The Pharma Innovation Journal 2022; 11(12): 4601-4605

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(12): 4601-4605

www.thepharmajournal.com
Received: 01-10-2022
Accepted: 03-11-2022

Sonawane CK
Assistant Professor, College of Agriculture, Malegaon, Nasik, Maharashtra, India

Somvanshi VL
Assistant Professor, College of Agriculture Pathri, Aurangabad, Maharashtra, India

Khating SM
Assistant Professor College of Agriculture Udgir, Latur, Maharashtra, India

Ilyas Mohammad
Associate Professor, COA, VNMKV, Parbhani, Maharashtra, India

Corresponding Author:
Sonawane CK
Assistant Professor, College of Agriculture, Malegaon, Nasik, Maharashtra, India

Population dynamics of major pests of *kharif* sorghum and their natural enemies and correlation with weather parameters

Sonawane CK, Somvanshi VL, Khating SM and Ilyas Mohammad

Abstract
A field experiment was conducted with the title Management of major pests of kharif sorghum. In Kharif season 2016 at Sorghum Research Station, VNMKV Parbhani (MS) India. The experiment was laid out in Randomized Block Design with Eight treatments and three replications. The seed of sorghum hybrid SPH-1641 was sown on 01st June 2016 by dibbling. The gross plot size was 5.4m X 4m and spacing was 45 X 15 cm. The population dynamics of major pests and their natural enemies in sorghum in years showed the incidence and peak time of the pests and natural enemies. The initiation of shoot fly eggs, dead heart due to shoot fly, stem borer dead hearts, ear head worm, lady bird beetle and chrysopa eggs was during 27th, 28th, 31th, 38th, 35th, and 38th MW, respectively during 2016. The peak incidence of shoot fly eggs, dead heart due to shoot fly, stem borer dead hearts, ear head worm, lady bird beetle and chrysopa eggs was observed during 28th, 31th, 43th, 39th, 35th, and 41st MW, respectively.

Keywords: *Atherigona soccata*, *Chilo partellus* Swinhoe, sorghum shoot bug, *Peregrinus maidis*, lady bird beetle, weather parameters

1. Introduction

Sorghum [*Sorghum bicolor* (L.) Moench] is an important cereal crop in India popularly known as 'Jawar', or 'Great millet'. It is probably originated in East Central Africa and it was introduced to India from East Africa in the year 1500 BC. The advantage of this cereal crop is that it can be cultivated in both *Kharif* and *Rabi* season. Sorghum is important feed and food crop in the world and used as fodder to feed millions of animals providing milk and meat for human being. Sorghum is very nutritious its fodder contains more than 50 percent digestible nutrients with 8 percent protein, 2.5 percent fat and 45 percent nitrogen free extract.

The major sorghum producing countries of the world are India, USA, South Africa, China, Nigeria, Sudan and Argentina, it contribute 60.13 million tones production from 40 million ha area (Anonymous, 2015-16) [1]. In the world, USA is the largest producer of sorghum occupying 20.03 percent of area with 16.41 percent production. In India the sorghum producing states are Maharashtra, Karnataka, Madhya Pradesh, Andhra Pradesh, Telangana, Tamil Nadu, Gujarat, UP, Rajasthan and Haryana. Among these Maharashtra, Gujrat, Rajasthan and Tamil Nadu are the major sorghum growing states. In India, sorghum is grown on 5.58 million hectare area with production of 4.41 million tonnes and productivity of 790 kg ha^{-1} (Anonymous 2015-16) [1].

Maharashtra is foremost sorghum growing states in the country with an area, production, productivity of *Kharif* jowar was 6.2 lakh ha, 3.68 lakh tonnes and 594 kg ha^{-1}, respectively (Anonymous 2015-16) [1]. About 150 insect species have been recorded on sorghum. Out of which 31 species are economically important. In Maharashtra about 18 important insect pests have been recorded on sorghum crop. Though a large number of pests have been reported on sorghum crop in Maharashtra very few have economic status. The major being sorghum shoot fly, *Atherigona soccata* Rondani, stem borer, *Chilo partellus* Swinhoe, sorghum shoot bug, *Peregrinus maidis* Ashmead, earhed bug, *Calocoris angustatus* Lethir, army worm, *Mythimna separata* Walker, midge fly, *Contarinia sorghicola* Coquillette, sorghum aphid, *Melanaphis sacchari* Zehntner, Gram caterpillar, *Helicoverpa armigera* Hubner, earhead hairy caterpillar, *Euproctis subnotata* Walker (Reddy and Davies, 1979) [8]. Among different insect pests shootfly (*Atherigona soccata* R.) is recognized as the most important. The sorghum shootfly also known as the sorghum stem fly is a widely distributed pest in Europe, Africa and Asia.

