The Pharma Innovation Journal 2023; 12(4): 1833-1835

www.ThePharmaJournal.com

The Pharma Innovation

**ISSN (E): 2277-7695**
**ISSN (P): 2349-8242**
**NAAS Rating: 5.23**
TPI 2023; 12(4): 1833-1835

www.thepharmajournal.com
Received: 23-01-2023
Accepted: 26-02-2023

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# Bio-efficacy of different insecticides against shoot fly and stem borer in pearl millet

**AM Parmar, GM Parmar, BA Gajera and PJ Davaria**

**Abstract**
A field experiment was conducted for the management of major insect pests in pearl millet at Instructional Farm, College of Agriculture, Junagadh Agricultural University, Junagadh during *Kharif* -2021. Results showed that treatment seed treatment of imidacloprid 600 FS @ 8.75 ml/kg followed by foliar spray of dimethoate 30 EC @ 0.03% at 35 DAG and seed treatment of imidacloprid 600 FS @ 8.75 ml/kg followed by foliar spray of chlorantraniliprole 20 SC @ 0.006% at 35 DAG were found effective treatments for the control of shoot fly and stem borer of pearl millet. Considering the ICBR, seed treatment of imidacloprid 600 FS @ 8.75 ml/kg followed by foliar spray of dimethoate 30 EC @ 0.03% at 35 DAG (1: 9.86) gave highest cost benefit ratio followed by seed treatment of thiamethoxam 35 FS @ 9.0 ml/kg followed by foliar spray of dimethoate 30 EC @ 0.03% at 35 DAG (1: 7.87) and foliar spray of profenophos 50 EC 0.05% at 20 and 35 DAG (1: 6.08).

**Keywords:** Pearl millet, stem borer, shoot fly, chlorantraniliprole, thiamethoxam

## Introduction
Pearl millet is the 4th most important cereal crop in the India after rice, wheat and maize. Pearl millet occupies 6.93 million ha with an average production of 8.61 million tonnes and productivity of 1243 kg/ha during 2018-19 (Anon., 2020) [1]. The major pearl millet growing states are Rajasthan, Maharashtra, Gujarat, Uttar Pradesh and Haryana which account for more than 90% of pearl millet acreage in the country. The United Nations General Assembly has declared the year, 2023 as the "International Year of Millets" to bring millets into the mainstream for exploiting their nutritional properties and promoting their cultivation and use. The resolution declaring 2023 as the International Year of Millets calls on all stakeholders to provide support to activities aimed at raising awareness thereof and framing and directing policies with respect to nutritional and health benefits of millet consumption, and their suitability for cultivation under adverse and changing climatic conditions.
Twenty six insects and two non-insect pests were found feeding on pearl millet (Balikai, 2010) [2]. Out of these, shoot fly, *Atherigona approximate* Malloch and stem borer, *Chilo partellus* Swinhoe are comparatively more serious pests attacking the crop. Losses in yield of Pearl millet crop due to shoot fly estimated to the tune of 23.3 to 36.5% in grain and 37.55% in fodder, while the estimated losses in pearl millet yield due to stem borer is 20 to 60% (Prem Kishore, 1996) [8]. There is a need to design alternate pest management options that have limited adverse effects on the environment and are effective against target insect pests. Objective of the study was to determine the effectiveness of the pesticides to reduce load of the chemical pesticides pearl millet agro ecosystem.

## Materials and Methods
The experiment was conducted in Randomized Block Design with ten treatments in three replication at Junagadh Agricultural University, Junagadh during *Kharif* -2021. The pearl millet variety GHB-1231 was sown at 60 × 10 cm spacing for this purpose. The gross plot size was 5.0 × 3.0 m and net plot size was 4.0 × 1.8 m. Seed treatment and soil applications of insecticides were given at the time of sowing. While, foliar application was given at 35 days after sowing of the crop. At vegetative stages, observation was recorded on 20 plants of net plot plant by counting the dead heart. Thus shoot fly dead heart percentage were worked out. For stem borer, plant sowing parallel holes due to stem borer larvae in the leaves were consider as damaged plant. At ear head stage, numbers of ear heads sowing shoot fly and stem borer (empty/white ear head) damage were recorded separately and thus percentage ear head damage was worked out from ear heads of 20 plants of net plot.

Grain and fodder yield was recorded from net plot area and data thus, obtained was analyzed statistically (Panse and Sukhatme, 1989) [5].

