Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2018; 6(5): 491-495

Received: 29-07-2018
Accepted: 30-08-2018

**Arundhati Sasmal**
Orissa University of Agriculture and Technology (OUAT), Bhubaneswar, Odisha, India

**Correspondence**
**Arundhati Sasmal**
Orissa University of Agriculture and Technology (OUAT), Bhubaneswar, Odisha, India

# Management of pink stem borer (*Sesamia inferens* walker) in finger millet (*Eleusine coracana* gaertn)

## Arundhati Sasmal

**Abstract**
Finger millet (*Eleusine coracana* Gaertn) popularly known as 'Ragi' is known for its unique nutritional properties and climate resilience. The present investigation was conducted at Berhampur, OUAT, Odisha during *Rabi* seasons of 2013-14 and 2014-15. In reference to the loss caused by pink stem borer, *Sesamia inferens* Walker (Noctuidae; Lepidoptera) in finger millet during *Rabi* season, the experiment was designed for deciding an appropriate management practice against pink stem borer. The experiment constituted seven treatments: release of *Trihogramma chilonis* four times at weekly interval, foliar spray of neem oil (300 ppm) @1.5lt/ha at 30 and 45 days after sowing (DAS), foliar spray of *Bacillus thuringiencis* (Bt) @1kg/ha at 30 and 45 DAS, soil application of Fipronil (0.3% GR) @20 kg/ha at 30 DAS, soil application of Cartap hydrochloride (4%GR) @20kg/ha at 30 DAS, soil application of Carbofuran (4%GR) @30kg/ha at 30 DAS and untreated control. In the present experiment application of Cartap hydrochloride (4%GR) @20kg/ha applied in the soil at 30 days after sowing (DAS) performed best against pink stem borer recorded 3.2%dead heart, 4.9% white ear head and highest incremental yield (7.9q/ha). This treatment had highest net benefit (Rs 10,250/ha) satisfy the economic viability.

**Keywords:** Finger millet, Ragi, Pink stem borer, Cartap hydrochloride, *Trihogramma chilonis*, *Bacillus thuringiencis*

## Introduction
Finger millet (Ragi) *Eleusine coracana* Gaertn is the most important and popular one among the small millet group. The small millets have high nutritional value, so named as nutri cereals. Finger millet is a climate resilient crop which can tackle climate change and can be fitted in different ecological situation. It can be adjusted to adverse climate conditions, can be grown in hilly dry lands as it requires small quantity of water. Finger millet is known for its unique nutritional properties Each 100gm grains have 354 Kilo calories of energy. It has high fiber content (3.6 gm./100 gm.) and calcium content (410 mg/100gm) compared to any other cereals coupled with high protein content (7.6 gm./100 gm.). It is rich in vitamins like thiamine, riboflavin, niacin and four rare essential amino acids like cysteine, tyrosine, tryptophan and methionine. It is rich in iron content (12.6mg/100gm), increases the red blood corpuscles in blood. Due to all these qualities it is a very good food for infants, elderly citizens and patients. This food lasts for a long time in the digestive system as it contains low glycaemic value which is a desirable attribute for diabetic patients. Due to high potassium content (314 mg/100gm) it increases the inbuilt resistance against bacterial and fungal diseases. Due to the presence of antioxidants it reduces the risk of heart, kidney problems and cancer. Prevention of dyslipideamia and regulation of glucose homoeostasis can be achieved by regular consumption of finger millet [3]. Finger millet crop previously being neglected now gaining its importance in diet. Now both area expansion and yield improvement is needed. Apart from the improvement in genetic attributes and agronomic practices some plant protection measures are also needed for enhancing yield in finger millet.

Among the insect pests associated with finger millet crop, pink stem borer, *Sesamia inferens* Walker (Noctuidae; Lepidoptera) is widely distributed and responsible for yield loss. This is one of the most important insect pest of finger millet during *Rabi* season. The pink stem borer was an important insect pest of sugarcane now shifted its infestation to rice and other crops [2]. *Sesamia inferens* infests sorghum, bajra, finger millet, wheat, rice, oat, barley, sugarcane and some grasses [9]. In India pink stem borer regularly attack finger millet crop in parts of Odisha, Karnataka, Tamil Nadu and Andhra Pradesh [5]. Pink stem borer causes extensive damage to

the crop in the peninsular India throughout the year and across the country [8]. Egg laying of this insect occurs in clusters in between leaf sheath and the whorl. After hatching the larvae enter into the stem reach the soft tissues and start feeding form 'S' shaped tunnels filled with excreta inside the stem [10]. Infestation of pink stem borer after ear head emergence causes completely white, chaffy panicle called 'White ear head (WEH)' [7].

