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# Bioefficacy of newer neonicotenoids against sucking insect pests of Bt cotton

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ABSTRACT

A field experiment was conducted at the experimental farm of Department of Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during *Kharif* 2013 to evaluate the bio-efficacy of neonicotenoids against sucking pests of *Bt* cotton. The results revealed that significantly lowest population of sucking pests per three leaves was recorded in nitenpyram 10 per cent WSG @ 100 g a.i./ha, dinotefuran 20 per cent SG @ 50 g a.i./ha and clothianidin 50 per cent WDG @ 20 g a.i./ha were the most effective treatments in reducing incidence of sucking pests on *Bt* cotton as compared to acetamiprid 20 per cent SP @ 20 g a.i./ha, imidacloprid 17.8 SL, thiamethoxam 25 per cent WS @ 25 g a.i./ha and thiacloprid 21.7 per cent SC @ 30 g a.i./ha.

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## INTRODUCTION

Cotton (*Gossypium hirsutum* L.), is the "King of fibre" popularly known as "White gold", an important cash crop in India. Cotton belongs to the family "Malvaceae" and genus "*Gossypium"*. It is popularly known as "Friendly fibre" because, in India, cotton crop contributes about 80 per cent of the raw material to textile industry in the country providing livelihood for more than 100 million people, through production, processing, trading and marketing (Rakesh and Kathane, 1989). India occupies first place in area and second in production on global basis after China.

Among the various causes of low productivity of cotton in India the insect pests is one of the major cause. About 200 insect pests are reported to attack cotton crop in India (Anonymous, 1992). The pests of major significance in Bt cotton are sucking pests like aphids (*Aphis gossypii*, Glover), jassids (*Amrasca biguttula*, Ishida), whiteflies (*Bemisia tabaci*, Gennadius) and thrips (*Thrips tabaci* Linnman) these affect the yield considerably causing losses of 11.20 per cent to 20.90 per cent in Marathwada region. Sucking pests, also referred to as "sap feeders", limit the realization of potential productivity of cotton, they are deleterious to the cotton plant growth and development by being assimilate sappers, stand reducers and light stealers. The heavy infestation of nymph and adults of sucking pests resulted in leaf yellowing, wrinkled leaves, leaf distortion and oily spots on leaves. Secondly, they found to secrete honey dew which leads to growth and development of sooty mould fungus (*Capnodium* sp.) on leaves. The fungus inhibits the photosynthetic activity

of the plants resulting into chlorosis that affect the seed cotton yield. Moreover, whitefly also act as a vector to transmit leaf curl disease in cotton. Neonecotenoids evolved the new era in pest management in Indian agriculture, keeping in mind the potential of neonecotenoids in management of cotton sucking pests, it was tried to evaluate their comparative bioefficacy and safety to cotton ecosystem, so that these products can be included in a compatible manner to develop an effective IPM module in coming future.

## MATERIAL AND METHODS

Studies on efficacy of newer neonicotenoids against sucking pests of *Bt* cotton was carried out during *Kharif* 2013 in research farm, Department of Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. The cotton variety Bunny Bt was grown in the observation plots with recommended agronomic package of practices without any crop protection measures. The experiments were carried out plots of 5.5×4.7m in Randomized Block Design (RBD) with eight treatments replicated thrice. In the present investigation, seven newer necotenoids *viz*., clothianidin, nitenpyram, dinotefuran, acetamiprid, imidacloprid, thiamethoxam, thiacloprid were evaluated and compared with untreated check against sucking insect pest complex of Bt cotton.

Observations on the number of nymph and adults of aphids, jassids, thrips and whiteflies was recorded from randomly selected five plants one day before spraying and 1, 3, 7 and 14 days after insecticidal spray. The data obtained was subjected to vx+0.5 transformations before analysis. The data was statistically analyzed by standard analysis of variance method.

## RESULTS AND DISCUSSION

Studies on efficacy of newer neonicotenoids against sucking pests of Bt cotton concluded that all the neonecotenoids were superior over untreated control in controlling sucking insect pests on Bt cotton.

**Aphids :**

The pretreatment count indicated that there was no statistical difference in all treatments. The live count of nymphs and adults of aphids ranged from 36.00 to 42.20 aphids/3 leaves justifying the need undertake plant protection interventions. The post treatment findings indicated that all the insecticidal treatments significantly reduced the aphid population up to seven days. Moreover, at 14 DAS lowest aphid count was recorded from the plots treated with nitenpyram 50 WDG @ 100 g a.i./ha (20.84 aphids/3 leaves). It was at par with dinotefuran 20 SG @ 50 g a.i./ha (20.84 aphids/3 leaves) and clothianidin 50 WDG @ 20 g a.i./ha (21.35 aphids/3 leaves). Rest of the insecticides recorded higher counts 22.51 aphids/3 leaves (acetamiprid 20 SP @) 20 g a.i.) to 29.97 aphids/3 leaves (thiacloprid 21.7 SL @ 30 g a.i.).

