RESEARCH ARTICLE

# EVALUATION OF NEWER INSECTICIDES AGAINST MAIZE PINK STEM BORER: MAJOR CONSTRAINT INSECT PEST OF MAIZE IN RAIPUR, CHHATTISGARH

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**Abstract:** The present studies were carried out during spring seasons of the year 2013-14 and 2014-15 at Research cum Instructional Farm, IGKV, Raipur (C.G.).Nine insecticides from different groups were applied as foliar sprays (liquid formulations) and whorl application (granular formulations) on maize crop against pink stem borer *Sesamia inferens*, Walker .The treatment was given at 15 days after germination of the crop when pink stem borer infestation was observed in the field. Among the insecticides evaluated, spinosad 45 SC proved to be highly effective in reducing the pink borer infestation with minimum leaf injury level (2.94) and tunnel length (2.31cm) resulting in higher grain yield(61.63 q/ha.).

**Keywords**: Chemical control, Maize, *Sesamia inferens,* Spinosad, Tunnel length

## INTRODUCTION

Insect pests are one of the major limitations for low yield of maize. In India, nearly 32.1 per cent of the actual produce is lost due to insect pests (Borad and Mittal, 1983).In India the crop is being attacked by about 139 species of insect pests with varying degree of damage to the maize crop. However, only about a dozen of these are quite serious (Siddiqui and Marwaha, 1993). Among the different insect pests, stem borer species associated with maize in India are *Chilo partellus* Swinhoe and *Sesamia inferens* Walker, commonly known as pink stem borer. Losses due to *S. inferens* which is a major pest during post rainy season in south India varied from 25.7 to 78.9 percent. The infestation of the maize stalk borer (*Chilo partelllus*) throughout India during rainy season while, *S.inferens* only in peninsular India during winter season as serious pest causing grain yield losses ranging from 18.0 to 49.0 percent.

The pink stem borer, *Sesamia inferens* is one of the major insect pests of maize, that causes wide damage to the crop in peninsular India during rabi season. In India, it is reported as a pest in Andhra Pradesh, Karnataka, Tamilnadu, Madhya Pradesh, Maharashtra, Orissa, West Bengal, Bihar, Assam, Uttar Pradesh, Delhi and Punjab. (Reddy *et al.*, 2003).Injudicious and indiscriminate use of chemical pesticides in the past has created a number of problems like insecticide resistance, insecticide residues, pest resurgence, environmental pollution and direct and indirect hazards to human beings etc. The larva of pink stem borer after hatching moves in large numbers inside the leaf whorl and remain there up to III instar in gregarious form, later on these larvae comes out from the whorl and bore inside the stem. This stage is critical to formulate effective management by insecticides.

## MATERIAL AND METHOD

The present studies were carried out during spring seasons of the year 2013-14 and 2014-15 at Research cum Instructional Farm, IGKV, Raipur (C.G.) to evaluate the efficacy of nine chemicals against pink stem borer on maize crop. The experiment was carried out by sowing NK-30 hybrid maize hybrid on January 22, 2013 and January 23, 2014 in randomized block design (RBD) with three replications. Row to row and plant to plant spacing were 75 cm and 25 cm respectively. The size of the plot was 4 x 3 $m^2$.Test insecticides from different groups were applied as foliar sprays (liquid formulations) and whorl application (granular formulations). The details of test insecticides are furnished in Table 1

The treatment was given at 15 days after germination of the crop when pink stem borer infestation was observed in the field. In case of liquid formulations the required quantity of each insecticide was measured and mixed with small quantity of water and made up to the required quantity of the spray fluid. The spray fluid was stirred thoroughly before pouring in to the sprayer. In case of granular insecticides per plant was weighed and applied in the deep leaf whorls of the plant.

The observation on the extent of infestation by stem borer in the form of leaf injury including dead heart was recorded (1-9 scale) 30 days after sowing on 10 randomly selected plants. Plant height, stem tunneling and grain yield were recorded at crop maturity stage.

