Environment and Ecology 40 (4B) : 2393—2396, October—December 2022
ISSN 0970-0420

# Screening of Elite Bread Wheat (*Triticum aestivum*) Germplasms Against Shoot Fly, *Atherigona approximata* Malloch

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Received 31 July 2022, Accepted 6 September 2022, Published on 10 November 2022

## ABSTRACT

Shoot flies (Diptera: Muscidae) of *Atherigona* spp. are the major insect pest in several cereals and millets throughout the globe and causing significant crop yield loss. Usually, bread wheat (*Triticum aestivum* L.) is less attacked by insect pest, however under changed climate-pest scenario, shoot fly becomes potential major insect pest in recent days. Our present investigation registered *Atherigona approximata* Malloch as major shoot fly species exist under wheat ecosystem. Among the 30 wheat genotypes screened, none of them were found to be highly resistant but, two advanced germplasms, UAS BW-12417 and UAS BW-11110 were found to be resistant against shoot fly with 3.13 and 5.00 % dead heart incidence. Meanwhile, 16 entries are categorized as moderately resistant, 8 are grouped under susceptible and 4 genotypes are classified as highly susceptible. The obtained results will help in near future to recommend varieties for shoot fly infected locations.

**Keywords** Dead heart, Genotypes, Screening, Shoot fly, Wheat.

## INTRODUCTION

Bread wheat (*Triticum aestivum*) is a cereal grain which is a worldwide staple food and has been considered as "King of Cereals" for centuries because of the acreage it occupies, higher productivity and its predominant position in the food grain trade at international market. Wheat crop occupied largest cultivable area among the food grain crops (222.68 m ha) in the world due to its feeding boon to mankind and has reached production of about 756 million tonnes during 2017-18 (Anon 2020). World trade in wheat is greater than all other crops combined whereas in India, wheat is the second major cereal crop next to rice. It is a key crop for green revolution which made India as the second highest producer of wheat next to China with a total wheat production of 107.18 million tonnes from 31.05 million hectare area with the average productivity of 3.5 t/ha (Anon 2020). The main wheat-growing states in India includes Uttar Pradesh, Madhya Pradesh, Rajasthan, Punjab, Maharashtra, Haryana, Bihar, Karnataka, Gujarat and Uttarakhand (Ramadas *et al*. 2019).

Karnataka state has a unique way of wheat cultivation where the major three cultivated species are

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being grown in hot tropical climate which is characterized by high temperature during the crop growth. It is one of the important *rabi* crop grown under both rainfed and irrigated condition in Northern Karnataka with the annual production of about 2.3 lakh tonnes from 1.93 lakh hectare cultivated area (Anon 2019). But, Karnataka has very low (1193 kg/ha) productivity of wheat as compared to the national average of 3368 kg/ha (Anon 2019) due to several reasons where it includes the insect pests like termites, aphids and shoot fly. It is fact that the wheat is less attacked by insect pests in field as compared to other food grain crops but, the insect pests and diseases together reported to cause 20 to 37 % yield loss (Pimentel 1997) and the peak infestation of shoot fly was noticed in irrigated belts of Karnataka than in the rainfed crop. Therefore, in the present investigation an attempt was made to identify the resistant germplasms against shoot fly infestation.

## MATERIALS AND METHODS

The field experiment on genotype screening was conducted at Main Agricultural Research Station (MARS), University of Agricultural Sciences, Dharwad during *rabi* 2019-20 under All India Coordinated Research Project (AICRP) on wheat in irrigated condition. Totally, 30 germplasms of wheat were evaluated for their reaction against shoot fly. Each germplasm was sown in two rows of three-meter length with 23 cm spacing (row to row). All the crop production technologies were adopted to get good crop except plant protection measures against insect pests.

The observations on per cent dead heart due to shoot fly was recorded from two rows by counting the total number of plants and plants showing dead heart symptom at 15 Days After Emergence (DAE) and 30 DAE. The per cent dead heart was calculated as per the formula indicated below.

$$\text{Dead heart (\%)} = \frac{\text{Number of plants showing dead heart}}{\text{Total number of plants observed}} \times 100$$

The mean dead heart was calculated by using the data recorded during 15 and 30 DAE and the genotypes were categorized by adopting the scale used by Kalappanavar *et al*. (2010).

