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# PERFORMANCE OF SORGHUM (GIRD) GERMPLASM FOR RESISTANCE TO SHOOT FLY (*ATHERIGONA SOCCATA* RONDANI) AND STEM BORER (*CHILO PARTELLUS* SWINHOE)

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**ABSTRACT**

The experiment was carried out during *kharif* 2013-14 at College of Agriculture, Indore, (M.P) to study the performance of Gird germplasm against resistance to shootfly(*Atherigona soccata* Rond.)and stem borer(*Chilo partellus* Swin.).Experiment was carried under two sets of protected and unprotected conditions of 48 gird genotypes with Randomized Block Design with two replications.At 21 DAE, lowest shoot fly dead heart damage was recorded in Gird-8,30(58.34%)(unprotected) and Gird-2 (46.84%) (protected) and at 28DAE least damage was in Gird-43(61.09%)(unprotected) and Gird-43(51.67%) (protected). Three types of observations, were recorded to measure the damage caused by stem borer viz. leaf injury percent, dead heart percent and stem tunneling percent(per plant basis). The leaf injury infestation at 30 DAE has been significantly reported in all genotypes but the lowest damage was in Gird-8 (7.77%) (Unprotected) and in Gird-37(5.38%) (protected). The stem borer dead heart was least in Gird-33(58.33%) and Gird-3(48.18%) under unprotected and protected conditions respectively. The stem tunneling under protected and unprotected conditions was lowest in Gird-3(4.70%) and Gird-43(5.60%). The maximum yield was recorded per plot basis, Gird-8(0.26kg) followed by Gird-47 (0.23kg) under unprotected condition and 0.31kg (Gird-8) followed by Gird 47 (0.30kg) under protected condition. In overall, of all the screened germplasm Gird-8 showed moderate resistance to pest damage and was with highest yield under both protected and unprotected conditions.

## INTRODUCTION

Sorghum (*Sorghum bicolor* (L.) Moench) is a vital life-sustaining food crop for human being as well as for livestock in many parts of world. Sorghum is grown in both Kharif as well as Rabi season ( Ganesh *et al*. 2012). Sorghum is the fifth most important cereal crop in the world and in semi arid tropics. The crop is cultivated under diverse agro ecosystem and the grain yield is influenced by various biotic and abiotic factors.

In India , sorghum is the third important cereal after rice and wheat, grown on average 6.18 million ha$^{-1}$ (first rank in world) with production of 5.33 million tons (fourth rank in the world) and productivity 863 kg ha$^{-1}$(thirty fifth rank in the world) (USDA 2013). In Madhya Pradesh, sorghum crop is grown mainly in *kharif* season cultivated mainly in Malwa, Jhabua, Nimar, Gird and Satpura plateau . About 150 species have been reported to damage sorghum in different agro-ecosystems (Jotwani *et al*. 1980). Borad and Mittal (1983) reported that nearly 32.2% of the grain yield was lost due to insect damage. Major emphasis has been placed on developing cultivars resistant to shoot fly and stem borer . Considerable progress has been made in developing techniques to screen for resistance to insects, identifying the source of resistance and transferring resistance to high-yielding sorghum cultivars .Yield loss of 55 to 83 % has been recorded due to stem borer infestation in northern India (Jotwani *et al*., 1971). In case of sorghum shoot fly, maximum yield losses of 75.6 percent in grain and 68.6 per cent in fodder has been recorded.(Pawar *et al*., 1984). Due to variation in the agro climatic conditions of different regions, insects show varying trends in their incidence pattern and extent of damage to the crop. Besides, different weather factors also play a key role in determining the incidence and dominance of a particular pest or pest complex (Meena *et al*., 2013). Screening for resistance to insects under green house or field conditions is the most effective method of developing insect resistant cultivars.

Keeping these views in mind, the present study was conducted to keep current information and potentiality to about shootfly and stem borer damage to the crop.

## MATERIALS AND METHODS

The experiment was conducted during *kharif* 2013-14 at All India Co-ordinated Sorghum Improvement Project (AICSIP), College of Agriculture, R.V.S.K.V.V. Indore (M.P.) . Indore is situated in the "Malwa Plateau", which is Agro-climatic zone of Madhya Pradesh the soil of this region is medium black cotton soil.

