

## Management of Shoot Fly in Major Cereal Crops

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### ABSTRACT

Cereals are known as staple food and the important source of calories and protein. Among all the insect pests of cereals, shoot fly takes first place in damaging the crop by attacking central shoot of the plant and they cause symptoms of “dead heart”. Number of management practices are reported for shoot fly but they are not effective. Soil application of either carbofuran 3G or phorate 10G gave better results but these are not economically faceable for poor farmers. Shoot fly has very short life cycle and it attack the crop immediately after germination, moreover the crop will be highly susceptible for shoot fly upto 25 days. The insect has capacity to attack the side shoots which have emerged due to dead heart formation.

**Key words:** Shoot fly management, dead hearts, shoot fly hosts

### INTRODUCTION

Cereals are the most important staple food and the important source of calories and protein for the millions, besides their use as food they are also used as feed for cattle and as raw material for various industries. Among the many production constraints, insects are major limiting factors in crop production. Among insects, shoot fly *Atherigona soccata* Rondani is a major yield limiting factor that causes considerable damage in major cereals. In sorghum, this pest causes maximum yield losses of 75.6 % grain & 68.6 % in fodder<sup>18</sup>. In Pearl millet 20-50 %<sup>20</sup> and in case of Maize 60 % loss was recorded<sup>2</sup>.

**Major cereals:** Sorghum, Maize, Wheat, Pearl millet and Barley

**Shoot fly species:** *Atherigona soccata* Rondani, *A. Naqvii*, *Atherigona approximata* Malloch, *Delia flavibasis* Stein, *Delia arambourgi* Seguy, *Delia steiniella* Emden & *Atherigona oryzae* Malloch.

**Sorghum shoot fly** (*Atherigona soccata* Rondani) Commonly called as Sorghum shoot fly, Sorghum stem fly & Millet stem fly. **Nature of damage:** Maggots creep down under the leaf sheaths till they reach base of the seedlings. Cut the growing point or central shoot which results in formation of characteristic “**dead hearts**”.

If shoot infestation occurs under conditions of high humidity, infested plants may not produce the typical dead heart symptoms and damaged leaf becomes thin and papery and wraps around the other leaves.

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As a result, the plants may fail to grow normally.

**Host range:** *Sorghum bicolor* is the preferred host<sup>9</sup>. It can develop on many grasses particularly Johnson grass, *Sorghum halepense*. Other host grasses include viz., Brachiaria, Corn, Cynodon, Echinochloa, Eragrostis, Panicum, Pennisetum, Setaria, other Sorghum spp, and Wheat. Cereals other than sorghum are unimportant as hosts for multiplying *A. soccata*<sup>9,11</sup>. Davis and Seshu Reddy<sup>9</sup> have reported that *Sorghum halepense* is most important alternative host plant other than the cultivated sorghum.

#### Management practices:

- 1. Sowing date:** Early and uniform sowing of resistant cultivar over large areas reduce damage by shoot fly. Early sowing (7-10 days before the onset of monsoon rains) to avoid the active period of shoot fly emergence. If early sowing is not possible then use high seed rate to compensate for later thinning out of the dead hearts from infested fields<sup>15</sup>.
- 2. Nutrient management:** Shoot fly damage can be influenced by factors that affect plant growth. The application of balanced fertilizer can help in reducing shoot fly incidence. Incidence of shoot fly on sorghum cultivar CPV-86 decreased with the application of nitrogen, while in another cultivar CSH-8R, the incidence increased upto 60kg N/ha but declined at 90kg/ha<sup>10</sup>.
- 3. Intercultivation/weeding:** Intercultivation can reduce pest populations by exposing the pupae to parasites, predators and other adverse environmental factors. Weeding helps in removal of infested seedlings and alternate hosts such as fodder sorghums and grasses.
- 4. Field sanitation Fallowing:** Do not move soil from infested plots to non-infested plots. Fallowing and closed season will reduce the carryover and build-up of the shoot fly from one season to the next<sup>16</sup>.
- 5. Crop rotation:** Crop rotation can minimise pest damage by confusing the insects with chemical aromas emitting

from non host plants. Using crop combinations that encourage the activity and abundance of natural enemies. It has been shown that shoot fly damage is reduced when sorghum is intercropped with leguminous crops<sup>16</sup>. Set up fishmeal trap @ 12/ha till the crop is 30 days old.

