2 | Acetamiprid 20 SP @ 0.01 | | 25.68 bcd | 1:11.06 |
| 3 | Carbosulfan 25 EC @ 0.025 | | 20.61 fg | 1:2.05 |
| 4 | Clothianidin 50 WDG @ 0.025 | | 27.34 b | 1:3.24 |
| 5 | Fipronil 5 EC @ 0.1 | | 23.44 def | 1:5.93 |
| 6 | Thiamethoxam 25 WG @ 0.0125 | | 26.01 bcd | 1:7.05 |
| 7 | Thiacloprid 48 SC @ 0.024 | | 21.35 efg | 1:2.77 |
| 8 | Imidacloprid 17.8 SL @ 0.008 | | 30.81 a | 1:16.54 |
| 9 | Diafenthiuron 50 WP @ 0.05 | | 26.93 bc | 1:6.13 |
| 10 | Control | | 19.57 g | - |
| Mean | | | 24.60 | - |
| S. Em. ± | | Treatment (T) | 1.06 | - |
| | | Year (Y) | 0.66 | - |
| | | T x Y | 1.98 | - |
| C.D. at 5% | | T | - | - |
| | | Y | Sign | - |
| | | T x Y | NS | - |
| C.V. % | | 13.92 | - | |

Note:
1.Treatment means with letter(s) in common are at par by DNMRT at 5% level of significance.
2.500 liter spray solution required for one spray per ha and 3 sprays were given during the cropping season
3.Labour charges @ Rs. 200/- per day x 2 labour = Rs 400 /ha/spray
4.Price of cotton lint yield: Rs. 4250 per quintal

Diafenthiuron 50 WP @ 0.05% was found significantly most effective than rest of the treatments (Table 1). Imidacloprid 17.8 SL @ 0.008% was next best insecticide. Clothianidin 50 WDG @ 0.025%, acetamiprid 20 SP @ 0.01% and acephate 75 WP @ 0.075% were mediocre in their effectiveness against thrips. Carbosulfan 25 EC @ 0.025%, fipronil 5 EC @ 0.1% and thiamethoxam 25 WG @ 0.0125% were found less effective and recorded higher thrips population. Muhammad *et al.* (2004) and Ameta and Sharma (2005) reported the highest reduction of thrips in cotton plots treated with imidacloprid.

**Toxicity of synthetic insecticides against natural enemies**

The data on toxicity of insecticides against natural enemies *viz., C. carnea* (adult), coccinellids (grubs and adult) and spiders are presented in Table 2. All insecticides relatively expressed more or less equal toxicity to the population of *Chrysoperla* (adult) and coccinellids (grubs and adult). In case of spider population, higher population of spider was

observed when plots treated with difenthiuron 50 WP @ 0.05%, acetamiprid 20 SP @ 0.01% and carbosulfan 25 EC @ 0.025% (Table 2) and was comparatively less toxic. Thiacloprid 48 SC @ 0.024%, thiamethoxam 25 WG @ 0.0125%, acephate 75 WP @ 0.075% and clothianidin 50 WDG @ 0.025% recorded somewhat lower population of these natural enemies and found comparatively toxic to the activity of spiders.

**Impact on seed cotton yield and economics**

The data on seed cotton yield of various insecticidal treated plots are presented in Table 3. The imidacloprid treated plots yielded the highest (30.81 q/ha) seed cotton followed by clothianidin (27.34 q/ha), diafenthiuron (26.93 q/ha), thiamethoxam (26.01 q/ha), acetamiprid (25.68 q/ha), acephate (24.21 q/ha), fipronil (23.44 q/ha), thiacloprid (21.35 q/ha), carbosulfan (20.61 q/ha) and control (19.57 q/ha). Clothianidin, difenthiuron, thiamethoxam and acetamiprid were at par with each other. Thiacloprid and carbosulfan recorded significantly lower yield and were at par with control. As per the report of Kalyan *et al*. (2012), imidacloprid treated plots exhibited significantly higher seed cotton yield (1225.0 kg/ha) while fipronil treated plots recorded moderately (983 kg/ha) yield of seed cotton. In case of Insecticidal Cost Benefit Ratio (ICBR), it was the highest obtained from the plots treated with imidacloprid (16.54) followed by acetamiprid (11.06), acephate (10.38), thiamethoxam (7.05), difenthiuron (6.13), fipronil (5.93), clothianidin (3.24), thiacloprid (2.77) and carbosulfan (2.05).

