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Effect of indoxacarb against tomato fruit borer (*Helicoverpa armigera* Hub.) and phytotoxicity to tomato plants

Abstract

Present study was undertaken at Crop Research Centre of G.B.U.A&T., Pantnagar to evaluate the effect of Indoxacarb against H. armigera in tomato. The percent damage of fruits by H. armigera was observed in Indoxacarb 75 and 60g a.i./ha dosage with 7.0 and 8.0 per cent fruit damage. Indoxacarb 50g a.i./ha was at par with Chlorpyrifos having 14.66 and 11.83 per cent fruit damage, respectively. Indoxacarb at 30 and 40g a.i. /ha though had significantly lesser fruit damage 18.33 and 17.50, respectively but these dosage were less effective compared to Chlorpyrifos. As far as percent fruit damage over the untreated control is concerned maximum reduction in damage (83.17%) was obtained with Indoxacarb 75g a.i./ha followed by Indoxacarb 60g a.i./ha (71.89%), Chlorpyrifos (58.56%). Indoxacarb at 30, 40 and 50g a.i./ha reduced the per cent damage by 35.94, 40.57 and 48.72 per cent respectively. Indoxacarb treated treatments at 60 and 70g a.i./ha dosage yielded the highest yield of marketable fruits 29.16 and 29.50 tons/ha respectively. While in untreated control, it was 16.66 tons/ha. All the treatments treated with Indoxacarb including 150 and 250g a.i./ha dosage did not show phytotoxic effect. The considering larval control, damage to the fruits and ultimately the yield of marketable fruits as well as plant safety, Indoxacarb can be used at 60 or 75g a.i. /ha dosage.

Keywords: *helicoverpa armigera*, bollworm, tomato, indoxacarb, phytotoxicity

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Introduction

The bollworm, *Helicoverpa armigera* Hübner (Lepidoptera: Noctuidae), a highly polyphagous species,[1,2] and a pest of major economic importance on a wide range of crops, particularly cotton, soybeans, tobacco, chickpea and pigeonpea.[3,4] The polyphagous pest of worldwide occurrence inflicting annual crop damage in India worth US $1 billion.[5] This pest accounts for the consumption of half of the total insecticide used in India for protection of different crops.[6] *H. armigera* is one of the important and key pests in tomato fields in India,[7] loss in tomato yield to the tune of 50 to 80 per cent.[8] In Tamil Nadu, losses of fruit range 40-50%.[9] Similarly, in Northern India, 30% loss of the fruit was observed due to tomato fruit worm.[10] Selvanarayanan et al.,[11] reported 5–55% losses from this insect pest in the tomato growing areas of India. Tomato fruit worm has also caused 35% yield loss in tomato[12] and 37.79% specifically in Karnataka, India.[7] Indoxacarb is an oxadiazine insecticide that blocks the sodium channels in insect nerve cells, causing lepidopteran larvae to stop feeding within 4hours, become paralyzed and die within 2 to 5days.[13] It is more effective as a stomach poison than as a contact poison. Indoxacarb is fairly selective, having activity primarily against lepidopteran larvae and certain species of sucking insects such as Lygus bugs. However, the activity of indoxacarb against the sucking insects is weaker than for Lepidoptera because of its slower bioactivation, lower sensitivity and a less favorable method of oral uptake in the sucking insects. Indoxacarb allows most predators and immature wasp parasites to survive.[14,15]

The present investigation was therefore undertaken to test the effectiveness of Indoxacarb to control controlling *H. armigera* in tomato in comparison to chalorpyriphos.

Materials and methods

The present investigations were carried out at Crop Research Centre of G. B. Pant University of Agriculture & Technology, Pantnagar-263145, Uttarakhand (India). During cropping season (2008-2009) maximum temperature (28-35°C), minimum temperature (15-21°C), maximum relative humidity (80-92%) and minimum relative humidity (50-55%) were observed. Present study was undertaken to control the *H. armigera* in tomato variety Pant T-3. Two spraying of Indoxacarb 14.5 SC(@30, 40, 50, 60 and 75g a.i./ha) and Chlorpyrifos 20 EC (@ 500g a.i./ha) was done on the appearance of insect, at flowering/fruit setting stage. The tomato variety, Pant Type-3 was sown in 5x4.8 m plot size at row and plant density of 60x50cm, replicated thrice. The space between treatments and replication were 1x1.5 m taken. The total seven treatments were taken i.e. Indoxacarb 14.5 SC @ 30g a.i./ha, Indoxacarb 14.5 SC@40g a.i./ha, Indoxacarb 14.5 SC@50g a.i./ha, Indoxacarb 14.5 SC @ 60g a.i./ha, Indoxacarb 14.5 SC@75g a.i./hac, Chlorpyrifos 20 EC@500g a.i./ha and one (control). The spray volume was 400 lit/ha, hollow cone type nozzle and sprayed the crop two times. Separate treatments of 6x6m^2 were sprayed with Indoxacarb 14.5 SC@150 and 250g a.i./ha to observe phytotoxic effect on leaves, flowers and fruits. The spray was done on the appearance of insect and at flowering and fruit setting stage (Appendix 1).