Similar trends of results regarding sucking insect pest incidence were reported by Wang Qiang *et al*. (1995). They reported 95 per cent field control of aphids after 5, 7 and 10 days of treatment with imidacloprid 37.5 g per ha on cotton crop. More than 90 per cent control of aphids, *Aphis gossypii* was recorded by Layton *et al.* (1996) in imidacloprid treated plots. Weekly imidacloprid treatment reduced aphid population on cotton (Wells *et al.*, 1998). Acetamiprid gave 91 per cent control of aphids on cotton at 2, 5, 7, 10 and 15 days after application, Bellottini *et al.* (1999). Dhandapani *et al.* (2002) reported that seed treatment of cotton with the new insecticides, clothianidin (Poncho 600 FS) at 9 ml per kg seed and imidacloprid (Gaucho 600 FS) at 12 ml per kg seed, effectively controlled the sucking pests of cotton *viz.*, aphids, thrips and leaf hoppers. Two sprays of clothianidin @ 20 and 25 g a.i./ha rendered very good protection to crop

**Table 1 : Bioefficacy of different insecticides against aphids (*Aphis gossypii*) in Bt cotton 2013**

| Sr. No. | Treatments | Dose (g a.i./ha) | Precount | Mean of three sprays | | | |
|---|---|---|---|---|---|---|---|
| | | | | 1 DAS | 3 DAS | 7 DAS | 14 DAS |
| 1. | Dinotefuran 20 (%) SG | 50 | 36.10 (6.04) | 1.32 (1.22) | 4.00 (1.82) | 5.88 (2.42) | 20.84 (4.32) |
| 2. | Acetamiprid 20 (%) SP | 20 | 36.00 (6.04) | 2.21 (1.47) | 5.06 (2. 02) | 9.05 (2.87) | 22.51 (4.56) |
| 3. | Imidacloprid 17.8 SL | 25 | 41.15 (6.45) | 2.8 (1.83) | 6.16 (2.36) | 12.84 (3.41) | 24.00 (4.80) |
| 4. | Clothianidin 50 (%) WDG | 20 | 38.00 (6.20) | 1.85 (1.37) | 4.19 (1.85) | 8.14 (2.73) | 21.35 (4.55) |
| 5. | Thiamethoxam 25 (%) WS | 25 | 42.20 (6.53) | 3.62 (1.56) | 7.84 (2.29) | 16.86 (3.96) | 27.4 (5.24) |
| 6. | Thiacloprid 21.7 (%) SC | 30 | 37.04 (6.12) | 6.80 (2.62) | 10.32 (3.09) | 18.13 (4.10) | 29.97 (5.48) |
| 7. | Nitenpyram 10 (%) WSG | 100 | 36.40 (6.07) | 0.80 (1.03) | 3.30 (1.61) | 4.93 (2.22) | 20.64 (4.30) |
| 8. | Untreated control | -- | 38.10 (6.21) | 38.79 (6.3) | 37.6 (6.15) | 40.76 (6.41) | 35.93 (6.02) |
| | S.E. ± | | 0.06 | 0.61 | 0.53 | 0.50 | 0.22 |
| | C.D. (P=0.05) | | NS | 2.00 | 1.73 | 1.65 | 0.74 |

Figures in parenthesis √ x+0.5, NS= Non significant

against the attack of sucking pests of cotton Patil *et al.* (2007). Other researchers also reported effectiveness of newer neonicotenoides against cotton aphids Kendappa *et al*. (2002).

