The Pharma Innovation Journal 2025; 14(9): 51-55

www.ThePharmaJournal.com

The Pharma Innovation

**ISSN (E): 2277-7695**
**ISSN (P): 2349-8242**
**Impact Factor (RJIF):** 6.34
TPI 2025; 14(9): 51-55

www.thepharmajournal.com
Received: 19-07-2025
Accepted: 21-08-2025

**Achal Dolas**
Research Scholar, Department of Entomology, Post Graduate Institute, Dr. Panjabrao Deshmukh Vidyapeeth, Akola, Maharashtra, India

**VU Sonalkar**
Associate Professor, Sorghum Research Unit, Dr. PDKV, Akola, Maharashtra, India

**G Shyam Prasad**
Principal Scientist, Indian Institute of Millets Research (IIMR), Hyderabad, Telangana, India

**A Kalaisekar**
Associate Professor, Oilseed Research Unit, Dr. PDKV, Akola, Maharashtra, India

**PN Mane**
Department of Entomology, Post Graduate Institute, Dr. Panjabrao Deshmukh Vidyapeeth, Akola, Maharashtra, India

**DB Undirwade**
Department of Entomology, Post Graduate Institute, Dr. Panjabrao Deshmukh Vidyapeeth, Akola, Maharashtra, India

**SS Mane**
Director of Extension Education, Dr. PDKV, Akola; Dean, Dr. PDKV, Akola, Maharashtra, India

**Prabhu C Ganiger**
Scientist, ICAR- AICRP on Small Millets, University of Agricultural Sciences, GKVK, Bengaluru, Karnataka, India

**Corresponding Author:**
**Achal Dolas**
Department of Entomology, Post Graduate Institute, Dr. Panjabrao Deshmukh Vidyapeeth, Akola, Maharashtra, India

# Diversity and distribution of sorghum shoot fly in western Vidarbha

**Achal Dolas, VU Sonalkar, G Shyam Prasad, A Kalaisekar, PN Mane, DB Undirwade, SS Mane and Prabhu C Ganiger**

**DOI:** https://www.doi.org/10.22271/tpi.2025.v14.i9a.26266

**Abstract**
The diversity and distribution studies of shoot flies revealed that, across the five districts surveyed, three species belonging to the genus *Atherigona* were recorded: *Atherigona soccata*, *Atherigona simplex*, and *Atherigona oryzae*. In addition, four other dipteran flies were identified, representing the families Anthomyiidae, *Platystomatidae*, *Lonchaeidae*, and Chloropidae. Within Anthomyiidae, the genus Delia was observed, though only in very low numbers in certain parts of Western Vidarbha. Among all identified species, *Atherigona soccata* was the most prevalent.
The study also revealed a higher female-to-male ratio of shoot flies across the five surveyed districts. In all surveyed fields, shoot fly damage was recorded above the economic threshold level. The highest incidence of shoot fly infestation was observed in Akola, Buldhana, and Washim, whereas comparatively lower incidence was recorded in Amravati and Yavatmal districts.

**Keywords:** *Atherigona*, *soccata*, *simplex*, *oryzae*, *Anthomyiidae*, *Platystomatidae*, *Lonchaeidae*, *Chloropidae*, Delia, *Anthomyiidae*, Shoot fly