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**Table 1.** Details of the insecticidal treatments

| Treatments | Dosage /ha | Method of application |
|---|---|---|
| Buprofezin 25%SC | 800 ml/ha | Foliar application |
| Carbofuran 3G @0.3kg/ha | 10 kg/ha | Whorl application |
| Cartap hydrochloride 4G @0.3kg/ha | 7.5 kg/ha | Whorl application |
| Imidacloprid 70WG | 35 g/ha | Foliar application |
| Chlorantraniliprole 18.5 SC | 60 ml/ha | Foliar application |
| Spinosad 45 SC | 160 ml/ha | Foliar application |
| Fipronil 0.3 G @0.06 kg/ha | 20 kg /ha | Whorl application |
| Emamectin benzoate 5 % SG | 200 g/ha | Foliar application |
| Thiamethoxam 25 % WG. | 100 g/ha | Foliar application |
| Control | | |

The yield data of each treatment was recorded replication wise and subjected to statistical analysis to test the significance of mean yield in different treatments. The percentage increase in yield over untreated control was also calculated by following formula (Gomez and Gomez, 1994)

% increase in yield over untreated control

$$= \frac{[\text{Yield in treatment-Yield in untreated control}]}{\text{Yield in untreated control}} \times 100$$

## RESULT AND DISCUSSION

Among the treatments, the granular formulations were applied in leaf whorls and the liquid formulations were applied as foliar sprays. Following observation were taken after spraying:

**Leaf Injury Rating (LIR)**

Data recorded on leaf injury rating at 30 days after germination presented in the Table 2.indicated significant superiority of insecticidal treatments over control in reducing pink stem borer incidence. The mean leaf injury rating ranged from 2.07 to 3.98 in spring season 2013-14 based on 1-9 scale in the insecticidal treatments compared to 6.00 in untreated plants. Among the insecticidal treatments spinosad 45 SC and chlorantraniliprole 18.5 SC were found to be at par and significantly effective over the rest of the treatments in controlling the pink stem borer where the leaf injury was as low as 2.07 and 2.20 respectively. Emamectin benzoate 5WG, carbofuran 3G and fipronil 0.3G treatments were also gave significantly good control and was at par. The mean leaf injury in Emamectin benzoate 5WG spray, carbofuran 3G and fipronil 0.3G application was 2.53, 2.57 and 2.62 respectively. Application of thiamethoxam 25WG and Imidacloprid 70WG recorded leaf injury of 2.87 and 3.15 and significantly controlled the pink stem borer as compared to the control (6.00). Buprofezin 25%SC and Cartap hydrochloride 4G were found to be the least effective by recording 3.35 and 3.98 leaf injury rating respectively.

**Table 2.** Relative efficacy of different insecticides against *S. inferens* during 2013-14

| Treatments | Leaf injury at 30 DAS (LIR) | Plant height at harvest (cm) | Tunnel length (cm) | Grain Yield (q/ha.) | Per cent increase over control |
|---|---|---|---|---|---|
| Buprofezin 25%SC | 3.35 | 159.83 | 5.30 | 53.73 | 24.37 |
| Carbofuran 3G | 2.57 | 160.20 | 1.06 | 54.24 | 25.55 |
| Cartap hydrochloride 4G | 3.98 | 161.80 | 4.66 | 51.40 | 18.98 |
| Imidacloprid 70WG | 3.15 | 166.63 | 5.6 | 56.13 | 29.93 |
| Chlorantraniliprole 0.4 G | 2.20 | 165.77 | 2.18 | 61.53 | 42.43 |
| Spinosad 45 SC | 2.07 | 169.77 | 2.23 | 62.71 | 45.16 |
| Fipronil 0.3G | 2.62 | 165.37 | 3.23 | 56.84 | 31.57 |
| Emamectin benzoate 5WG | 2.53 | 162.03 | 3.10 | 54.98 | 27.26 |
| Thiamethoxam 25WG. | 2.87 | 160.53 | 4.80 | 54.07 | 25.16 |
| Control | 6.00 | 138.47 | 7.13 | 43.20 | - |
| Overall mean | 3.13 | 161.04 | 3.93 | 54.88 | - |
| S.Em | 0.541 | 2.939 | 0.92 | 1.166 | - |
| CD at 5% | 1.61** | 8.73** | 2.76** | 3.47** | - |