**Table 2 : Bioefficacy of different insecticides against jassids (*Amrasca bigutulla bigutulla*) in Bt cotton 2013**

| Sr. No. | Treatments | Dose (g a.i./ha) | Precount | Mean of three sprays | | | |
|---|---|---|---|---|---|---|---|
| | | | | 1 DAS | 3 DAS | 7 DAS | 14 DAS |
| 1. | Dinotefuran 20 (%) SG | 50 | 5.08 (2.36) | 0.47 (0.96) | 1.00 (1.25) | 1.65 (1.44) | 2.81 (1.79) |
| 2. | Acetamiprid 20 (%) SP | 20 | 5.90 (2.52) | 1.14 (1.26) | 1.60 (1.44) | 2.19 (1.62) | 3.47 (1.97) |
| 3. | Imidacloprid 17.8 SL | 25 | 4.99 (2.34) | 1.22 (1.30) | 1.86 (1.50) | 2.53 (1.70) | 4.01 (2.11) |
| 4. | Clothianidin 50 (%) WDG | 20 | 4.12 (2.15) | 0.61 (1.04) | 1.38 (1.37) | 2.01 (1.69) | 2.99 (1.84) |
| 5. | Thiamethoxam 25 (%) WS | 25 | 4.59 (2.25) | 1.3 (1.33) | 1.9 (1.53) | 2.66 (1.76) | 3.83 (2.06) |
| 6. | Thiacloprid 21.7 (%) SC | 30 | 4.92 (2.26) | 1.53 (1.41) | 2.39 (1.68) | 2.89 (1.80) | 4.45 (2.19) |
| 7. | Nitenpyram 10 (%) WSG | 100 | 5.92 (2.53) | 0.05 (0.73) | 0.61 (1.02) | 1.26 (1.28) | 2.44 (1.69) |
| 8. | Untreated control | -- | 5.90 (2.52) | 4.76 (2.28) | 4.56 (2.22) | 4.97 (2.31) | 5.33 (2.40) |
| | S.E. ± | | 0.05 | 0.16 | 0.12 | 0.11 | 0.08 |
| | C.D. (P=0.05) | | NS | 0.53 | 0.41 | 0.36 | 0.27 |

Figures in parenthesis √x+0.5, NS= Non-significant

**Table 3 : Bioefficacy of different insecticides against Thrips (*Thrips tabaci*) in Bt cotton 2013**

| Sr. No. | Treatments | Dose (g a.i./ha) | Precount | Mean of three sprays | | | |
|---|---|---|---|---|---|---|---|
| | | | | 1 DAS | 3 DAS | 7 DAS | 14 DAS |
| 1. | Dinotefuran 20 (%) SG | 50 | 30.40 (5.55) | 0.29 (0.86) | 2.34 (1.64) | 6.63 (2.43) | 16.24 (4.07) |
| 2. | Acetamiprid 20 (%) SP | 20 | 29.89 (5.51) | 0.91 (1.14) | 3.33 (1.93) | 7.45 (2.69) | 25.16 (5.05) |
| 3. | Imidacloprid 17.8 SL | 25 | 29.72 (5.49) | 1.11 (1.23) | 5.11 (2.05) | 8.32 (2.75) | 26.16 (5.14) |
| 4. | Clothianidin 50 (%) WDG | 20 | 30.65 (5.58) | 0.24 (0.84) | 2.57 (1.67) | 6.73 (2.57) | 19.21 (4.33) |
| 5. | Thiamethoxam 25 (%) WS | 25 | 30.15 (5.53) | 1.46 (1.34) | 3.98 (2.10) | 9.86 (3.07) | 28.75 (5.40) |
| 6. | Thiacloprid 21.7 (%) SC | 30 | 28.46 (5.35) | 1.77 (1.47) | 5.00 (2.32) | 10.47 (3.17) | 31.4 (5.63) |
| 7. | Nitenpyram 10 (%) WSG | 100 | 30.15 (5.53) | 0.11 (0.77) | 1.94 (1.48) | 6.04 (2.37) | 15.78 (3.93) |
| 8. | Untreated control | -- | 29.28 (5.45) | 30.44 (5.55) | 30.75 (5.57) | 30.73 (5.57) | 31.40 (5.67) |
| | S.E. ± | | 0.02 | 0.56 | 0.46 | 0.37 | 0.24 |
| | C.D. (P=0.05) | | NS | 1.83 | 1.53 | 1.23 | 0.82 |

Figures in parenthesis √x+0.5, NS= Non-significant

**Table 4 : Bioefficacy of different insecticides against whiteflies (Bemisia tabaci) in Bt cotton 2013**

| Sr. No. | Treatments | Dose (g a.i./ha) | Precount | Mean of three sprays | | | |
|---|---|---|---|---|---|---|---|
| | | | | 1 DAS | 3 DAS | 7 DAS | 14 DAS |
| 1. | Dinotefuran 20 (%) SG | 50 | 4.14 (2.07) | 0.00 (0.70) | 0.17 (0.80) | 0.83 (1.14) | 3.20 (1.90) |
| 2. | Acetamiprid 20 (%) SP | 20 | 3.68 (2.04) | 0.16 (0.80) | 0.34 (0.90) | 1.18 (1.29) | 3.80 (2.06) |
| 3. | Imidacloprid 17.8 SL | 25 | 4.22 (2.17) | 0.00 (0.70) | 0.38 (0.58) | 1.72 (1.48) | 4.21 (2.20) |
| 4. | Clothianidin 50 (%) WDG | 20 | 4.99 (2.34) | 0.00 (0.70) | 0.26 (0.86) | 1.12 (1.27) | 3.36 (1.90) |
| 5. | Thiamethoxam 25 (%) WS | 25 | 5.90 (2.52) | 0.51 (0.99) | 0.65 (1.03) | 1.89 (1.54) | 4.21 (2.16) |
| 6. | Thiacloprid 21.7 (%) SC | 30 | 4.12 (2.15) | 0.17 (0.80) | 0.87 (1.12) | 2.40 (1.69) | 4.58 (2.24) |
| 7. | Nitenpyram 10 (%) WSG | 100 | 4.59 (2.25) | 0.00 (0.70) | 0.10 (0.77) | 0.37 (0.90) | 2.97 (1.82) |
| 8. | Untreated control | -- | 4.57 (2.34) | 4.83 (2.30) | 4.69 (2.29) | 4.83 (2.30) | 6.28 (2.65) |
| | S.E. ± | | 0.05 | 0.19 | 0.19 | 0.15 | 0.06 |
| | C.D. (P=0.05) | | NS | 0.63 | 0.63 | 0.49 | 0.21 |