In this experiment, 48 gird genotypes were grown under protected and unprotected conditions and replicated twice in Randomized Block Design (RBD). Seeds were planted in rows 0.45m, plants 0.12m and observations on the major insect pests of sorghum *i.e.* shootfly (*Atherigona soccata* Rondani) and stem borer (*Chilo partellus* Swinhoe). Crop insect pests were recorded following Plant inspection method (PIM) adopted by Subharani and Singh (2004) for pest complex study . Stem borer and shoot fly observations were recorded on the basis of number of dead heart from each plot and converted into percent dead hearts. All the data obtained with regard to the pests incidence and yield were analyzed statistically using the analysis of variance Fisher and Yates (1963).

## RESULTS AND DISCUSSION

The germplasm grown under protected conditions were significantly resistant to pest damage than the germplasm under unprotected conditions that were non-significantly effective for incidence of shootfly and stem borer.

### Shoot fly (*Atherigona soccata* Rondani) dead heart percent

The shoot fly incidence was recorded at 21 and 28 days after emergence (DAE) of the crop.

At 21DAE, under unprotected condition, the lowest dead heart percent due to shoot fly was recorded in Gird 8 and Gird 30 with 58.34percent of infestation. Under protected condition, the lowest dead heart percent infestation by shoot fly have

**Table 1: Performance of Gird genotypes against shoot fly incidence**

| Treatment | Shoot fly dead heart percent at 21DAE | | Shoot fly dead heart percent at 28DAE | |
|---|---|---|---|---|
| | Unprotected | Protected | Unprotected | Protected |
| Gird-2 | 66.0(54.4) | 46.8(43.2) | 67.5(55.3) | 65.6(54.1) |
| Gird-3 | 70.8(57.4) | 65.8(54.3) | 69.0(56.2) | 55.0(47.9) |
| Gird-4 | 64.7(53.6) | 63.1(52.6) | 74.6(59.8) | 64.5(53.5) |
| Gird-5 | 72.2(58.5) | 53.1(46.8) | 77.9(62.2) | 59.3(50.5) |
| Gird-6 | 78.1(62.2) | 68.5(55.9) | 78.8(62.6) | 66.6(54.7) |
| Gird-7 | 60.4(51.1) | 56.3(48.6) | 76.3(61.0) | 70.9(57.3) |
| Gird-8 | 58.3(49.8) | 57.5(49.4) | 66.1(54.7) | 60.7(51.3) |
| Gird-9 | 69.9(56.7) | 68.7(56.1) | 67.3(55.2) | 57.5(49.3) |
| Gird-10 | 72.8(58.6) | 53.3(46.9) | 78.3(62.7) | 68.3(55.7) |
| Gird-11 | 64.3(53.4) | 50.0(45.0) | 64.7(53.8) | 61.8(51.8) |
| Gird-12 | 65.6(54.3) | 59.3(50.4) | 65.7(54.2) | 65.6(54.1) |
| Gird-13 | 64.7(53.8) | 64.1(53.2) | 66.3(54.8) | 61.6(51.9) |