**Significant at 1% level

During 2014-2015 spring season spinosad 45 SC and chlorantraniliprole 18.5 SC and carbofuran 3G were found to be significantly effective over the rest of the treatments in controlling pink stem borer. The mean leaf injury in spinosad 45 SC and chlorantraniliprole 18.5 SC and Carbofuran 3G was 3.82, 4.00 and 4.02

respectively and at par. The mean leaf injury rating in imidacloprid 70WG, emamectin benzoate 5WG, thiamethoxam 25WG and fipronil 0.3G was 4.15, 4.15, 4.22 and 4.50 respectively as against 6.90 in control. Buprofezin 25%SC and Cartap hydrochloride 4G were found to be the least effective treatments.(Table 4.40)The pooled analysis also indicated the similar trend. The mean leaf injury rating ranged between 2.94 to 4.61 on 1-9 scale in the insecticidal treatments compared to 6.45 in the control. (Table 3)

**Table 3.** Relative efficacy of different insecticides against *S. inferens* during 2014-15

| Treatments | Leaf injury at 30 DAS (LIR) | Plant height at harvest (cm) | Stem tunneling (cm) | Grain Yield (q/ha.) | Per cent increase over control |
|---|---|---|---|---|---|
| Buprofezin 25%SC | 4.60 | 164.10 | 4.46 | 53.11 | 25.40 |
| Carbofuran 3G | 4.02 | 161.40 | 4.20 | 57.11 | 34.85 |
| Cartap hydrochloride 4G | 5.23 | 144.80 | 5.86 | 45.15 | 6.61 |
| Imidacloprid 70WG | 4.15 | 163.30 | 4.33 | 56.60 | 33.64 |
| Chlorantraniliprole 0.4 G | 4.00 | 160.37 | 2.66 | 60.04 | 41.77 |
| Spinosad 45 SC | 3.82 | 166.32 | 2.40 | 60.55 | 42.97 |
| Fipronil 0.3G | 4.50 | 164.80 | 3.30 | 57.02 | 34.63 |
| Emamectin benzoate 5WG | 4.15 | 164.60 | 2.10 | 59.89 | 41.41 |
| Thiamethoxam 25WG. | 4.22 | 161.17 | 5.03 | 56.51 | 33.43 |
| Control | 6.90 | 122.27 | 7.90 | 42.35 | - |
| Overall mean | 4.56 | 157.31 | 4.22 | 54.83 | - |
| S.Em | 0.67 | 1.85 | 0.88 | 1.585 | - |
| CD at 5% | - | 5.50** | 2.63** | 4.71** | - |

**Significant at 1% level

Among the insecticide treatments Spinosad 45 SC and Chlorantraniliprole 18.5 SC were found to be significantly effective over the rest of the treatments in controlling pink stem borer, where the incidence as low as 2.94 and 3.11 respectively. Carbofuran 3G (3.28), emamectin benzoate 5WG (3.34) also gave significantly good control. Similarly, Thiamethoxam 25WG, Fipronil 0.3G and Imidacloprid 70WG significantly controlled the pink stem borer, where the leaf injury was 3.54, 3.56 and 3.65 respectively as against 6.45 in control. Buprofezin 25%SC (3.98) and Cartap hydrochloride 4G (4.61) were found to be the least effective against the pink stem borer *S.inferens.*