- 6. Host plant resistance:** SPV-1413, SPV-1450, SPV-1467, Sel-3, P-311, SPV-1015, M-35-1, Swati and CSV 14R (suitable for rainy and post rainy seasons) Prem Kishor<sup>21</sup>.
- 7. Biocontrol :** Egg parasitoids viz., *Trichogrammatoidea bactrae* Nagaraj, *T. simmondsi* West, *Trichogramma evanescens* Sch, *T. kalkae* Sch.& Feij, *T. chilonis* Ishii and *T. australicum* Gir. Larval parasitoids viz., *Aprostocetus* spp. And *Neotrichoporoids* (*Tetrastichus nyemitawus*).
- 8. Chemical control:** Apply any one of the following insecticides like Methyl demeton 25 EC 500 ml/ha, Carbofuran 3%G 33.3 kg/ha, Dimethoate 30%EC 1155 ml/ha and Phorate 10%G 10 kg/ha. Shekharappa and Bhuti<sup>22</sup> reported that severe damage can be seen in early stage and lasts up to four weeks causing severe reduction in plant population. Thus, early sowing with high seed rate @ 10 kg/ha and thinning at 28 DAE was found significantly superior in managing shoot fly. Lowest per cent damage was found in IS 2312 (20.45% DH) which is at par with the genotype, SPV 839 (40.87%). Genotypes namely, CSH nos., 5, 6, 9, ICSV 745, RS 29 and DJ 6514 recorded more than 80 % dead heart damage. Sorghum treated with Thiamethoxam @ 3g/kg seeds and followed by a spray of endosulfan 35 EC @ 0.07 % at 45 DAE was recorded lowest shoot fly damage, intercropping sorghum with redgram with seed treatment of Thiamethoxam @ 3g/kg seeds reduced shoot fly significantly and was found cost effective. Intercropped sorghum has recorded lowest number of eggs, this is because of the repellent action of intercrops. The highest per cent plant protection and lowest dead hearts were recorded in Carbofuran 3G treatment (56.2 %)

and which was at par with sorghum + garlic (58.6 %), and sorghum + onion (63.7 %) <sup>14</sup>. Spurthi *et al* <sup>25</sup> reported that less number of dead hearts recorded in endosulfan spray (22.62%) followed by sorghum+ cowpea (23.90%). Nagesh chikkarugi <sup>16</sup> reported that soil application of carbofuran 3G @ 20 kg/ha + whorl application of carbofuran 3G @ 8 kg/ha at 30 DAE + *Pongemia pinnata* leaf extract @ 5% spray at 60 DAE recorded least per cent dead hearts (4.3%). Balikai <sup>4</sup> reported that seed treatment with Imidacloprid 70 WS @ 10g/kg seeds recorded lowest shoot fly incidence of 8.4% dead hearts. Intercropping with chickpea (2:2) + seed treatment with thiamethoxam 70 WS @ 3g/kg seeds recorded lowest percent dead hearts Balikai and Bhagawat <sup>5</sup>. Seed dressing with imidacloprid 70 WS @ 10g/ 100g seeds was found to be most effective in reducing the damage caused by shoot fly (14.3 % DH) and in enhancing the grain yield <sup>6</sup>. Shivpuje and Thombare <sup>23</sup> observed that carbofuran seed treatment (5%) and soil application (3g/m furrow) were effective in controlling sorghum shoot fly. Karibasavaraja *et al.* <sup>14</sup> reported that the seed dress with thiamethoxam 70 WS @ 4 and 5 g ai/kg seeds proved to be best for the management of shoot fly and afforded highest protection of 85% and 89.4% respectively over control. Borad *et al* <sup>7</sup> showed that seed treatment with carbofuran (3.5 ST) 3.5 % , soil application of carbofuran 3G and monocrotophos 10G 2g/m row were most effective treatments for obtaining high grain and stover yields. Anita *et al.* <sup>1</sup> reported that NSKE 5 % was best with least % dead hearts and it was on par with Azagro 5% and neem oil 2%. Among the shoot fly larval parasitoids, parasitism due to *Aprostocetus spp.* reached 15% in September 1975 and 35% in August 1977 <sup>19,26</sup> furrow application of phorate @ 1.5 kg/ha and 3kg/ha gave effective control of shoot fly 8.5 to 11% dead hearts were obtained in phorate treated plots. Balikai *et al* <sup>5</sup> showed that seed soaking for 8-10 hours either in CaCl<sub>2</sub>(2%)+ endosulfan(0.07%) or in endosulfan(0.07%) reduced the shoot fly incidence effectively and increased the seed

yield. Shrinivas <sup>24</sup> reported that genotype SPV 1664 recorded less per cent dead hearts (15.61%). Among all plant products tested NSKE 5% has recorded less percent dead hearts at 21 and 28 DAE. NSKE (5%) in combination with panchagavya (3%) was found effective against shoot fly by recording less per cent dead heart (21.08%). Among different indigenous technologies evaluated GCK (5%) recorded least per cent dead hearts (27.68%) and higher grain yield.