## Introduction
Sorghum (*Sorghum bicolor*), an important cereal crop of the family Poaceae, is also known as the "King of Millets." Globally, it ranks third in area and production after wheat and rice, with India contributing 16% to total world production, making it the fourth largest producer (Gautam & Singh, 2018) [8]. A half-cup serving of sorghum provides approximately 316 calories, 3 g fat, 2 mg sodium, 69 g carbohydrates, 7.5 g fibre, 2.5 g sugars, and 10 g protein (Anonymous, 2021) [1].
The Sorghum genus consists of about 25 flowering plants, some cultivated as cereals for human consumption and others used as forage for livestock. The species *S. bicolor*, originally domesticated in Africa, has spread worldwide and is now the fifth most important cereal after maize, rice, wheat, and barley. Sorghum is highly resilient, requiring less water and withstanding considerable climatic variability compared to other cereals. Because of its capacity to thrive under limited water availability and high temperatures, it is often referred as the "camel crop." Though not free from abiotic and biotic stresses, sorghum maintains good yield potential under unpredictable weather conditions, making it a viable crop amid climate change challenges.
Sorghum is widely adapted to diverse agro-ecological zones, particularly in the semi-arid tropics (SAT), where it is extensively grown in marginal, fragile, and drought-prone environments. Apart from grain production, it is cultivated for forage and used as green fodder, silage, or hay. Globally, sorghum grain is also a key ingredient in poultry and cattle feed, especially in the USA, China, and Australia. In India, sorghum is cultivated over 41.91 million ha, producing 61.18 million tonnes annually with a productivity of 1460 kg/ha (Anonymous, 2023) [3]. Maharashtra, Karnataka, Madhya Pradesh, Andhra Pradesh, and Rajasthan are the leading sorghum-producing states.
Despite its adaptability, sorghum is vulnerable to more than 150 insect species during its growth cycle (Sharma *et al*., 1997a) [13]. Maharashtra alone reports about 18 major insect pests that significantly damage sorghum, including the shoot fly (*Atherigona soccata*), stem borer (*Chilo partellus*), and fall armyworm (*Spodoptera frugiperda*). In the state, sorghum is grown on about 1.65 million ha, with an average yield of 1038 kg/ha—lower than the national average of 1110 kg/ha (Anonymous, 2022) [2]. This yield gap is attributed to environmental stress, water scarcity, seed quality, inadequate fertilizer use, pests, and diseases, with insect damage being one of the foremost constraints.

The genus *Atherigona* Rondani is one of the most diverse within the Muscidae family, comprising around 300 recognized species, 156 of which occur in the Afrotropical region (Dike, 1990 [7]; Couri *et al*., 2006 [5]; Muller, 2015) [11]. In Vidarbha, the major sorghum pests include shoot fly, stem borer, fall armyworm, and midge fly, with shoot fly being the most destructive. The maggots hatch, migrate to the leaf surface, enter the leaf sheath, and bore into the stem, cutting the growing point and producing the characteristic "dead heart" symptom. This damage forces the plant to produce side tillers, significantly reducing yield. Infestation is typically more severe during the Kharif season. The female adult, a whitish-grey fly, lays cigar-shaped white eggs (Plate 1) on the lower leaf surface, mostly in the morning hours. Eggs hatch in 2-3 days, producing dirty-white, legless larvae. Mature larvae (Plate 2) are yellow, about 6 mm long, and complete four instars in 8-10 days. Pupation (Plate 3) occurs at the stem base or in the soil, lasting 8-10 days. The entire life cycle is completed in 17-21 days.

Several *Atherigona* species are recognized as major pests of grasses and cereals. *A. soccata*, in particular, is highly destructive to sorghum and millet across Africa, Asia, and Latin America, with infestations resulting in up to 90% seedling mortality due to dead heart formation (Van den Berg *et al*., 2005) [15]. In India, shoot fly infestation causes yield losses 80-90% in grain and 68% in fodder (Balikai & Bhagwat, 2009 [4]; Kahate *et al*., 2014) [9]. Infestation usually occurs within 1-4 weeks after seedling emergence, peaking in August during the Kharif season (Pawar *et al*., 2015) [12]. Shoot fly composition varies with location, and different species may coexist in sorghum fields. However, systematic studies on shoot fly species composition have not been conducted in Vidarbha. Therefore, surveys on shoot fly diversity and composition in sorghum during Kharif have been initiated.

## Materials and Methods

The present investigation was conducted during the Kharif season of 2023 to study the composition of shoot flies infesting sorghum. The study was carried out on farmers' fields across Western Vidarbha, and the collected samples were processed in the Sorghum Research Unit Laboratory, Dr. Panjabrao Deshmukh Krishi Vidyapeeth (PDKV), Akola.

### Sample Collection

From each location, a minimum of 15-20 dead heart seedlings representing the whole field were collected during August. The samples were placed in cotton bags (25 × 20 cm) and transported to the laboratory. These bags were maintained at room temperature for 2-3 days to allow adult emergence.

### Laboratory Processing

The emerged adult shoot flies were carefully transferred into sterile glass vials free of contaminants. For larval collection (Plate 2), the collected dead heart seedlings were split open, and larvae were extracted and preserved in glass vials containing 70% ethanol. Both adult (Plate 4) and larval specimens were properly labelled and forwarded to the Principal Investigator (Entomology), AICRP-Sorghum, IIMR Hyderabad, for taxonomic identification and species composition studies. The consignments of collected specimens were dispatched within 50 days after sowing (DAS) to ensure sample quality.