| Gird-14 | 66.7(54.8) | 63.1(52.7) | 72.6(58.6) | 67.4(55.5) |
| Gird-15 | 62.9(52.5) | 59.3(50.5) | 70.0(56.8) | 70.0(56.8) |
| Gird-16 | 67.7(55.4) | 53.5(47.0) | 72.3(58.3) | 68.9(56.1) |
| Gird-17 | 63.5(52.8) | 63.1(52.8) | 70.0(56.8) | 66.6(54.7) |
| Gird-18 | 73.4(59.0) | 67.6(55.3) | 73.2(58.0) | 72.5(58.4) |
| Gird-19 | 68.9(56.1) | 67.8(55.5) | 73.8(59.3) | 66.9(54.9) |
| Gird-20 | 65.7(54.2) | 57.5(49.3) | 80.3(63.9) | 70.8(57.4) |
| Gird-21 | 76.3(61.0) | 61.9(52.0) | 76.6(61.1) | 65.6(54.3) |
| Gird-22 | 59.3(50.5) | 55.6(48.3) | 74.8(59.9) | 66.4(54.7) |
| Gird-24 | 70.8(57.4) | 57.1(49.1) | 79.1(62.9) | 65.8(54.3) |
| Gird-25 | 63.7(53.0) | 62.5(52.2) | 68.5(55.9) | 63.6(52.9) |
| Gird-26 | 68.7(56.0) | 62.0(52.0) | 65.0(53.7) | 70.7(57.2) |
| Gird-27 | 61.0(51.4) | 48.5(44.1) | 66.1(54.4) | 60.1(50.9) |
| Gird-28 | 73.5(59.1) | 61.8(51.8) | 63.5(52.9) | 59.4(50.4) |
| Gird-29 | 64.3(53.4) | 64.1(53.3) | 81.6(64.7) | 66.2(54.5) |
| Gird-30 | 58.3(49.8) | 57.3(49.3) | 67.7(55.4) | 67.4(55.2) |
| Gird-31 | 62.5(52.3) | 61.9(51.9) | 69.2(56.3) | 68.1(55.7) |
| Gird-32 | 71.9(58.0) | 48.0(43.9) | 81.7(64.8) | 68.5(55.9) |
| Gird-33 | 78.1(62.1) | 73.5(59.0) | 82.1(65.0) | 80.7(64.6) |
| Gird-34 | 70.9(57.4) | 66.6(54.7) | 79.1(62.8) | 70.5(57.3) |
| Gird-35 | 71.6(58.0) | 67.5(55.3) | 69.0(56.3) | 59.4(50.4) |
| Gird-36 | 66.2(54.5) | 60.7(51.2) | 72.8(58.6) | 71.2(57.6) |
| Gird-37 | 71.8(58.0) | 67.5(55.4) | 88.7(70.4) | 60.3(51.0) |
| Gird-38 | 70.1(57.2) | 65.8(54.3) | 70.8(57.4) | 68.3(55.7) |
| Gird-39 | 72.1(58.1) | 64.3(53.4) | 77.1(61.4) | 70.0(56.8) |
| Gird-40 | 80.0(63.5) | 63.1(52.7) | 73.3(59.1) | 70.8(57.4) |
| Gird-41 | 66.6(54.8) | 59.3(50.4) | 70.0(57.0) | 68.3(55.7) |
| Gird-42 | 60.8(51.3) | 54.7(47.7) | 79.3(63.0) | 70.0(57.0) |
| Gird-43 | 73.2(58.9) | 49.7(44.8) | 61.0(51.5) | 51.6(45.9) |
| Gird-44 | 62.9(52.5) | 58.3(49.8) | 75.5(60.4) | 63.8(53.1) |
| Gird-45 | 65.9(54.3) | 59.4(50.4) | 78.1(62.1) | 72.5(58.4) |
| Gird-46 | 68.4(55.8) | 67.5(55.3) | 78.8(62.6) | 71.2(57.6) |
| Gird-47 | 69.3(56.4) | 53.3(46.9) | 75.0(60.1) | 78.8(62.6) |
| Gird-48 | 76.7(61.2) | 56.2(48.6) | 78.0(62.2) | 73.2(58.9) |
| Gird-49 | 77.9(62.0) | 68.5(55.9) | 74.2(59.5) | 68.8(56.3) |
| Gird-50 | 71.1(57.5) | 66.0(54.4) | 71.0(57.4) | 64.1(53.2) |
| SEm± | 3.0 | 2.8 | 2.9 | 3.0 |
| CD at 5% | 6.3 | 5.8 | 6.1 | 6.3 |