**Tunnel length**

The data showed that stem tunneling was comparatively low in the insecticide treated plots as compare to the control. The mean tunnel length in cm ranged between 1.06 cm to 4.80 cm in insecticide treated plots compared to 7.13 cm in the control plot during 2013-14 spring season. (Table 2)Among the insecticide treated plots, applied with carbofuran 3G recorded lowest stem tunneling (1.06 cm) followed by chlorantraniliprole 18.5 SC (2.18 cm) and spinosad 45 SC (2.23 cm).Maximum tunnel length was observed in imidacloprid 70WG (5.60) and buprofezin 25%SC(5.30 cm)among the insecticidal treatments. The stem tunneling was significantly low and ranged between 2.10 to 5.86 cm in insecticidal treated plots compared to 7.90 cm in the control plot during 2014-15 also. (Table 3). Among the insecticidal treatments, emamectin benzoate 5WG (2.10 cm) followed by spinosad 45 SC (2.40 cm) and chlorantraniliprole 0.4 G (2.66 cm).Tunnel length was maximum in cartap hydrochloride 4G (5.86 cm) and thiamethoxam 25WG (5.03 cm) respectively as against 7.90 cm in control. Pooled analysis indicated that the mean tunnel length in the insecticidal treatments ranged between 2.31 to 5.26 cm as compared to 7.51 cm per meter stem in the control. Spinosad 45 SC, chlorantraniliprole 18.5 SC, emamectin benzoate 5WG, carbofuran 3G and fipronil 0.3G had shown low stem tunnel length of 2.31, 2.42, 2.60, 2.63, and 3.20 and were at par. Among the insecticidal treatments highest tunnel length was recorded in buprofezin 25%SC, thiamethoxam 25WG, imidacloprid 70WG and cartap hydrochloride 4G with 4.88 and 4.91 4.94 and 5.26 cm tunnel length respectively. (Table 4)

**Plant Height**

In case of control plot where insecticide spray was not done, there was significant reduction in plant height compared to the insecticide treated plots. The mean plant height ranged between 159.83 cm to 169.77 cm in the insecticidal treatment plots compared to 138.47 cm in control plot during 2013-14 spring season. (Table 2) There was significant reduction in plant height of control plot (122.27 cm) than the insecticide treated plots during 2014-15 spring season also. The mean plant height in chlorantraniliprole 18.5 SC, thiamethoxam 25WG, carbofuran 3G, imidacloprid 70WG, buprofezin 25%SC, emamectin benzoate 5WG, fipronil 0.3G and spinosad 45 SC 160.37, 161.17, 161.40, 163.30, 164.10, 164.60, 164.80 and 166.32 respectively at par. Lowest plant height was observed in cartap hydrochloride 4G (144.80 cm) among the insecticidal treatments. (Table 3)

Significant reduction in plant height was evident in control (130.37cm) as compare to the insecticidal treatments when pooled analysis was considered. The mean plant height in spinosad 45 SC, chlorantraniliprole 18.5 SC, fipronil 0.3G, imidacloprid 70WG, emamectin benzoate 5WG, buprofezin 25%SC 166.04, 165.08, 165.07,164.97, 163.32 and 162.15 cm respectively and was at par. Two insecticides thiamethoxam 25WG and carbofuran 3G recorded lowest plant height of 160.85 and 160.62 cm respectively. (Table 4)

**Grain yield**

The data indicated that all treatments recorded significantly superior and increased grain yield over control during 2013-14 in spring season**.** Spinosad 45 SC and chlorantraniliprole 18.5 SC were found to be most effective against pink stem borer and recorded significantly superior grain yields of 62.71q/ha and 61.53 q/ha respectively with 45.16 and 42.43 per cent increased grain yield respectively. Fipronil 0.3G and imidacloprid 70WG. Grain yields of 56.84 and 56.13 q/ha was at par. The plots received emamectin benzoate 5WG, carbofuran 3G, thiamethoxam 25WG, buprofezin 25%SC treatment yielded 54.98, 54.24, 54.07, and 53.73 q/ha respectively. Among the treatments, lowest grain yield (51.40 q/ha) was recorded in case of plots treated with cartap hydrochloride 4G. (Table 2)

In data of 2014-15 also recorded significantly higher grain yield from the insecticidal treated plots over control. The per cent increase in grain yield ranged between 6.61 and 42.97 in the treated plots, maximum being with the plots sprayed with spinosad 45 SC. The plots received emamectin benzoate 5WG, carbofuran 3G, fipronil 0.3G, imidacloprid 70WG, thiamethoxam 25WG and buprofezin 25%SC gave significantly more yield and were at par with mean grain yield of 59.89, 57.11, 57.02, 56.60, 56.51 and 53.11 q/ha respectively. Among all the treatments lowest grain yield was recorded in cartap hydrochloride 4G treatment (45.15 q/ha). (Table 3)