**Plate 1:** Shoot fly eggs

**Plate 2:** Shoot fly larvae

**Plate 3:** Shoot fly pupae

**Plate 4:** Shoot fly adults

### Data Recording and Identification

The entire number of shoot flies emerging from each sample was recorded for all surveyed locations and districts. Technical identification and confirmation of species diversity were done at IIMR, Hyderabad and the AICRP on Small Millets, ICAR, UAS, GKVK, Bengaluru.

## Results and discussion

The studies conducted to document the diversity and species richness of shoot flies and other dipteran flies from samples collected across five districts of Western Vidarbha during Kharif 2023 have been summarized in tables. The identification results revealed that three species of shoot flies belonging to the genus *Atherigona* were recorded, namely *Atherigona soccata*, *Atherigona simplex*, and *Atherigona oryzae*. In addition, four other dipteran flies were identified, representing the families Anthomyiidae, Platystomatidae, Lonchaeidae, and Chloropidae. Within the family Anthomyiidae, the genus Delia was observed, though only in very low proportions in certain parts of Western Vidarbha (Table 1).

A total 291 flies emerged from samples collected from Akola, Amravati, Buldhana, Washim, and Yavatmal districts. The maximum number of 175 flies of *Atherigona soccata* emerged from the samples of five districts of Western Vidarbha followed by 39 flies of *Lonchaeidae* spp., 31 flies of *Platystomatidae* spp., 25 flies of Chloropidae spp., nine flies of *Atherigona oryzae*, seven flies of genus Delia. There was minimum of 5 flies of *Atherigona simplex* that emerged from samples of five districts of Western Vidarbha (Table 2).

**Table 1:** Percentage composition of Shoot flies

| **Family** | ***Muscidae*** | | | ***Anthomyiidae*** | ***Platystomatidae*** | ***Lonchaeidae*** | ***Chloropidae*** |
|---|---|---|---|---|---|---|---|
| | ***Atherigona*** | | | ***Delia*** | - | - | - |
| Species | *A. soccata* | *A. Simplex* | *A. oryzae* | - | - | - | - |
| Akola | 61.11 | 2.08 | 2.08 | 2.08 | 11.11 | 13.19 | 8.33 |
| Amravati | 63.33 | 0.00 | 3.33 | 0.00 | 10.00 | 13.33 | 10.00 |
| Buldhana | 57.14 | 2.86 | 2.86 | 2.86 | 11.43 | 14.29 | 8.57 |
| Washim | 58.33 | 1.67 | 5.00 | 3.33 | 10.00 | 13.33 | 8.33 |
| Yavatmal | 59.09 | 0.00 | 4.55 | 4.55 | 9.09 | 13.64 | 9.09 |
| Mean total- | 59.80 | 1.32 | 3.56 | 2.56 | 10.33 | 13.56 | 8.87 |

**Table 2:** District-wise Composition of Shoot Flies in Western Vidharba (Kharif 2023)

| **Family** | ***Muscidae*** | | | ***Anthomyiidae*** | ***Platystomatidae*** | ***Lonchaeidae*** | ***Chloropidae*** | **Total Number of individuals identified** |
|---|---|---|---|---|---|---|---|---|
| | ***Atherigona*** | | | ***Delia*** | - | - | - | |
| Species | *A. soccata* | *A. Simplex* | *A. oryzae* | - | - | - | - | |
| Akola | 88 | 3 | 3 | 3 | 16 | 19 | 12 | 144 |
| Amravati | 19 | 0 | 1 | 0 | 3 | 4 | 3 | 30 |
| Buldhana | 20 | 1 | 1 | 1 | 4 | 5 | 3 | 35 |
| Washim | 35 | 1 | 3 | 2 | 6 | 8 | 5 | 60 |
| Yavatmal | 13 | 0 | 1 | 1 | 2 | 3 | 2 | 22 |
| Total | 175 | 5 | 9 | 7 | 31 | 39 | 25 | 291 |

The present study is strongly supported by the findings of Davies *et al*. (1980) [6], who recorded 13 species of shoot flies belonging to the two genera *Atherigona* and *Acritochaeta*. Among these, *Atherigona soccata* was the most common species, while *Acritochaeta orientalis* Schiner was the second most prevalent species recorded in sorghum fields.

These results are further corroborated by Sherwill *et al*. (1999) [14], who identified four major shoot fly species attacking late-planted sorghum in the subtropical region in South Africa. Among these, *A. soccata* was the most abundant species (39.3%), followed by *Scoliophthalmus trapezoides* (34.4%) and *Anacamptoneurum obliquum* (15.3%). *A. erinaceus* was the least abundant, representing the lowest proportion among the four species identified.