Larval count

Larvae were counted from five marked plants on apical shoots, leaf lets, flowers, flower calyses as well as fruits. The observation were recorded one day before spray, 3,5,7 and 15days after spray.

Fruit damage

Fruits were picked from net plot area i.e leaving each border row as well as one boarder plant in each row. Healthy and damaged fruits were counted to complete cumulative damage in terms of per cent damaged fruits by *H. armigera.*

Yield

Ripe fruits were picked and weight of healthy fruits was recorded from net plot area from each plot and total yield in terms tons/ha was completed.

Phytotoxicity

All the above ground plant parts were observed for leaf scorching, plant deformity, fruit deformity and flower deformation in each plot treated with Indoxacarb 14.5 SC @ 150 and 250g a.i./ha dosage.

Data analysis

All the data were subjected to the analysis of variance in RBD. Larval counts were analyzed with original as well as square root transformation. Data on per cent damaged fruits was analyzed be in terms of original as well as angular transformation. Yields of marketable fruits was analyzed by simple RBD with original figures in terms o tons/ha (Figure 1).

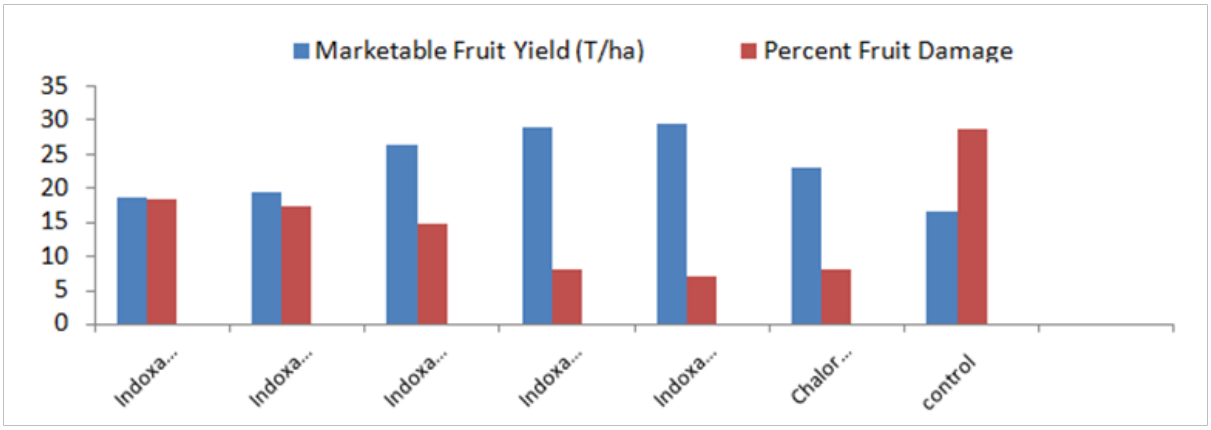

Figure 1 Effect of indoxacarb on fruit damage and marketable fruit yield of tomato.

Results and discussion

The results revealed that the larval population of *H. armigera* before the spray did not have any significant difference among different treatments.