**Table 2: Performance of sorghum genotypes (Gird) against stem borer incidence and yield parameters**

| Treatment | SB LI % at 30 DAE | | SB DH % at 45 DAE | | SB ST% at harvest | | Yield in Kg per plot | |
|---|---|---|---|---|---|---|---|---|
| | Unprotected | Protected | Unprotected | Protected | Unprotected | Protected | Unprotected | Protected |
| Gird-2 | 11.6(19.9) | 8.4(16.8) | 78.5(62.7) | 71.7(57.9) | 8.1(16.5) | 6.2(14.4) | 0.08 | 0.11 |
| Gird-3 | 8.2(16.6) | 6.2(14.4) | 62.0(52.2) | 48.1(43.9) | 5.8(13.9) | 4.7(12.5) | 0.17 | 0.22 |
| Gird-4 | 10.2(18.7) | 7.7(16.2) | 66.2(54.5) | 63.5(52.9) | 6.7(15.0) | 6.1(14.3) | 0.10 | 0.14 |
| Gird-5 | 12.1(20.3) | 7.7(16.1) | 81.6(64.8) | 74.1(59.5) | 7.8(16.2) | 5.5(13.6) | 0.07 | 0.08 |
| Gird-6 | 9.6(17.9) | 8.8(17.2) | 67.5(55.3) | 62.5(52.5) | 7.3(15.7) | 6.7(15.0) | 0.07 | 0.12 |
| Gird-7 | 7.8(16.2) | 9.3(17.8) | 71.0(57.5) | 65.2(54.0) | 6.3(14.6) | 6.2(14.4) | 0.13 | 0.16 |
| Gird-8 | 7.7(16.1) | 6.9(15.2) | 63.5(52.9) | 58.1(49.7) | 6.6(14.9) | 5.6(13.7) | 0.26 | 0.31 |
| Gird-9 | 11.8(20.1) | 6.5(14.8) | 81.6(64.7) | 73.3(59.1) | 7.3(15.7) | 6.0(14.2) | 0.11 | 0.15 |
| Gird-10 | 9.6(18.0) | 8.4(16.9) | 69.4(56.5) | 62.5(52.2) | 6.7(15.0) | 6.1(14.3) | 0.10 | 0.17 |
| Gird-11 | 8.3(16.7) | 7.1(15.4) | 66.4(54.7) | 61.1(51.4) | 6.7(15.0) | 6.5(14.7) | 0.16 | 0.24 |
| Gird-12 | 7.9(16.3) | 7.8(16.2) | 63.0(52.6) | 61.9(51.9) | 6.6(14.9) | 6.4(14.6) | 0.14 | 0.14 |
| Gird-13 | 10.4(18.7) | 7.7(16.1) | 73.2(58.8) | 54.2(47.4) | 7.0(15.4) | 6.9(15.2) | 0.21 | 0.22 |
| Gird-14 | 11.7(20.0) | 8.5(16.9) | 77.0(62.0) | 68.4(55.9) | 7.3(15.7) | 6.8(15.1) | 0.07 | 0.10 |
| Gird-15 | 11.2(19.6) | 6.4(14.6) | 66.6(54.7) | 57.5(49.3) | 7.8(16.2) | 5.7(13.8) | 0.11 | 0.12 |
| Gird-16 | 8.1(16.5) | 7.6(15.7) | 79.1(62.9) | 66.3(54.6) | 6.9(15.2) | 6.7(15.0) | 0.15 | 0.16 |
| Gird-17 | 8.3(16.7) | 9.0(17.4) | 67.8(56.4) | 65.7(54.2) | 6.5(14.7) | 6.3(14.5) | 0.09 | 0.13 |
| Gird-18 | 8.4(16.8) | 7.8(16.3) | 73.6(59.1) | 60.4(51.0) | 6.7(15.0) | 5.8(13.9) | 0.13 | 0.16 |
| Gird-19 | 12.3(20.5) | 8.7(17.1) | 78.5(62.7) | 73.8(59.3) | 7.7(16.1) | 6.8(15.1) | 0.05 | 0.09 |
| Gird-20 | 11.2(19.5) | 9.7(18.1) | 76.6(61.2) | 71.0(57.4) | 7.4(15.8) | 6.7(15.0) | 0.09 | 0.11 |
| Gird-21 | 11.6(19.9) | 8.7(17.1) | 73.3(59.1) | 71.0(57.4) | 7.4(15.7) | 6.4(14.7) | 0.11 | 0.15 |
| Gird-22 | 11.8(20.1) | 7.3(15.7) | 70.0(56.8) | 70.0(57.1) | 7.5(15.8) | 7.3(15.6) | 0.08 | 0.13 |
| Gird-24 | 9.5(17.9) | 7.7(16.1) | 71.5(57.7) | 65.2(54.1) | 7.2(15.6) | 6.3(14.5) | 0.07 | 0.08 |
| Gird-25 | 9.7(18.0) | 8.4(16.8) | 75.0(60.3) | 71.2(57.6) | 7.6(15.9) | 6.7(15.0) | 0.14 | 0.16 |