**Table 4.** Relative efficacy of different insecticides against *S. inferens* during 2013-14 and 2014-15

| Treatments | Leaf Injury Rating at 30 DAS (LIR) | Plant height at harvest (cm) | Stem tunneling (cm) | Grain Yield (q/ha.) | Per cent increase over control |
|---|---|---|---|---|---|
| Buprofezin 25% SC | 3.98 | 162.15 | 4.88 | 53.42 | 24.90 |
| Carbofuran 3G | 3.28 | 160.62 | 2.63 | 55.67 | 30.16 |
| Cartap hydrochloride 4G | 4.61 | 153.28 | 5.26 | 48.27 | 12.85 |
| Imidacloprid 70WG | 3.65 | 164.97 | 4.94 | 56.36 | 31.77 |
| Chlorantraniliprole 0.4 G | 3.11 | 165.08 | 2.42 | 60.78 | 42.10 |
| Spinosad 45 SC | 2.94 | 166.04 | 2.31 | 61.63 | 44.09 |
| Fipronil 0.3G | 3.56 | 165.07 | 3.26 | 56.93 | 33.10 |
| Emamectin benzoate 5WG | 3.34 | 163.32 | 2.60 | 57.43 | 34.27 |
| Thiamethoxam 25WG. | 3.54 | 160.85 | 4.91 | 55.29 | 29.27 |
| Control | 6.45 | 130.37 | 7.51 | 42.78 | - |
| Overall mean | 3.84 | 159.17 | 4.07 | 54.86 | - |
| S.Em | 0.419 | 1.71 | 0.626 | 1.01 | - |
| CD at 5% | 1.25** | 5.10** | 1.86** | 3.01** | - |

**Significant at 1% level

The pooled data revealed that, the insecticidal treatments gave significantly higher grain yield over control (42.78 q/ha).The per cent increase in grain yield ranged between 12.85 per cent and 44.09 per cent. Among the insecticidal treatments spinosad 45 SC and chlorantraniliprole 0.4 G which were most effective against pink stem borer, also produced the highest and significantly superior grain yield of 61.63 and 60.78 q/ha which was 44.09 per cent and 42.10 per cent increase respectively over the control. Emamectin benzoate 5WG, fipronil 0.3G and imidacloprid 70WG also gave significantly more grain yields of 57.43, 56.93 and 56.36 q/ha respectively at par. Grain yields of carbofuran 3G (55.67 q/ha) and thiamethoxam 25WG 55.29 (q/ha) were at par. Among the all insecticidal treatments lowest grain yield was recorded in Cartap hydrochloride 4G treatment (48.27 q/ha). (Table 4)

Similar results were also found by Rameash *et al*. (2012), they recorded stem borer infestation ranged from 20.00 to 31.67 per cent. The infestation levels were very low in the spinosad and emamectin benzoate treatment throughout the study period. Foliar application of spinosad 240 EC and emamectin 1.9 EC were reported to reduce the damage of *C.partellus* and *Atherigona soccata* below ETL (Shahzad *et al*. 2010).

Similarly, Patra *et al.* (2009) observed the highest efficacy of spinosad in recording lowest shoot and fruit infestation of 7.47 and 9.88% respectively followed by indoxacarb, emamectin benzoate.

The field experiments conducted by Justin and Preetha (2014) and their results revealed that chlorantraniliprole 0.4 GR was proved to be the best among all the tested insecticides with reduced stem borer infestation and recorded higher yield. Highest efficacy of chlorantraniliprole was also reported by Misra (2011) against *L. orbonalis* when applied @ 40 and 50 g a.i/ha. Both these treatments were significantly superior and statistically on par with each other resulting in around 95-97and 87-90 per cent reduction in the shoot as well as fruit damage respectively. Ahmad *et al*. (2003) reported the efficacy of imidacloprid 70 WS +carbofuran 3G @ 5g/kg seed +750 g a.i./ha,thiamethoxam 70 WS +fipronil 0.3 G @5 g/kg seed +75 g a.i/ha were found moderately effective against *C. partellus* over untreated control and recorded 15.00 and 17.00 per cent dead hearts.

On the contrary ,Pal *et al.*(2009) who recorded superiority of Imidacloprid 17.8 S L @ 150 ml/ha in controlling maize stem borer with minimum leaf injury rating (2.4), dead hearts (7.4 %) at 40 DAS and maximum grain yield (36.29 q/ha).

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