Similarly, the present identification study is in agreement with the findings of Khan (2023) [10], who reported three species of *Atherigona* across seven districts of Southern Rajasthan, namely *A. soccata*, A. oryzae, and *A. delia*. In addition, three other dipteran flies-Chloropidae spp., Lonchaeidae spp., and *Platystomatidae* spp. also emerged from the collected samples. The abundance of these flies indicated A. soccata as the dominant species, with 189 individuals, followed by Chloropidae spp. (29), *Lonchaeidae* spp. (20), *A. delia* (11), and A. oryzae (10). The lowest emergence was observed for *Platystomatidae* spp. (6) from the surveyed districts of Southern Rajasthan.

### Shoot Fly Composition in Different Districts of Western Vidarbha

#### Akola District

From the samples collected across seven tehsils of Akola district, 144 flies were emerged. Among these, *Atherigona soccata* was predominant, with 88 individuals, followed by 19 flies of *Lonchaeidae* spp., 16 flies of *Platystomatidae* spp., and 12 flies of Chloropidae spp. The lowest emergence was observed for *Atherigona simplex*, *A. oryzae*, and *Delia*, with only 3 flies each (Table 2).

#### Amravati District

From Amravati district, a total of 30 flies were recorded. The maximum emergence was of *A. soccata* (19 individuals), followed by 4 flies of *Lonchaeidae* spp., and 3 flies each of *Platystomatidae* spp. and Chloropidae spp. The minimum was A. oryzae with 1 fly, while A. simplex and Delia were not recorded from the samples (Table 2).

#### Buldhana District

In Buldhana district, the collected samples yielded 35 flies in total. Among these, *A. soccata* was again the dominant species with 20 flies, followed by 5 flies of *Lonchaeidae* spp., 4 flies of *Platystomatidae* spp., and 3 flies of Chloropidae spp. Only 1 fly each of A. simplex, A. oryzae, and Delia was recorded, representing the lowest abundances (Table 2).

**Washim District**

Samples from three tehsils of Washim district produced 60 flies. The maximum emergence was from *A. soccata* with 35 flies, followed by 8 flies of *Lonchaeidae* spp., 6 of *Platystomatidae* spp., 5 of Chloropidae spp., 3 of A. oryzae, and 2 of Delia. The lowest number was recorded for A. simplex, with only 1 fly (Table 2).

**Yavatmal District**

In samples from Yavatmal district, a total of 22 flies emerged. The majority belonged to *A. soccata* (13 flies), followed by three of *Lonchaeidae* spp., and two of *Platystomatidae* spp. and Chloropidae spp. Only one fly each of *A. oryzae* and *Delia* was observed, while *A. simplex* was absent from the samples (Table 2).

**Overall Species Composition in Western Vidarbha**

Across the five surveyed districts of Western Vidarbha, the emergence pattern highlighted *A. soccata* as the most dominant species, accounting for 59.80% of the total population. This was followed by *Lonchaeidae* spp. (13.56%), *Platystomatidae* spp. (10.33%), Chloropidae spp. (8.87%), A. oryzae (3.56%), Delia (2.56%), and *A. simplex* (1.32%). The overall abundance pattern of shoot fly species and associated dipteran flies is presented in Table 1 and Figure 1.