| Gird-26 | 7.8(16.2) | 6.4(14.6) | 70.7(57.2) | 58.5(49.9) | 6.2(14.4) | 5.8(13.9) | 0.09 | 0.19 |
| Gird-27 | 8.1(16.6) | 9.0(17.5) | 63.3(52.7) | 60.0(50.9) | 6.6(14.8) | 6.5(14.7) | 0.07 | 0.09 |
| Gird-28 | 9.2(17.6) | 5.7(13.9) | 63.5(52.9) | 60.8(51.2) | 6.5(14.7) | 5.4(13.4) | 0.21 | 0.23 |
| Gird-29 | 8.7(17.1) | 8.5(16.9) | 60.7(51.3) | 55.7(48.3) | 6.9(15.2) | 6.4(14.6) | 0.09 | 0.14 |
| Gird-30 | 11.1(19.4) | 9.9(18.4) | 75.2(60.4) | 72.5(58.4) | 6.6(14.9) | 6.5(14.8) | 0.07 | 0.11 |
| Gird-31 | 10.5(18.8) | 11.8(20.1) | 70.7(57.2) | 65.0(53.8) | 7.3(15.6) | 7.3(15.6) | 0.07 | 0.08 |
| Gird-32 | 11.1(19.5) | 8.2(16.7) | 70.9(57.6) | 61.2(51.5) | 7.6(16.0) | 6.4(14.6) | 0.08 | 0.09 |
| Gird-33 | 9.2(17.6) | 6.8(15.0) | 58.3(49.8) | 55.0(47.9) | 6.6(14.9) | 5.9(14.1) | 0.09 | 0.15 |
| Gird-34 | 12.1(20.3) | 8.9(17.4) | 78.8(62.6) | 70.7(57.2) | 7.2(15.6) | 6.2(14.4) | 0.07 | 0.10 |
| Gird-35 | 9.4(17.8) | 8.2(16.7) | 75.0(60.3) | 63.8(53.0) | 6.7(15.0) | 6.4(14.7) | 0.13 | 0.16 |
| Gird-36 | 8.1(16.4) | 8.6(17.1) | 67.5(55.4) | 61.4(51.6) | 6.5(14.7) | 6.4(14.7) | 0.09 | 0.08 |
| Gird-37 | 14.9(22.7) | 5.3(13.4) | 75.7(60.5) | 67.2(55.1) | 8.3(16.7) | 5.4(13.4) | 0.12 | 0.15 |
| Gird-38 | 10.8(19.2) | 9.5(17.9) | 81.6(64.7) | 69.0(56.2) | 6.6(14.9) | 6.6(14.9) | 0.14 | 0.18 |
| Gird-39 | 13.3(21.4) | 5.6(13.7) | 73.3(59.1) | 65.5(54.0) | 7.6(16.0) | 5.7(13.8) | 0.08 | 0.12 |
| Gird-40 | 11.6(19.9) | 7.4(15.8) | 76.2(60.8) | 67.1(55.0) | 7.3(15.7) | 7.3(15.7) | 0.10 | 0.10 |
| Gird-41 | 12.6(20.8) | 9.0(17.5) | 80.0(63.4) | 72.5(58.4) | 7.9(16.3) | 7.3(15.6) | 0.10 | 0.09 |
| Gird-42 | 10.2(18.7) | 8.0(16.4) | 70.8(57.4) | 61.8(51.8) | 6.5(14.7) | 5.8(13.9) | 0.11 | 0.18 |
| Gird-43 | 8.6(17.0) | 8.6(17.1) | 72.5(58.4) | 68.6(56.1) | 5.6(13.6) | 5.6(13.6) | 0.16 | 0.18 |
| Gird-44 | 12.1(20.3) | 8.2(16.7) | 69.0(56.2) | 60.7(51.6) | 7.1(15.4) | 7.1(15.4) | 0.14 | 0.22 |
| Gird-45 | 12.8(20.9) | 9.1(17.5) | 81.6(64.7) | 71.1(57.6) | 6.7(15.0) | 6.6(14.9) | 0.11 | 0.12 |
| Gird-46 | 11.5(19.8) | 7.2(15.6) | 79.1(62.9) | 61.2(51.5) | 6.5(14.8) | 6.1(14.3) | 0.18 | 0.23 |
| Gird-47 | 12.2(20.4) | 6.9(15.2) | 70.5(57.1) | 63.3(52.7) | 7.9(16.3) | 5.7(13.8) | 0.23 | 0.30 |
| Gird-48 | 12.1(20.3) | 9.7(18.1) | 76.3(60.9) | 66.6(54.7) | 7.0(15.3) | 6.3(14.5) | 0.13 | 0.16 |
| Gird-49 | 8.5(16.9) | 6.8(15.1) | 76.6(61.2) | 69.8(56.7) | 6.9(15.2) | 5.9(14.0) | 0.18 | 0.20 |
| Gird-50 | 9.9(18.3) | 8.7(17.1) | 76.3(60.9) | 68.3(55.7) | 6.7(15.0) | 6.3(14.6) | 0.13 | 0.17 |
| SEm± | 1.1 | 0.8 | 3.7 | 3.1 | 0.5 | 0.5 | 0.02 | 0.02 |
| CD at 5% | 2.4 | 1.8 | 7.6 | 6.4 | 1.1 | 1.1 | 0.05 | 0.04 |