Fruit damage

The larval population of *H. armigera* before the spray did not have any significant difference among different treatments. The percent damage of fruits by *H. armigera* was summarized in Table 1 which shows original as well as angular transformed data. Based on analysis of angular transformed data the lowest fruit damage was observed in Indoxacarb 75 and 60g a.i./ha dosage with 7.0 and 8.0 per cent fruit damage. Indoxacarb 50g a.i./ha was at par with and Chlorpyrifos having 14.66 and 11.83 per cent damage respectively. Indoxacarb at 30 and 40g a.i./ha though had significantly lesser fruit damage (18.33 and 17.50 respectively) but these dosage were less effective compared to Chlorpyrifos. As far as percent of fruit damage over the untreated control is concerned maximum reduction in damage (83.17%) was obtained with Indoxacarb 75g a.i./ha followed by 60g a.i./ha (71.89%) and Chlorpyrifos (58.56%). Indoxacarb at 30, 40 and 50g a.i./ha reduced the per cent damage by 35.94, 40.57 and 48.72 per cent respectively. Kranthi et al.,[16] suggested the indoxacarb can be used on 90 and 120 day old crop to manage H. armigera. The study showed that the indoxacarb is more toxic to *H. armigera* compared to spinosad. For second in star larvae of *H. armigera*, 400ppm spinosad can give maximum mortality (4.667), while 200ppm of indoxacarb can give complete mortality after 48hours.[17] Indoxacarb controls efficiently most of the larval stages of *Helicoverpa armigera* by stopping the feeding of the insect which causes the immobility and the death within 24 to 60h. A rate of 37.5g of active ingredient per hectare allows a good protection of tomato against *Helicoverpa armigera*.[18] Indoxdcarb @ 50g ai/ha was found effective in all the test of doses in controlling the diamondlldck moth in cabbage. Among the different doses of Indoxacarb evaluated foliar spray @ 50g ai/ha recorded lowest larval population.[19]

Marketable fruit yield

Indoxacarb at 60, 70 and 50g a.i./ha dosage yielded the highest yield of marketable fruits 29.16, 29.50 and 26.5 tons/ ha, respectively. These three dosage of idoxacarb better than that of Chlorpyrifos (23.00 tons/ha). However, Indoxacarb at lower dosage i.e. 40 (19.33 tons/ha) and 30g a.i. /ha (18.66 tons/ha) was at par with the untreated control (16.66tons/ha). Bharpoda et al.,[20] revealed that among the different insecticides studied, indoxacarb sprayed on 'H 6' cotton at 75g a.i. /ha showed significant superiority to the rest of the insecticides in terms of giving higher protection to buds and bolls of cotton crop against bollworms. The effectiveness of indoxacarb was also reflected on

seed cotton yield (2055 kg/ha). The different sequential application of microbials and neemazol were equally effective as that of sequential application of synthetic chemical insecticides viz., endosulfan 35 EC(@350g a.i./ha), quinolphos 25 EC(@250g a.i./ha) and indoxacarb 14.5 SC (@ 75g a.i./ha) in reducing *H. armigera*larval population and fruit damage.[21] The significant reduction in larval population of *H. armigera* in protected treatments as compared to unprotected treatments after spraying of effective insecticides, which ultimately increased 69.98 per cent in grain yield (683kg/ha) in protected treatments. 41.17 per cent loss in grain yield could be avoided by giving proper protection against *H. armigera* on chickpea.[22]

Table 1 Effect of insecticides on fruit damage and marketable fruit yield

S. No.	Treatments	Marketable fruit yield (T/ha)	Percent fruit damage
1	Indoxacarb 14.5 SC@30 g a.i./ha	18.66(25.56)	18.33(25.32)
2	Indoxacarb 14.5 SC@40 g a.i./ha	19.33(26.06)	17.50(24.17)
3	Indoxacarb 14.5 SC@50 g a.i./ha	26.50(30.97)	14.66(22.45)
4	Indoxacarb 14.5 SC@60 g a.i./ha	29.16(32.67)	8.00(16.38)
5	Indoxacarb 14.5 SC@75 g a.i./ha	29.50(32.86)	7.00(15.24)
6	Chlorpyriphos 20 EC@500 g a.i./ha	23.00(28.61)	11.83(19.91)
7	control	16.66(24.05)	28.66(32.55)
CD (P≤0.01)		5.29(3.53)	3.53(4.68)
CD (P≤0.05)		3.82(2.84)	2.54(3.37)

Phytotoxicity

All the treatments treated with Indoxacarb including 150 and 250g a.i./ha dosage did not show phytotoxic effect. No leaf scorching, plant and fruit deformity or flower damage was observed indicating. There by its safety to tomato variety pant type-3.

This can be concluded that considering larval control, damage to the fruits and ultimately the yield of marketable fruits as well as plant safety, Indoxacarb can be used at 60 or 75g a.i./ha dosage.

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None.

Conflict of interest

The author declares no conflict of interest.

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