Figures in parenthesis √x+0.5, NS = Non significant

**Jassids :**

During *Kharif* 2013 the incidence of jassids was recorded in the range of 4.12 to 5.92 jassids/3 leaves before initiation insecticidal spray. The pooled data on jassid incidence of three sprays showed that all the newer neonecotenoids significantly recorded minimum jassid population over a span of 14 days. The order of efficacy was nitenpyram, dinotefuran, clothianidin, acetamiprid, thiamethoxam, imidacloprid and thiacloprid. It indicated that the most newer compounds had performed even better in minimizing jassid population over regularly established neonecotenoids.

In the present investigation the most newly developed neonecotenoids clothianidin, dinotefuran, nitenpyram and thiacloprid were compared with well accepted acetamiprid, imidacloprid and thiamethoxam. The data on these newly evolved molecules is not available. The present findings are in accordance with the findings of earlier workers who reported that thiamethoxam 25 WG @ 25 g a.i./ha (Dhawan and Simwat, 2002), acetamiprid 20 SP @ 80 g a.i./ha (Rathod, 2003), clothianidin 50 WDG @ 25 g a.i./ha against all sucking pests (Patil *et al*., 2007), seed treatment with thiamethoxam 70 WS at 4.3 g/kg seed and imidacloprid 600 FS at 12 ml/kg seed (Vodadaria *et al*., 2001) was most effective. Saleem *et al*. (2001) reported the effectiveness of thiamethoxam and imidacloprid against jassids upto 7 days only.

**Thrips :**

Thrips with their rasping and sucking type of mouthparts are known to feed on *Bt* cotton and emerged as major pest in recent years. Before application of insecticides thrips population was very high and ranged between 28.46 to 30.65/3 leaves. All the insecticidal treatments were significantly superior over untreated control throughout the experiment. Initially at 1 and 3 DAS all the insecticides showed equal effectiveness statistically. However, at 7 DAS thrips count in all insecticidal treatments was increased minimum in nitenpyram treated plots (6.04 thrips/3 leaves) and maximum in thiacloprid treated plots (10.47 thrips/3 leaves). The data recorded at 14 DAS indicated that none of the spray treatments was effective in managing pest population.

The earlier workers reported that thrips can be effectively managed by acetamiprid (Bhosle *et al*., 2009, Raghuraman *et al*., 2008 and Singh and Kumar, 2005). Imidacloprid and dinotefuran had successfully controlled thrips (Rathod *et al*., 2002). Seed treatment with clothianidin (Pancho 600 FS) at 9 ml/kg seed and imidacloprid (Gaucho 600 FS) at 12 ml/kg effectively controlled sucking pests of cotton *viz*., aphids, thrips and leaf hopper upto 8 weeks after sowing (Dhandapani *et al*., 2002).

**Whiteflies :**

During the experimental period the whitefly population was quite less naturally and the pretreatment count ranged from 3.68 to 4.99 whiteflies/3 leaves. After the interventions the pooled average data showed that all the insecticidal treatments were equally effective upto 3 days after spray. At 14 DAS nitenpyram (2.97 whiteflies/3 leaves) was the most superior treatment followed by dinotefuran (3.20 whiteflies/ 3 leaves) and clothianidin (3.36 whiteflies/3 leaves) which were statistically at par. It clearly indicated that these compounds have even better efficacy as compared to other neonecotenoids at 14 DAS.

These findings are discussed here in light of the work done by the earlier researchers. Kumar *et al*. (2001) showed that spirotreatment @ 75 g a.i./ha and imidacloprid @ 25 g a.i./ha were equally effective in managing cotton whitefly. Raghuraman and Gupta (2005) reported that acetamiprid @ 40 g a.i./ha and imidacloprid @ 100 g a.i./ha were found to be the most effective treatments against whitefly on cotton. Acetamiprid and thiamethoxam were the most promising insecticides against whitefly (Muhammad *et al*., 2004).

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