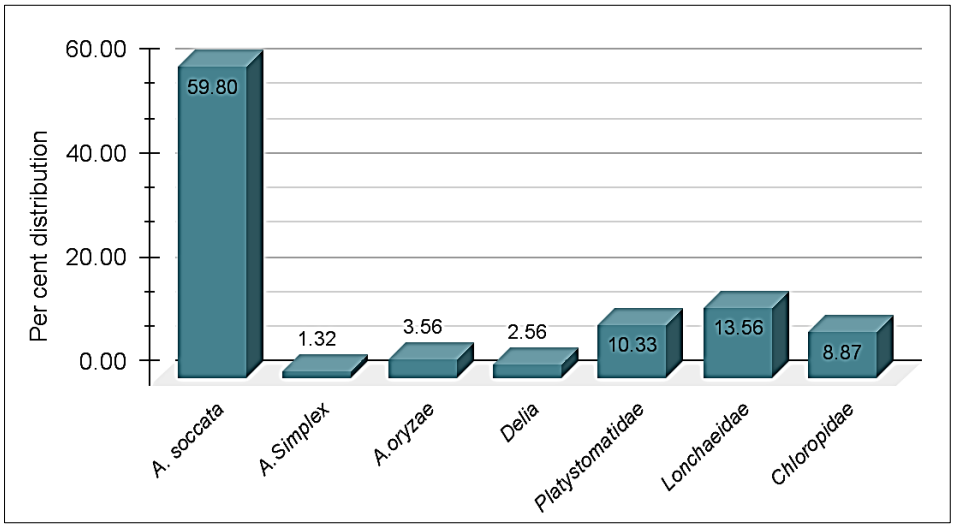


**Fig 1:** Shoot fly composition across Western Vidarbha

The present investigation revealed results comparable to those reported by Khan (2023) [10]. In his study, data on the relative density of different fly species indicated that *Atherigona soccata* contributed the highest proportion, accounting for 71.59% of the total emerged population. This was followed by Chloropidae spp. (10.98%), *Lonchaeidae* spp. (7.57%), A. delia (4.16%), and A. oryzae (3.78%). The lowest relative density was recorded for *Platystomatidae* spp., which accounted for only 2.27% of the population.

District-wise analysis of shoot fly composition in the present study showed that *A. soccata* and Chloropidae spp. were most abundant in Amravati district among the five surveyed districts of Western Vidarbha. In contrast, *A. simplex*, *Platystomatidae* spp., and *Lonchaeidae* spp. were found in greater proportions in Buldhana district compared to the other four districts. Similarly, Delia was recorded in the highest proportion in Yavatmal district, while A. oryzae.

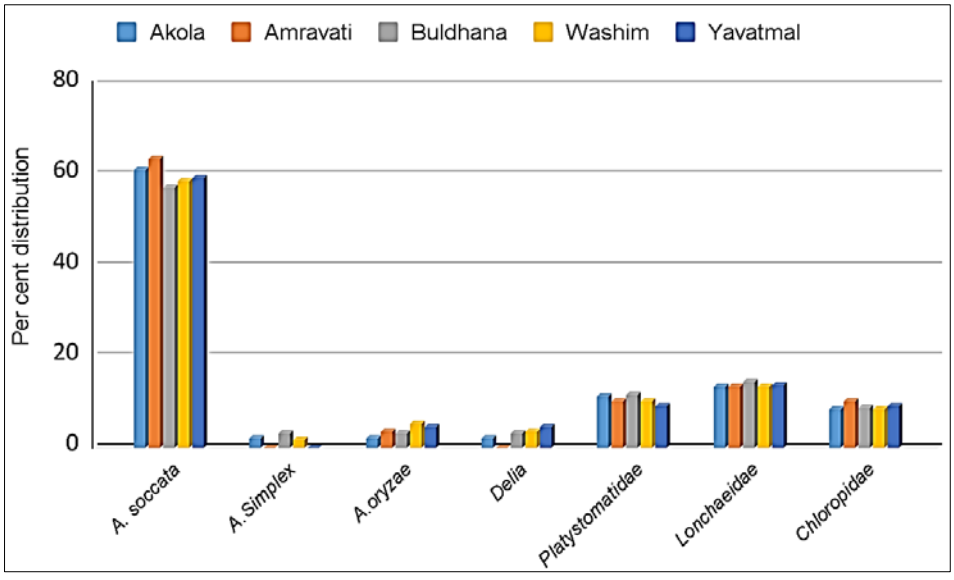


**Fig 2:** District-wise composition of the shoot fly

During the present investigation, a subset of samples was examined for sex determination among shoot flies. Out of 85 identified specimens, 50 were females and 35 were males, indicating a higher proportion of females of the population. This corresponds to a male-to-female ratio of 1:1.43 (Table 3). The observed sex ratio in Western Vidarbha is consistent with the findings of Davies (1980) [6], who reported that, in studies on sorghum, females were more numerous than males, with a recorded sex ratio of 1:1.27.