(Note : Values in parenthesis indicate the arcsine transformation).

been in Gird 2 with 46.84 percent of infestation.

At 28DAE, under unprotected condition the lowest dead heart percent infestation by shoot fly has been found in Gird 43 with 61.09 percent of dead heart. Under protected condition, the lowest dead heart infestation by shoot fly has been found in Gird 43 with 51.67 percent of infestation (Table 1).

Present findings are falling in line with earlier study by Subbarayudu *et al*. (2002) reported that the seed treatment with imidacloprid at 10 and 14 ml/kg effectively reduced the damage due to shoot fly, resulted in least number of dead hearts.

**Stem borer (*Chilo partellus* Swinhoe) incidence in Gird material**

There were three types of observations, recorded to characterize or measure the damage caused by stem borer viz., leaf injury percent, dead heart percent and stem tunneling percent (per plant basis).

**Percent leaf injury due to stem borer at 30 DAE (SBLI)**

Under unprotected conditions, the lowest leaf injury infestation at 30 DAE due to stem borer has been reported in Gird 8 (7.77%) and under protected conditions the lowest leaf injury has been reported in Gird 37 (5.38 %) .(Table 2)

**Percent dead heart due to stem borer at 45 DAE (SBDH)**

Significant differences were found among all the entries at 45 DAE for dead heart caused by stem borer. Under unprotected conditions range was observed between 58.33 to 81.69 percent and among all genotypes Gird 33 (58.33 %) has been found least affected by stem borer dead heart and in protected condition dead heart range has been recorded between 48.18 to 74.17 percent and among genotypes Gird 3 (48.18 %) was less affected by stem borer dead heart.( Table 2).

**Stem tunneling percent damage due to stem borer at harvest (SBST)**

Under unprotected crop the less stem tunneling due to stem borer was found in Gird 43 (5.60 %) and maximum stem tunneling was recorded in Gird 37 (8.30%). Under protected crop the less stem tunneling due to stem borer was found in Gird 3 (4.70 %) and maximum stem tunneling was recorded in Gird 22, 31, 41 (7.30 %) and Gird 40 (7.35 %).(Table 2).

The present findings are supported with different genotypes by Singh and Shankar (2000); Kishore (2001); Subbarayudu *et al.* (2011) (a) and Subbarayudu *et al.* (2011)(b) .