## RESULTS AND DISCUSSION

Dead heart is characterized by deformed stunted growth of the plant caused by borers on the region immediately behind the growing bud which results in the drying up of entire central shoot of the plant during the vegetative growth period with profused side tillers, not necessarily productive one. The data on dead heart percentage was recorded at 15 and 30 days after emergence (DAE) of wheat crop. The significant difference was noticed among the genotypes with respect to dead heart percentage both at 15 and 30 DAE. The mean and standard deviation for the sown genotypes were calculated and found 12.43 and 6.96, respectively (Table 1). By considering mean and standard deviation, the wheat genotypes were cate-

**Table 1.** Dead heart incidence due to shoot fly (*Atherigona approximata* Malloch) in different entries of wheat. DAE: Days after emergence.

| Sl. No. | Germplasm | Dead heart (%) 15 DAE | 30 DAE | Mean |
|---|---|---|---|---|
| 1 | DWR-162 | 13.39 | 24.55 | 18.97 |
| 2 | MACS-2496 | 7.78 | 13.89 | 10.83 |
| 3 | GW-322 | 10.48 | 19.05 | 14.76 |
| 4 | UAS-342 | 4.92 | 7.38 | 6.15 |
| 5 | MACS-6222 | 8.75 | 15.83 | 12.29 |
| 6 | UAS-334 | 9.14 | 16.57 | 12.86 |
| 7 | DBW-168 | 12.33 | 21.92 | 17.12 |
| 8 | HD-3090 | 9.68 | 16.67 | 13.17 |
| 9 | NIAW-1415 | 6.32 | 10.53 | 8.42 |
| 10 | UAS-347 | 11.43 | 20.00 | 15.71 |
| 11 | UAS-304 | 20.63 | 36.83 | 28.73 |
| 12 | UAS BW-10486 | 6.25 | 9.38 | 7.81 |
| 13 | UAS BW-10237 | 13.24 | 23.53 | 18.38 |
| 14 | UAS BW-11430 | 6.77 | 10.53 | 8.65 |
| 15 | UAS BW-11371 | 7.14 | 13.39 | 10.27 |
| 16 | UAS BW-11114 | 6.25 | 8.75 | 7.50 |
| 17 | UAS BW-11110 | 3.85 | 6.15 | 5.00 |
| 18 | UAS BW-11142 | 7.81 | 15.63 | 11.72 |
| 19 | UAS BW-11048 | 18.42 | 33.33 | 25.88 |
| 20 | UAS BW-11256 | 14.81 | 26.54 | 20.68 |
| 21 | UAS BW-11257 | 15.49 | 26.76 | 21.13 |
| 22 | UAS BW-12711 | 6.48 | 11.11 | 8.80 |
| 23 | UAS BW-12707 | 6.35 | 9.52 | 7.94 |
| 24 | UAS BW-12417 | 3.13 | 3.13 | 3.13 |
| 25 | UAS BW-12309 | 10.32 | 17.46 | 13.89 |
| 26 | UAS BW-12436 | 4.41 | 7.35 | 5.88 |
| 27 | UAS BW-12373 | 6.45 | 9.68 | 8.06 |
| 28 | UAS BW-12407 | 5.75 | 8.05 | 6.90 |
| 29 | UAS BW-12409 | 4.81 | 7.69 | 6.25 |
| 30 | UAS BW-12432 | 7.94 | 11.11 | 9.52 |
| | Mean ± SD | 9.09 ± 4.55 | 15.77 ± 9.40 | 12.43 ± 6.96 |

**Table 2.** Categorization of genotypes based on per cent dead heart infestation due to shoot fly (*Atherigona approximata*) during *rabi*, 2019-20. Mean: 12.43 SD: 6.96.

| Sl. No. | Category | Score | Number of genotypes |
|---|---|---|---|
| 01 | Highly resistant (Mean – 2 SD) | -1.49 | 0 |
| 02 | Resistant (Mean – SD) | -1.50 to 5.47 | 2 |
| 03 | Moderately resistant (Mean) | 5.48 to 12.43 | 16 |
| 04 | Susceptible (Mean + SD) | 12.44 to 19.39 | 8 |
| 05 | Highly susceptible (Mean + 2 SD) | 19.40 to 26.35 | 4 |

gorized into highly resistant (Mean – 2SD), resistant (Mean – SD), moderately resistant (Mean), susceptible (Mean + SD) and highly susceptible (Mean + 2SD) based on dead heart incidence (Table 2).