**Table 3:** Sex ratio among shoot fly collections from Western Vidarbha (Kharif, 2023)

| Sr. No. | Sample Location | Total | Male | Female |
|---|---|---|---|---|
| 1 | Kalambi-L1, Akola | 3 | - | 3 |
| 2 | Dongargaon-L2, Akola | 6 | 6 | - |
| 3 | Malkapur,Yavatmal | 1 | - | 1 |
| 4 | Babhulgaon block,Akola | 3 | 1 | 2 |
| 5 | SRU, Research and breeding plot,Akola | 1 | 1 | - |
| 6 | Cropping system field | 4 | 2 | 2 |
| 7 | Kanheri,Akola | 10 | 3 | 7 |
| 8 | Alanda,Akola | 10 | 4 | 6 |
| 9 | Mahagaon,Akola | 4 | 1 | 3 |
| 10 | Bodkha,Akola | 2 | - | 2 |
| 11 | Malegaon,Washim | 1 | 1 | - |
| 12 | Kalambeshwar,Washim | 12 | 2 | 10 |
| 13 | Wadap,Washim | 3 | 2 | 1 |
| 14 | Chandas,Washim | 1 | - | 1 |
| 15 | Dongaon,Buldhana | 3 | 2 | 1 |
| 16 | Aregaon-L1, Buldhana | 8 | 4 | 4 |
| 17 | Jambhrunwadi,Washim | 5 | 1 | 4 |
| 18 | ARS,Washim | 3 | 2 | 1 |
| 19 | Gopalkhed,Akola | 5 | 3 | 2 |
| | Total | 85 | 35 | 50 |
| | Ratio | | 1.00 | 1.42 |
| | Per cent | | 41.18 | 58.82 |

## References


1. Anonymous. Sorghum Nutrition Facts and Health Benefits. 2021. https://www.verywellfit.com/sorghum-nutrition-facts-and-health-benefits-5093271
2. Anonymous. Agricultural Statistics at a glance. 2022. https://agricoop.nic.in/Documents/CWWGDATA/Agricultural_Statistics_at_a_Glance_2022_0.pdf
3. Anonymous. Indian Farming. ICAR Magazine. 2023;73(01):10-15. https://www.icar.org.in/sites/default/files/Indian-farming-January-2023.pdf
4. Balikai R, Bhagwat VR. Evaluation of integrated pest management components for the management of shoot fly, shoot bug and aphid in Rabi sorghum. Karnataka J Agric Sci. 2009;22(3):532-534.
5. Couri MS, Pont AC, Penny ND. Muscidae (Diptera) from Madagascar: identification keys, descriptions of new species, and new records. Proceedings of the California Academy of Sciences. 2006;57(29):799-923.
6. Davies JC, Reddy KV, Reddy YV. Species of shoot flies reared from sorghum in Andhra Pradesh, India. Tropical Pest Management. 1980;26(3):258-261. https://doi.org/10.1080/09670878009414408
7. Dike MC. Two new species of Atherigona from Nigeria with a key for the identification of Afrotropical species of the subgenus Acritochaeta (Diptera: Muscidae). Systematic Entomology. 1990;15(3):297-303.
8. Gautam Y, Singh PK. Economic analysis of sorghum in Maharashtra, India. Int J Agricult Stat Sci. 2018;14(2):601-606.
9. Kahate NS, Raut SM, Ulemale PH, Bhogave AF. Management of Sorghum Shoot Fly. Popular Kheti. 2014;2:72-74.
10. Khan SA. Diversity and Seasonal Incidence of Shoot fly Infesting Sorghum in Southern Rajasthan. Krishikosh Repository. 2023. https://krishikosh.egranth.ac.in/items/620b8c43-2785-4b4c-9baf-8dbf7f206aba
11. Muller BS. Illustrated Key and Systematics of Male South African Atherigona s. str. (Diptera: Muscidae). African Invertebrates. 2015;56(3):845-918. https://doi.org/10.5733/afin.056.0301
12. Pawar RJ, Bromhal GS, Carey JW, Foxall W, Korre A, Ringrose PS, *et al*. Recent advances in risk assessment and risk management of geologic CO2 storage. International Journal of Greenhouse Gas Control. 2015;40:292-311. https://doi.org/10.1016/j.ijggc.2015.06.014
13. Sharma HC, Singh F, Nwanze KF. Plant resistance to insects in sorghum. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics; 1997a. 216 p.
14. Sherwill T, Byrne ST, Van den Berg J. Shoot fly species on sorghum in the Mpumalanga subtropics of South Africa: relative abundance and infestation levels. African Plant Protection. 1999;5(1):31-35.
15. Van den Berg J, Bronkhorst L, Mgonja M, Obilana AB. Resistance of sorghum varieties to the shoot fly, Atherigona soccata Rondani (Diptera: Muscidae) in Southern Africa. International Journal of Pest Management. 2005;51(1):1-5. https://doi.org/10.1080/0967087040001650