In reference to the loss caused by pink stem borer in finger millet during *Rabi* season at Odisha, one experiment was designed on appropriate management aspect considering both economy and environmental aspect.

## 2. Materials and Methods

The present investigation was conducted at Berhampur, Odisha (Orissa University of Agriculture and Technology). The experiment was conducted under the supervision of 'All India Coordinated Small Millet Improvement Project (AICSMIP)' during *Rabi* seasons of 2013-14 and 2014-15. The bio-efficacy of bio-control agents, botanical pesticides, biopesticides and granular insecticides were evaluated against pink stem borer in finger millet (Ragi) crop. The variety 'Bhairabi' was included in the experiment. The experiment constituted seven treatments. Treatment 1 ($T_1$): release of *Trihogramma chilonis* @3 cards/ha (20000 parasitized eggs/card) started after appearance of moth and released four times at weekly interval.

Treatment 2 ($T_2$): foliar spray of neem oil (300 ppm) @1.5lt/ha twice at 30 and 45 days after sowing (DAS)

Treatment 3 ($T_3$): foliar spray of Bt @1kg/ha twice at 30 and 45 DAS

Treatment 4 ($T_4$): application of Fipronil (0.3% GR) @20 kg/ha at 30 DAS

Treatment 5 ($T_5$): application of Cartap hydro chloride (4%GR) @20kg/ha at 30 DAS

Treatment 6 ($T_6$): application of Carbofuran (4%GR) @30kg/ha at 30 DAS.

Treatment 7 ($T_7$): untreated control.

The treatments were replicated thrice in RCBD design. Line sowing of seeds was done during 1st week of January. Recommended dose of fertilizers @ 40:20:20 kg N, $P_2O_5$ and $K_2O$/ha were provided and no plant protection chemicals were given to ensure the natural biodiversity of insects.

The number of total tillers and dead hearts (DH) were counted in 10 randomly selected hills from each treatment plots at 40 DAS and 50 DAS. The percentage of stem borer affected tillers (DH%) was calculated for each entry by computing the formula.

Percentage of dead heart (DH%) = [No of stem borer affected tillers (Dead heart)/ Total no of tillers in each entry] X 100

While comparing the dead heart from different treatments, the per cent reduction in dead heart over control was calculated using the following formula.

Reduction in dead heart over control (%) = (C - T)/ C X 100

Where, T= dead heart from treated plot. C= dead heart from control plot

The number of total tillers and white ear head (WEH) were counted in 10 randomly selected hills from each treatment plots at finger maturity stage. The percentage of white ear head (WEH %) was also calculated for each entry by computing the formula.

Percentage white ear head (WEH %) = [No of stem borer affected panicles/ Total no of panicles in each entry] X 100

For comparing the white ear head from different treatments, the per cent reduction in white ear head over control was calculated using the following formula.

Reduction in white ear head over control (%) = (C - T)/ C X 100

Where, T= white ear head from treated plot. C= white ear head from control plot

Fingers were harvested from each treatment plot and threshed separately to get the grain yield. Further the grain yield from each treatment plot was converted into yield/hectare. Yield data was analyzed and yield differences among different treatments were calculated. While comparing the yield from different treatments, the per cent increase in yield over control was calculated using the following formula.

Increase in yield over control (%) = (T - C)/ C X 100

Where, T=Yield from treated plot. C=Yield from control plot.

Economics of different treatments were worked out as per the market price of finger millet prevailing during the course of studies. For economic analysis, the factors considered were cost of different treatment components. Income generated from increased yield and net returns were worked out. Value of increased yield over untreated control was calculated by multiplying the increased yield over control by prevailing market price of finger millet (Rs 1500 per quintal). The net profit over untreated control was worked out by deducting cost of treatments from price of increased yield over control.

### 2.1 Statistical analysis

The data obtained from an individual treatment plot of each replication were processed to square root transformation after adding 0.5 with the raw data. The converted values were analysed as per the procedure [4].