#### Maize shoot fly

SN: *Atherigona soccata*, *A. naqvii* and *A. orientalis*

**Nature of damage:** The attack is maximum when the crop is in seedling stage. Tiny maggots creep down under the leaf sheaths till they reach base of the seedlings, then cut the growing point or central shoot which results in the formation of characteristic “dead hearts”.

**Management practices:** Water logging condition should be avoided, Antiqua Gr-1, African tall, Ageti-76, EBR composite pop corn and Deccan 103 were observed to be less susceptible. Application of 10% Phorate granules in furrows before sowing @15kg/ha should be done and the insecticide should be covered with thin layer of soil after which seed should be sown. Spraying with 0.01% Metasystox after one week of germination. Hari and Jawala Jindal <sup>12</sup> reported that furrow application of carbofuran 3G@ 5kg/acre or phorate 10G @ 4kg/acre and seed treatment with chlorpyrifos 20EC @ 5ml/kg seeds gave complete protection in respect of dead heart formation. Per cent height reduction due to shoot fly was lowest in hybrid JH 3459. Chatterji *et al* <sup>8</sup> indicated that there were no significant difference among carbofuran WP at 1, 2 and 4 per cent and carbofuran quick and slow release granules and fensulfothion 10 G. Panwar and Sharma <sup>17</sup> reported that maize germplasms F-733, Chh-10 and Deccan-103 are less susceptible to shoot fly where as Ganga-11 is most susceptible genotype and recorded 43.08% dead hearts.

#### Pearl millet shoot fly

SN: *Atherigona approximata* Malloch

**Nature of damage:** Maggot feeds on the seedlings and produce “dead heart”. Sometimes, the shoot is not killed because of quick growth of the plant. It also causes damage to earheads in later stages and forms chaffy grains.

**Management:** Sowing resistant cultivars viz., MP-16, MP-19, MP-53, MP-67, MH-49, MH-52, MH-9, MH-82, MH-99 and MH-105. Sowing should be done after onset of monsoon or within 10-15 days after the first monsoon shower. Staggered sowing is to be avoided since it results in the build-up of shoot fly population. Increase in seed rate to 3.3kg/ha and later remove and destroy the affected seedlings to check shoot fly damage<sup>21</sup>.

#### Wheat Shoot fly

SN: *Atherigona naqvii*, *Atherigona oryzae*

**Nature of damage:** Newly hatched maggots creep into the leaf sheaths of tillers and cut the central growing shoots causing “dead hearts”. In case of severe infestation the plant assumes bushy appearance with large number of tillers.

**Management:** The timely sowing of crops (mid-November). If late sowing is done and shoot fly incidence (dead hearts) is noticed, spraying of cypermethrin@50g ai/ha to control the insect. Out of 41 wheat genotypes, least incidence of shoot fly was recorded in HI-8682 (3%) followed by HP-1913 (4%) and maximum was in KRL-213 (24%) as reported by Kalappanavar *et al*<sup>13</sup>.

**Barley shoot fly** (*Delia flavibasis* Stein (Tafa), *Delia arambourgi* Seguy (Davidson), *Delia steiniella* Emden) belongs to family Anthomyiidae.

**Nature of damage:** “Dead hearts”

**Host range:** Barley shoot fly survives on several alternate hosts in grass family viz., Maize (*Zea mays*), Wheat (*Triticum spp.*), Blurish millet (*Pennisetum americanum*) and other grasses. Host preference study of *D. flavibasis* conducted at the Sinana Agricultural Research Center (SARC) with barley, teff, wheat, oat and maize revealed that barley and teff were the most preferred hosts.

#### CONCLUSION

Though number of management practices are reported for shoot fly but none of them are

proved to be very effective except the soil application of either carbofuran 3G or phorate 10G. Because the insect has very short life cycle and it attack the crop immediately after germination, moreover the crop will be highly susceptible for shoot fly upto 25 days. Hence it is also a limiting factor to apply insecticides as the seedling will be very small. The insect has capacity to attack the side shoots which have emerged due to dead heart formation. Hence there is lot of scope to search alternative control strategies to combat shoot fly in cereals.

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