**Yield parameters**

The data presented in (Table 2) among the various genotypes maximum yield in Kg per plot, under unprotected conditions was recorded in Gird 8 (0.26kg) followed by Gird 47 (0.23kg), Gird 28, 13 (0.21kg) the treatment and in protected condition; the maximum yield Gird 8 (0.31kg) followed Gird 47 (0.30kg). The present findings are supported by Kirar (1986) and Obonyo *et al.* (2008).

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## REFERENCES

**Borad , P. K. and Mittal, V. P. 1983.** Assessment of losses caused by pest complex to sorghum hybrid CSH-5. In proceedings, Crop losses due to insect pests (eds. Krishnamurthy Rao B.H. and K.S.R.K. Murthy).Rajendranagar. Hyderabad, India :*Entomological Society of India*. pp. 271-228.

**Fisher, R. A. and Yates, F. 1963.** Statistical tables for biological, agricultural and medical research. 6. Aufl. Oliver and Boyd, London 146 S. Preis 30.

**Ganesh , S. K. , Patel, T. and Vijaykumar, V. G. 2012.** Management of grain infecting fungi of sorghum through spray on earhead by chemical and non - chemical means. *The Bioscan*. **7(4):** 597-599.

**Jotwani, M. G. , Chandra, D., Young, W. R., Sukhani, T. R. and Saxena, P. R. 1971.** Estimation of avoidable losses caused by insect complex on sorghum hybrid CSH-1 and increase in yield over treated control. *Indian J. Entomology*. **33:** 375-383.

**Jotwani, M. G., Yong, W. R. and Teets, G. L. 1980.** Elements of integrated control of sorghum pests.FAO plant production and protection Paper, No. 39, Rome, Italy and Agricultural Organization. p. 159.

**Kirar, B. S. 1986.** Studies on insect pests of sorghum. M.Sc. (Ag.) M.Sc. (Ag.) Thesis, JNKVV, Jabalpur (M.P.).

**Kishore, P. 2001.** Resistance to shoot fly, *Atherigona soccata* Rondani and stem borer, *Chilo partellus* (Swinhoe) in new germplasm of sorghum. *J. Entomological Research*. **25: 4**, 273-282.

**Meena, R. S., Ameta, O. P. and Meena, B. L. 2013.** Population dynamics of sucking pests and their correlation with weather parameters in chilli, capsicum Annum l. Crop, *The Bioscan*. **8(1):** 177-180.

**Obonyo, D. N. , Ogola, J. B. O. and Kamau, A. W. 2008.** Effects of time of planting, fertilizer and insecticide on sorghum shoot fly, *Atherigona soccata* (Diptera: Muscidae), on two varieties of sorghum. *African Entomology*. **16(2):** 185-195.

**Pawar, V. M., Jadhav, G. D. and Kadam, B. S. 1984.** Compatibility of Oncol 50 SP with different fungicides on sorghum (CS 3541) against shoot fly (*Atherigona soccata* Rondani). *Pesticide Res. J.* **18**: 9-10.

**Singh ,V. S. and Kripa, S. 2000.** Screening of sorghum genotypes for their reaction to stem borer and shoot fly. *Indian J. Entomology*. **62: 1**, 34-36.

**Subbarayudu, B., Indira, S. and Rana, B. S. 2002.** Effect of integrated pest management modules on the incidence of sorghum shoot fly. *J. Research*, ANGRAU. **30(2):** 22-29.

**Subbarayudu, B., Prasad, G. S., Kalaisekar, A., Bhagwat, V. R. and Aruna, C. 2011a.** Evaluation of multiple resistances in sorghum genotypes against shoot fly *Atherigona soccata* (Rondani) and stem borer *Chilo partellus* (Swinhoe). *Indian J. Entomology*. **73: 1**, 26-29.

**Subbarayudu, B., Prasad, G. S., Kalaisekar, A., Bhagwat, V. R. and Elangovan, M. 2011b.** Evaluation of Sorghum Genotypes for Multiple Resistances to Shoot Pests. *Indian J. Plant protection*. **39:** 2.

**Subharani, S. and Singh, T. K. 2004.** Insect pest complex of pigeon pea (*Cajanus cajan*) in agro-ecosystem of Manipur. *Indian J. Entomol.* USDA 2013. United States Department of Agriculture (www.usda.org).