## 3. Results and Discussion

### 3.1 Dead heart DH)

#### 3.1.1 *Rabi*, 2013-14

The results illustrated in Table-1 shows that Cartap hydro chloride (4%GR) @20kg/ha recorded lowest dead heart (2.8%DH) followed by Carbofuran (4%GR) @30kg/ha (3.9%DH) and Fipronil (0.3% GR) @20 kg/ha (4.7%DH) as compared to 19.7%DH found in untreated control. The performance of Bt @1kg/ha and *Trihogramma chilonis* @3 cards/ha (20000 parasitized eggs/card) was found to be moderate with 14.3%DH and 15.8%DH in respective treatments.

#### 3.1.2 *Rabi*, 2014-15

During *Rabi*, 2014-15 same trend of performance was observed where Cartap hydro chloride (4%GR) performed best recorded 3.5%DH followed by Carbofuran (4%GR) @30kg/ha recorded 4.2%DH and Fipronil(0.3% GR) @20 kg/ha had 5.1%DH. The non-chemical treatments had registered moderate efficacy (14.6%DH to 20.1%DH) as compared to 21.3%DH in untreated control (Table-1)

The pooled mean dead heart of two seasons reveals that lowest dead heart (3.2%DH) was recorded in Cartap hydro chloride treatment followed by Carbofuran (4.1%DH) and Fipronil (4.9%DH).

Maximum reduction in the dead heart (84.39%) was found in Cartap hydro chloride (4%GR) treatment over untreated control (Figure-1). Carbofuran (4%GR) treatment had recorded 80.00% reduction in dead heart followed by Fipronil (0.3% GR) where 76.09% reduction in dead heart infestation was recorded.

**Table 1:** Stem borer infestation in different treatments during *Rabi*, 2013-14 and *Rabi*, 2014-15.

| Treatment | Treatment details | Dead heart (%DH) | | | White ear head (%WEH) | | |
|---|---|---|---|---|---|---|---|
| | | *Rabi*, 2013-14 | *Rabi*, 2014-15 | Pooled Mean | *Rabi*, 2013-14 | *Rabi*, 2014-15 | Pooled Mean |
| $T_1$ | *T. chilonis* | 15.8 (3.97) | 16.5 (4.07) | 16.2 (4.02) | 14.1 (3.77) | 13.6 (3.70) | 13.9 (3.73) |
| $T_2$ | Neem oil | 19.5 (4.43) | 20.1 (4.47) | 19.8 (4.45) | 15.3 (3.93) | 15.7 (3.97) | 15.5 (3.95) |
| $T_3$ | Bt | 14.3 (3.77) | 14.6 (3.83) | 14.5 (3.80) | 11.8 (3.43) | 12.5 (3.53) | 12.2 (3.48) |
| $T_4$ | Fipronil (0.3%GR) | 4.7 (2.13) | 5.1 (2.27) | 4.9 (2.20) | 5.7 (2.37) | 6.8 (2.57) | 6.3 (2.47) |
| $T_5$ | Cartap hydro chloride (4%GR) | 2.8 (1.70) | 3.5 (1.83) | 3.2 (1.77) | 4.2 (2.07) | 5.6 (2.37) | 4.9 (2.22) |
| $T_6$ | Carbofuran (4%GR) | 3.9 (1.97) | 4.2 (2.00) | 4.1 (1.98) | 7.0 (2.63) | 6.4 (2.53) | 6.7 (2.58) |
| $T_7$ | Untreated control | 19.7 (4.33) | 21.3 (4.63) | 20.5 (4.53) | 17.6 (4.20) | 16.4 (4.03) | 17.0 (4.12) |
| SE (m)± | | 0.041 | 0.041 | 0.028 | 0.053 | 0.040 | 0.045 |
| CD(0.05) | | 0.127 | 0.127 | 0.083 | 0.164 | 0.124 | 0.132 |

Values in parenthes are the square root transformed values.