**Treatment details**

1. Seed treatment of imidacloprid 600 FS @ 8.75 ml/kg followed by foliar spray of dimethoate 30 EC @ 0.03% at 35 DAG
2. Seed treatment of thiamethoxam 35 FS @ 9.0 ml/kg followed by foliar spray of dimethoate 30 EC @ 0.03% at 35 DAG
3. Soil application of cartap hydrochloride 4G @ 15 kg/ha followed by foliar spray of dimethoate 30 EC @ 0.03% at 35 DAG
4. Soil application of chlorpyriphos 10G @ 7.5 kg/ha followed by foliar spray of dimethoate 30 EC @ 0.03% at 35 DAG
5. Seed treatment of imidacloprid 600 FS @ 8.75 ml/kg followed by foliar spray of chlorantraniliprole 20 SC @ 0.006% at 35 DAG
6. Seed treatment of thiamethoxam 35 FS @ 9.0 ml/kg followed by foliar spray of chlorantraniliprole 20 SC @ 0.006% at 35 DAG
7. Soil application of cartap hydrochloride 4G @ 15kg/ha followed by foliar spray of chlorantraniliprole 20 SC @ 0.006% at 35 DAG
8. Soil application of chlorpyriphos 10G @ 7.5 kg/ha followed by foliar spray of chlorantraniliprole 20 SC @ 0.006% at 35 DAG
9. Foliar spray of profenophos 50 EC 0.05% at 20 and 35 DAG
10. Control

**Table 1:** Effect of pesticides against infestation of shoot fly and stem borer in pearl millet

| Treats | Shoot fly incidence (%) | | Stem borer incidence (%) | |
|---|---|---|---|---|
| | Vegetative stage | Ear head stage | Vegetative stage | Ear head stage |
| $T_1$ | 13.76 (5.66) | 9.48 (2.71) | 20.26 (11.99) | 14.87 (6.59) |
| $T_2$ | 15.09 (6.78) | 10.74 (3.47) | 21.59 (13.54) | 15.92 (7.52) |
| $T_3$ | 18.31 (9.87) | 13.57 (5.51) | 22.11 (14.17) | 17.60 (9.14) |
| $T_4$ | 18.58 (10.52) | 14.34 (6.13) | 16.41 (7.98) | 12.88 (4.97) |
| $T_5$ | 15.06 (6.75) | 11.03 (3.66) | 16.90 (8.45) | 13.55 (5.49) |
| $T_6$ | 16.80 (8.35) | 11.67 (4.09) | 18.63 (10.21) | 14.25 (6.06) |
| $T_7$ | 18.03 (9.58) | 14.16 (5.98) | 19.62 (11.27) | 14.91 (6.62) |
| $T_8$ | 17.36 (8.90) | 14.81 (6.53) | 16.34 (7.92) | 12.40 (4.61) |
| $T_9$ | 14.20 (6.02) | 8.95 (2.42) | 15.31 (6.97) | 11.07 (3.69) |
| $T_{10}$ | 24.44 (17.12) | 21.32 (13.22) | 26.14 (19.41) | 21.57 (13.52) |
| S.Em. ± | 0.51 | 0.77 | 0.89 | 0.78 |
| C. D. 5% | 1.57 | 2.28 | 2.65 | 2.31 |
| C. V. % | 9.76 | 10.22 | 7.99 | 9.10 |

Figures in parentheses are retransformed values; those outside are arcsine transformed values

**Table 2:** Economics of pesticides applied for the control of major pests of pearl millet

| Treat No. | Total cost of insecticides (Rs/ha) | Yield (kg/ha) | Gross realization (Rs/ha) | Realization over control (Rs/ha) | ICBR |
|---|---|---|---|---|---|
| $T_1$ | 1205 | 2514 | 61173 | 11878 | 1:9.86 |
| $T_2$ | 1090 | 2370 | 57878 | 8583 | 1:7.87 |
| $T_3$ | 1750 | 2050 | 50724 | 1429 | 1:0.82 |
| $T_4$ | 1675 | 2221 | 54517 | 5222 | 1:3.12 |
| $T_5$ | 3255 | 2441 | 59519 | 10224 | 1:3.14 |
| $T_6$ | 3140 | 2356 | 57547 | 8552 | 1:2.63 |
| $T_7$ | 3800 | 2170 | 53377 | 4082 | 1:1.07 |
| $T_8$ | 3725 | 2322 | 56777 | 7482 | 1:2.01 |
| $T_9$ | 1750 | 2459 | 59935 | 10640 | 1:6.08 |
| $T_{10}$ | - | 1989 | 49295 | - | - |

## Results and Discussions

### Shoot fly

The field experiment was conducted on pearl millet variety GHB-1231 to determine the efficacy of insecticides against shoot fly and stem borer during *kharif* 2021. Among the different insecticides, seed treatment of imidacloprid 600 FS @ 8.75 ml/kg followed by foliar spray of dimethoate 30 EC @ 0.03% at 35 DAG (5.66%) ($T_1$) was found to be the most effective in reducing the infestation of shoot fly at vegetative stage. However, it was at par with the foliar spray of profenophos 50 EC 0.05% at 20 and 35 DAG (6.02%) ($T_9$), seed treatment of thiamethoxam 35 FS @ 9.0 ml/kg followed by foliar spray of dimethoate 30 EC @ 0.03% at 35 DAG (6.78%) ($T_2$) and seed treatment of imidacloprid 600 FS @ 8.75 ml/kg followed by foliar spray of chlorantraniliprole 20 SC @ 0.06% at 35 DAG (6.75%) ($T_5$). While, at earhead stage foliar spray of profenophos 50 EC 0.05% at 20 and 35 DAG (2.42%) ($T_9$) was found to be the most effective in reducing the infestation of shoot fly at earhead stage. However, it was at par with the seed treatment of imidacloprid 600 FS @ 8.75 ml/kg followed by foliar spray of dimethoate 30 EC @ 0.03% at 35 DAG (2.71%) ($T_1$), seed treatment of thiamethoxam 35 FS @ 9.0 ml/kg followed by foliar spray of dimethoate 30 EC @ 0.03% at 35 DAG (3.47%) ($T_2$), seed treatment of imidacloprid 600 FS @ 8.75 ml/kg followed by foliar spray of chlorantraniliprole 20 SC @ 0.06% at 35 DAG (3.66%) ($T_5$) and seed treatment of thiamethoxam 35 FS @ 9.0 ml/kg followed by foliar spray of chlorantraniliprole 20 SC @ 0.06% at 35 DAG (4.09%) ($T_6$). The remaining treatments were found comparatively less effective in reducing shoot fly infestation in pearl millet crop.