Among 30 genotypes screened, none of the entries were found highly resistant against shoot fly infestation with dead heart score below -1.49% whereas, two advanced genotypes, UAS BW-12417 and UAS BW-11110 were found to be resistant against shoot fly with 3.13 and 5.00% dead heart incidence. Sixteen entries viz., UAS BW-12436 (5.88%), UAS-342 (6.15%), UAS BW-12409 (6.25%), UAS BW-12407 (6.90%), UAS BW-11114 (7.50%), UAS BW-10486 (7.81%), UAS BW-12707 (7.94%), UAS BW-12373 (8.06%), NIAW-1415 (8.42), UAS BW-11430 (8.65%), UAS BW-12711 (8.80%), UAS BW-12432 (9.52%), UAS BW-11371 (10.27%), MACS-2496(10.83%), UAS BW-11142 (11.72%) and MACS-6222 (12.29%) were reported to be moderately resistant against shoot fly attack. Meanwhile, eight elite wheat entries were found to be susceptible to shoot fly with per cent dead heart score of 12.44 to 19.39% viz., UAS-334 (12.86%), HD-3090 (13.17%), UAS BW-12309 (13.89%), GW-322 (14.76%), UAS-347 (15.71%), DBW-168 (17.12%), UAS BW-10237 (18.38%) and DWR-162 (18.97%). Four wheat genotypes were confirmed as highly susceptible to shoot fly infestation, including susceptible check i.e., UAS BW-11256 (20.68%), UAS BW-11257 (21.13%), UAS BW-11048 (25.88%) and UAS-304 (SC) (28.73%). Screening study including thirty wheat genotypes indicated that none of the entries were showed high degree of resistance against shoot fly but the genotypes like, UAS BW-12417 and UAS BW-11110 showed less shoot fly incidence of 3.13 and 5.00% dead heart and found to be resistant and can be utilised in future breeding studies as resistant sources. Meanwhile, the entries UAS-304 (28.73%), UAS BW-11048 (25.88%), UAS BW-11257 (21.13%) and UAS BW-11256 (20.68) were categorised as highly susceptible and can be reconsider them in field screening trials for further confirmation (Table 3).

**Table 3.** Screening of wheat genotypes against shoot fly (*Atherigona approximata*) at AICRP on wheat, UAS Dharwad during *rabi*, 2019-20.

| Sl. No. | Category | Genotypes |
|---|---|---|
| 01 | Highly resistant | Nil |
| 02 | Resistant | UAS BW-12417, UAS BW-11110 |
| 03 | Moderately resistant | UAS BW-12436, UAS 342, UAS BW-12409, UAS BW-12407, UAS BW-11114, UAS BW-10486, UAS BW-12707, UAS BW-12373, NIAW-1415, UAS BW-11430, UAS BW-12711, UAS BW-12432, UAS BW-11371, MACS-2496, UAS BW-11142, MACS-6222 |
| 04 | Susceptible | UAS-334, HD-3090, UAS BW-12309, GW-322, UAS-347, DBW-168, UAS BW-10237, DWR-162 |
| 05 | Highly susceptible | UAS BW-11256, UAS BW-11257, UAS BW-11048, UAS-304 |

In wheat, there is a scanty of research and literature pertaining to utilization of resistant germplasms to tackle shoot pests like shoot fly, since it had minor pest status in past. But now, it has got much scope in scientific field to work on resistant wheat sources as shoot fly attaining major pest status with considerable damage at vegetative stage due to changed environmental factors. In the earlier reports (Anon 2008, Anon 2009), PBW-550 and K- 0343 wheat genotypes were found to be promising against shoot fly when they tested in three locations for three seasons. Among the 41 wheat varieties screened by Kalappanavar *et al*. (2010), HI-8682, HP-1913, HI-8680 and HD-2987 genotypes were found to be resistant against shoot fly, *Atherigona oryzae* with least dead heart in wheat during both the year of investigation. In another study conducted by Kumar *et al*. (2010), NIDW-309, HW-3070, PBW-525, MACS-6165, NIDW-295, AKDW-2997-16, PBW-52 were categorised as resistant genotypes among 54 germplasms evaluated against shoot fly, *Atherigona naqvii*. By looking into the above findings, it is also interesting that the different shoot fly species were reported from different locations in wheat including our present investigation, where we identified it as *Atherigona approximata* Malloch which indicates the existence of species complex throughout different geographical locations. So, there is a scope in future to work on shoot fly in wheat, particularly in aspects like identification of resistant sources and documentation of shoot fly species diversity in different geographical locations of conventional wheat growing areas.

## ACKNOWLEDGEMENT

Authors wish to thank Dr Prabhu C. Ganiger, Entomologist, University of Agricultural Sciences, Bangalore-India for his extensive work on identification of shoot fly species along with untiring guidance and suggestions throughout the period of investigation. We also wish to thank Dr V. Rudra Naik, Assistant Director of Research, University of Agricultural Sciences, Dharwad for his much-needed help to get seed material and conduct this experiment at AICRP, Wheat.

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