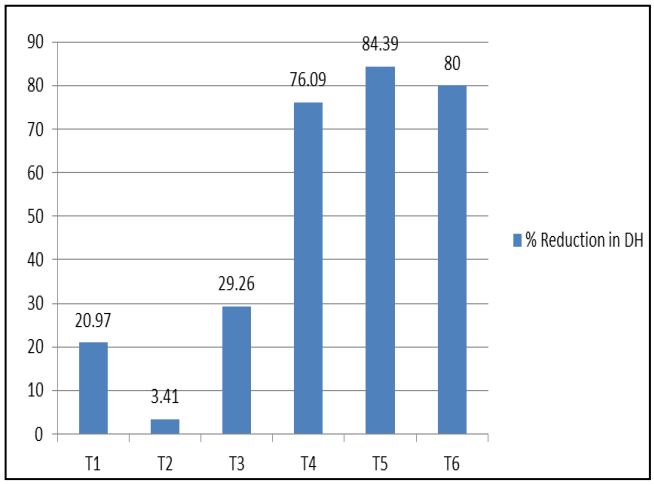


**Fig 1:** Percentage reduction in dead heart over untreated control.

| Treatment | % Reduction in DH |
|---|---|
| $T_1$ | 20.97 |
| $T_2$ | 3.41 |
| $T_3$ | 29.26 |
| $T_4$ | 76.09 |
| $T_5$ | 84.39 |
| $T_6$ | 80 |

### 3.2 White Ear Head (WEH)

#### 3.2.1 *Rabi*, 2013-14

Granular application of cartap hydrochloride (4%GR) performed best in reducing the stem borer at heading stage (Table 1). This treatment has recorded lowest white ear head (4.2%WEH) as compared to 17.6% WEH in untreated control. Fipronil 0.3%GR was found to be the next best treatment where 5.7%WEH was recorded. Among the non-chemical treatment Bt had registered lowest white head i.e.11.8%WEH as compared to 14.1%WEH in *T. chilonis* treatment and 15.3%WEH in neem oil treated plots.

#### 3.2.2 *Rabi*, 2014-15

Similar trend of effectiveness was observed during *Rabi*, 2014-15. The relative performance of treatments presented in Table-1 revealed that cartap hydrochloride (4%GR) had recorded lowest stem borer incidence at the finger initiation stage by recording 5.6%WEH. Other two granular insecticides performed statistically at par in managing the stem borer where 6.4% and 6.8% WEH were noted. Bio pesticides and biological control treatments registered lower white head (12.5% to 15.7%) than untreated control (16.4%) but not comparable with granular insecticides.

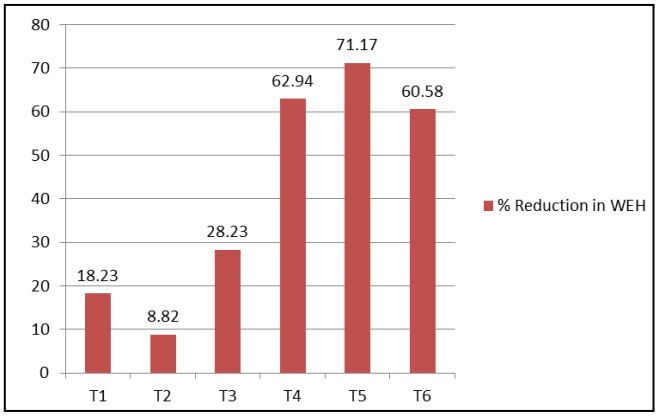


**Fig 2:** Percentage reduction in white ear head over untreated control.

| Treatment | % Reduction in WEH |
|---|---|
| $T_1$ | 18.23 |
| $T_2$ | 8.82 |
| $T_3$ | 28.23 |
| $T_4$ | 62.94 |
| $T_5$ | 71.17 |
| $T_6$ | 60.58 |

The pooled mean dead heart of two seasons reveals that the lowest white ear head (4.9%WEH) was recorded in Cartap hydro chloride (4%GR) treatment followed by Fipronil (6.3%WEH) and Carbofuran (6.7%WEH) as compared to 17.0%WEH in untreated control. Cartap hydrochloride is categorized as a highly effective, low toxic and low residue pesticide [1]. Cartap hydrochloride granular insecticide is safe to natural enemies of rice ecosystem [6].

Maximum reduction in white ear head (71.17%) was found in Cartap hydro chloride (4%GR) treatment over untreated control (Figure-2). Fipronil (0.3% GR) had recorded 62.94% reduction in dead heart infestation followed by Carbofuran (4%GR) treatment where 60.58% reduction in dead heart was recorded.

The finding 'Cartap hydrochloride treatment reduced incidence of dead hearts (35.6%) and white ear heads (28.4%) caused by yellow stem borer and reduced leaf damage by leaf folder in rice with increased grain yield in comparison with carbofuran as check insecticide as well as safe' [6] corroborates with the present findings.