### Stem borer

In case of stem borer, the minimum plant infestation (6.97%) was recorded in the treatment foliar spray of profenophos 50 EC 0.05% at 20 and 35 DAG ($T_9$) at vegetative stage. However, it was at par with the soil application of chlorpyriphos 10 G @ 7.5 kg/ha followed by foliar spray of chlorantraniliprole 20 SC @ 0.006% at 35 DAG (7.92%), soil application of chlorpyriphos 10 G @ 7.5 kg/ha followed by foliar spray of dimethoate 30 EC @ 0.03% at 35 DAG (7.98%) ($T_4$) and seed treatment of imidacloprid 600 FS @ 8.75 ml/kg followed by foliar spray of chlorantraniliprole 20 SC @ 0.006% at 35 DAG (8.45%). At earhead stage, the foliar spray of profenophos 50 EC 0.05% at 20 and 35 DAG (3.69%) ($T_9$) was found to be the most effective in reducing

the infestation of stem borer at earhead stage. However, it was at par with the soil application of chlorpyriphos 10 G @ 7.5 kg/ha followed by foliar spray of chlorantraniliprole 20 SC @ 0.06% at 35 DAG (4.61%) ($T_8$) and soil application of chlorpyriphos 10 G @ 7.5 kg/ha followed by foliar spray of dimethoate 30 EC @ 0.03% at 35 DAG (4.97%) ($T_4$). The remaining treatments were found comparatively less effective in reducing stem borer infestation in pearl millet crop.

The results obtained in the present study corroborate with the findings of Parmar *et al.* (2015) [6] who reported that foliar spray of profenophos 0.05% performed the best for the control of shoot fly and stem borer in pearl millet crop. According to Arun kumara *et al.* (2017) [2] chlorantraniliprole 0.4G was found superior one in reducing stem borer incidence in maize crop. Kumar and Alam (2017) [4] reported that the minimum mean per cent infestation (10.6%) was observed with foliar spray of chlorantraniliprole 20 SC @ 0.3 ml/l against stem borer in maize crop. Parmar *et al.* (2021) [7] also reported that seed treatment of imidacloprid 600 FS @ 8.75 ml/kg followed by foliar spraying of dimethoate 30 EC 0.03% at 35 DAG recorded significantly lowest shoot fly incidence at ear head stage of the pearl millet crop. Significantly least dead hearts (1.36 to 15.95%) observed with the treatment of thiamethoxam + cyantraniliprole against shoot fly in sorghum (Saxena *et al*., 2021) [9].

**Yield and economics**

Significantly the highest grain yield (2514 kg/ha) was recorded in the seed treatment of imidacloprid 600 FS @ 8.75 ml/kg followed by foliar spray of dimethoate 30 EC @ 0.03% at 35 DAG ($T_1$). However, it was found statistically at par with foliar spray of profenophos 50 EC 0.05% at 20 and 35 DAG (2459 kg/ha) ($T_9$) and seed treatment of imidacloprid 600 FS @ 8.75 ml/kg followed by foliar spray of chlorantraniliprole 20 SC @ 0.06% at 35 DAG (2441 kg/ha) ($T_5$). Seed treatment of imidacloprid 600 FS @ 8.75 ml/kg followed by foliar spray of dimethoate 30 EC @ 0.03% at 35 DAG ($T_1$) gave the highest cost-benefit ratio of (1: 9.86). The next best treatment is seed treatment of thiamethoxam 35 FS @ 9.0 ml/kg followed by foliar spray of dimethoate 30 EC @ 0.03% at 35 DAG (1: 7.87) ($T_2$) and foliar spray of profenophos 50 EC 0.05% at 20 and 35 DAG (1: 6.08) ($T_9$).

**Conclusion**

Result revealed that the seed treatment of imidacloprid 600 FS @ 8.75 ml/kg followed by foliar spray of dimethoate 30 EC @ 0.03% at 35 DAG was found the most effective in reducing the infestation of shoot fly. While, in case of stem borer, foliar spray of profenophos 50 EC 0.05% at 20 and 35 DAG was found to be most effective in reducing the infestation of stem borer.

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