## CONCLUSION

Imidacloprid 17.8 SL @ 0.008%, acetamiprid 20 SP @ 0.01%, thiamethoxam 25 WG @ 0.0125% and difenthiuron 50 WP @ 0.05 % were found more effective against sucking insect pests (aphid, leaf hopper, whitefly and thrips) infesting *Bt* cotton and produced higher yield. These insecticides can be recommended for the management of sucking insect pests in *Bt* cotton looking to their effectiveness, economics and safety to the natural enemies.

## REFERENCES

**Ameta, O. P. and Sharma, K. C. 2005.** Evaluation of confidor for the management of sucking insect pest of cotton. *Pestology*. **29(2):** 35-40.

**Anonymous 2013.** Cotton Production and Balance sheet. *The Cotton Corporation of India Limited* (http://cotcorp.gov.in).

**Awasthi, N. S., Barkhade, U. P., Patil, S. R. and Lande, G. K. 2013.** Comparative toxicity of some commonly used insecticides to cotton aphid and their safety to predatory coccinellids. *The Bioscan*. **8(3):** 1007-1010.

**Bharpoda, T. M., Patel, H. P., Patel, U. P., Patel, G. P., Patel, J. J. and Patel, J. R. 2000.** Integrated Pest Management (IPM) in cotton H-6 cultivated in Middle Gujarat. *Indian J. Ent*. **62(4):** 327-331.

**Dhawan, A. K., Sidhu, A. S. and Simwat, G. S. 1988.** Assessment of avoidable loss in cotton (*Gossypium hirsutum and G. arboreum*) due to sucking pests and bollworms. *Indian J. Agric. Sci*. **58**: 290-292.

**Gomez, K. A. and Gomez, A. A. 1984.** Statistical procedures for agricultural research, 2nd edition, A wiley interscience publication, J. Wiley and Sons, New York. pp. 302-307.

**Kalyan, R. K., Saini, D. P., Urmila, Jambhulkar, P. P. and Abhishek, P. 2012.** Comparative bioefficacy of some new molecules against jassids and whitefly in cotton. *The Bioscan*. **7(4):** 641-643.

**Muhammad, J. A., Ijaz, A. S., Saif Ullah, Muhammad, D. G. and Ashfaq, S. M. 2004.** Some morphological plant factors effecting resistance in cotton against thrips (*Thrips tabaci* L.). *Int. J. Agri. Bio*. **6(3):** 544-546.

**Preetha, G., Manoharan, T., Kuttalam, S. and Stanley, J. 2007.** Foliar application of imidacloprid 17.8 SL against bhendi aphid, *Aphis gossypii* Glover. *Pest Management in Horticultural Ecosystems*. **13:** 134-138.

**Raghuraman, M. and Gupta, G. P. 2005.** Field evaluation of neonicotinoids against whitefly *Bemisia tabaci* Gennadius in cotton. *Indian J. Ent*. **67(1):** 29-33.

**Razaq Muhammad, M., Anjum Suhail, Muhammad A., Jalal A. M., Mushtaq Ahmad, S. and Muhammad, H. A. 2005.** Evaluation of neonicotinoids and conventional insecticides against cotton jassid, *Amrasca devastans* (Dist.) and cotton whitefly, *Bemisia Tabaci* (Genn.) on cotton. *Pak. Entomol*. **27(1):** 75-78.

**Saleem, M. A., Khalid, M. and Riaz, H. 2001.** Comparative efficacy of some insecticides against some sucking insect pests of CIM-443, cotton. *Pak. Entomol*. **23(1/2):** 91-92.

**Srinivasan, M. R., Sheeba, J. R. and Palaniswamy, S. 2004.** Evaluation of thiamethoxam 70 WS and thiamethoxam 25 WG against cotton sucking insects. *Pestology*. **28(12):** 37-40.

**Vennila, S., Ramasundram, P., Sheo, R. and Kairon, M. S. 2000.** Cotton IPM and its Current Status. *Central Institute for Cotton Research Technical Bulletin*. **8**: 1-13.