### 3.3 Yield

#### 3.3.1 *Rabi*, 2013-14

Highest yield (21.7q/ha) was achieved in Cartap hydro chloride (4%GR) treatment preceded by Fipronil (0.3% GR) where 19.6q/ha and Carbofuran (4%GR) having 18.3q/ha yield. Bt spray had 17.2q/ha yield, bio control agent *T. chilonis* treatment had 16.9q/ha yield and neem oil spray had recorded 15.3q/ha grain yield compared to 13.5q/ha yield in untreated control (Table-2).

**Table 2:** Yield in different treatments during *Rabi*, 2013-14 and *Rabi*, 2014-15.

| Treatment | Treatment details | Yield (q/ha) | | | |
|---|---|---|---|---|---|
| | | ***Rabi*, 2013-14** | ***Rabi*, 2014-15** | **Pooled Mean** | **Incremental yield** |
| $T_1$ | *T. chilonis* | 16.9 | 17.5 | 17.2 | 3.0 |
| $T_2$ | Neem oil | 15.3 | 16.8 | 16.1 | 1.9 |
| $T_3$ | Bt | 17.2 | 18.5 | 17.9 | 3.7 |
| $T_4$ | Fipronil (0.3%GR) | 19.6 | 20.3 | 20.0 | 5.8 |
| $T_5$ | Cartap hydro chloride (4%GR) | 21.7 | 22.5 | 22.1 | 7.9 |
| $T_6$ | Carbofuran (4%GR) | 18.3 | 19.0 | 18.7 | 4.5 |
| $T_7$ | Untreated control | 13.5 | 14.8 | 14.2 | |
| SE (m)± | | 0.370 | 0.261 | 0.221 | |
| CD(0.05) | | 1.153 | 0.813 | 0.646 | |

### 3.3.2 *Rabi*, 2014-15

Same trend of grain yield was observed during *Rabi*, 2014-15 where maximum yield (22.5q/ha) was produced in Cartap hydro chloride (4%GR) treatment.

Pooled mean yield over two seasons reveals the superiority of Cartap hydro chloride (4%GR) treatment 22.1q/ha was achieved followed by 20.0q/ha yield in Fipronil (0.3% GR) and 18.7q/ha yield in Carbofuran (4%GR). Treatment with Bt and *T. chilonis* were at par in yield performance. Highest incremental yield (7.9q/ha) over control was gained in Cartap hydro chloride (4%GR) treatment where as 5.8q/ha yield gain was seen in Fipronil (0.3% GR).

From Figure-3 it is observed that highest yield improvement (55.63%) was achieved in Cartap hydro chloride (4%GR) treatment followed by 40.84% improvement in Fipronil (0.3% GR) treatment and 31.69%increase in Carbofuran (4%GR). Moderate improvement in yield was observed in bio intensive treatments. Bt spray had 26.05% improvement followed by *T. chilonis* where 21.12% yield improvement was observed. Neem oil had very less improvement ie. 13.38% yield improvement over control.

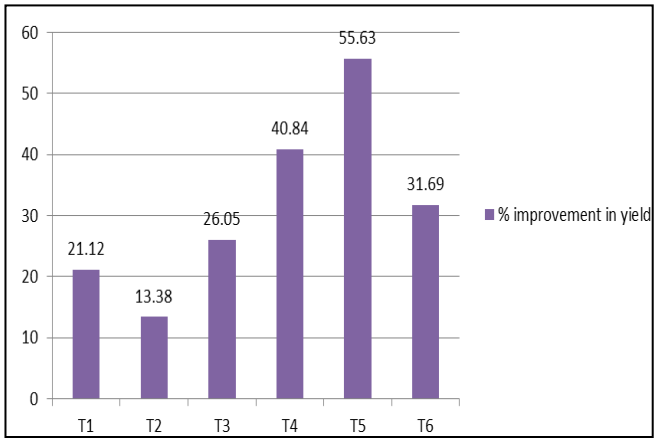


**Fig 3:** Percentage improvement in yield over untreated control.

| Treatment | % improvement in yield |
|---|---|
| $T_1$ | 21.12 |
| $T_2$ | 13.38 |
| $T_3$ | 26.05 |
| $T_4$ | 40.84 |
| $T_5$ | 55.63 |
| $T_6$ | 31.69 |

**Table 3:** Economies in different treatments.

| Treatment | Treatment details | Doses/ha | Rate | Plant Protection cost (Rs/ha) | Increase in yield over control (q/ha) | Income from increased yield (Rs/ha) | Net benefit (Rs/ha) |
|---|---|---|---|---|---|---|---|
| $T_1$ | *T. chilonis* | 3cards/ha X 4release | Rs 70/card | 840 | 3.0 | 4500 | 3660 |
| $T_2$ | Neem oil | 1.5l/ha X 2 spray | Rs 550/l | 1650 | 1.9 | 2850 | 1200 |
| $T_3$ | Bt | 1kg/ha X 2 spray | Rs750/kg | 1500 | 3.7 | 5550 | 4050 |
| $T_4$ | Fipronil (0.3%GR) | 20kg/ha | Rs110/kg | 2200 | 5.8 | 8700 | 6500 |
| $T_5$ | Cartap hydro chloride (4%GR) | 20kg/ha | Rs80/kg | 1600 | 7.9 | 11850 | 10250 |
| $T_6$ | Carbofuran (4%GR) | 30kg/ha | Rs80/kg | 2400 | 4.5 | 6750 | 4350 |
| $T_7$ | Untreated control | | | | | | |

Selling price of finger millet- Rs1500/q

### 3.4 Economics

Calculation of economics in different treatments was made by considering price of individual components of the treatments per hectare. Incremental income derived from the incremental yield was Rs 11,850/- in Cartap hydro chloride (4%GR) followed by Rs 8700/- in Fipronil (0.3% GR). Highest net benefit (Rs10250/hectare) was achieved in Cartap hydro chloride (4%GR) followed by Fipronil (0.3% GR) where Rs 6500/hectare net benefit was observed.

## 4. Conclusion

In the present experiment application of Cartap hydrochloride (4%GR) @20kg/ha at 30 DAS was found to be the best option for stem borer management in finger millet (Ragi) satisfying the economic viability. Cartap hydrochloride has a different mode of action from other insecticides. It has a systemic action for which it is very effective against borers or insects mining in plants. Besides it is safe to natural enemies of insect pests and nontoxic to mammals. So for minimizing the yield loss due to stem borer, Cartap hydrochloride (4%GR) @20kg/ha may be included in the finger millet production system to achieve better economy to the growers.

## 5. Acknowledgements

The author is obliged to the All India Co-ordinated Small Millet Improvement Project (AICSMIP) and Orissa University of Agriculture and Technology (OUAT) for providing physical and financial facilities for conducting the experiment.

## 6. References


1. Boorugu HK, Chrispal A. Cartap hydrochloride poisoning: A clinical experience. Indian Journal of Critical Care Medicine. 2012; 16(1):58-59.
2. Cheng-Xiang Li, Xuan Cheng, Shu-Mai. Distribution and Insecticide resistance of pink stem borer, *Sesamia inferens* (Lepidoptera: Noctuidae) in Taiwan. Formosan Entomol. 2011; 31:39-50.
3. Devi PB, Vijayabharathi R, Sathyabama S, Priyadarsini VB. Health benefits of finger millet (*Eleusine coracana* L.) polyphenols and dietary fiber: a review. Journal of Food Science and Technology. 2010; 47(1):19.
4. Gomez KA, Gomez AA. Statistical procedure for agricultural research. John Wiley and sons. New York. 1984, 207-215.
5. Jagadish PS, Mohapatra HK, Chakravarty MK, Srivastava N, Nangia N. A compendium of insect pests of Finger Millet and other Small Millets. All India Coordinated Small Millets Improvement Project. ICAR, UAS, GKVK, Bangalore, 2008, 8-9.
6. Karthikeyan K, Jacob S, Purushothaman SM. Effectiveness of Cartap hydrochloride against rice stem borer and leaf folder and its safety to natural enemies. Journal of Biological Control. 2007; 21(1):145-148.
7. Reddy M, Babu TR, Reddy DDR, Sreeramalu M. International pest control. 2003; 45(5):260-263.
8. Santosh HB, Sekhar JC, Rakshit S, Gadag RN, Dass Sain. Indian journal of Genetics and Plant breeding. 2008; 72(3):284-289.
9. Sidar YK, Deole S, Gajbhiye RK, Nirmal A. To evaluate the bio efficacy of granular insecticide molecules against pink stem borer. Journal of Entomology and Zoology Studies. 2017; 5(2):1114-1120.
10. Sonali D, Dubey VK, Mehta N. First record of the pink stem borer *Sesamia inferens* Walker in Maize crop at Raipur (Chhatisgarh) region. Insect Environment. 2013; 19(3):164-165.