In India, it is more serious in southern parts. It causes damage to the seedlings as well as to the early stages of the crop. Population dynamics is the study of the growth and structure of populations together with the factors that regulate their size and cause fluctuations in their density. Though a large number of pests have been reported on sorghum crop in Maharashtra, very few have economic status. The major being sorghum shoot fly *Atherigona soccata*, stem borer *Chilo partellus*, shoot bug *Peregrinus maidis* and aphids *Melanaphis sacchari*. Maximum yield losses of 75.60 percent in grain and 68.60 percent in fodder due to shoot fly have been reported by (Patel *et al.* 1986) [5]. The losses in grain yield due to stem borer *Chilo partellus* varies from 24.3 to 36.3 percent in different agro-climatic regions of India. Under natural infestation of shoot bug, it resulted into losses of 11.16 and 21.11 in grain and fodder yield respectively (Raju Anaji and Balikai, 2005) [7].

2. Materials and Methods

The present study was conducted at the Sorghum Research Station, College of Agriculture, VNMKV, Parbhani during the Kharif season of 2016-2017. Geographically Parbhani is situated at 409 m mean sea level altitude 19°16' North latitude and 76°47' E longitude. Its height from mean sea level is about 879 m. The mean annual rain fall of Parbhani is about 800 to 900 mm received during June to September. The sorghum crop was sown with SPH-1641 variety by following recommended agronomic practices and fertilizer application with 45 cm row to row and 15 cm plant to plant spacing. The observations for seasonal incidence were taken from 100 m^2 area. Observation for major insect pests starts counting at 7 days after emergence in each meteorological week. Plants showing shoot fly and stem borer dead heart symptoms were recorded in each meteorological week. Aphid damage rating (1-9) was taken. For *H. armigera* observation were recorded on number of larvae $earhead^{-1}$. The observation randomly selected on population of natural enemies like lady bird beetle and chrysopa per ten plants were recorded.

3. Results and Discussion

3.1 Population dynamics of major insect-pest of sorghum

3.1.1 Shoot fly egg counts

The data on egg counts of *Atherigona soccata* were recorded on ten plants per quadrate at weekly interval during the middle period of MW. The data is presented in table-2. The incidence of eggs was started from 27^{th} MW (2.2 eggs/10 plants) and increased gradually to reach its peak in 28^{th} MW. Thereafter it declined gradually and started disappearing from 32^{nd} MW.

3.1.2 Shoot fly dead hearts

The data of population dynamics on shoot fly dead hearts are presented in table-2. This data revealed that shootfly dead hearts ranged between 6.90 to 15.01 percent. The occurrence of dead hearts started from 28^{th} MW (12.10 percent) and increased gradually to reach its peak in 31^{th} MW (15.01 percent).

3.1.3 Population dynamics of stem borer

The data on population dynamics of stem borer dead hearts is presented in table-3. The dead hearts percentage ranged between 3.31 to 11.42 percent. The occurrence of stem borer dead hearts started from 31^{st} MW (3.31 percent) and increased gradually to reach its peak in 43^{th} MW (11.42 percent). The present findings are parallel with the findings of earlier research worker like Balikai (2000) [2] who observed shoot fly population began to increase in July reached to its highest in August and declined thereafter, with slight peak during October and again declined. One with 94.0 percent during 32^{nd} MW. Similarly shoot fly incidence was minimum during 26^{th} MW. Raigar *et al*., (2002) [6] observed that shoot fly infestation initiated a week after germination with average 8.36 percent dead hearts. Thereafter, the infestation continues to increase and become constant after third week of August. The shoot fly dead hearts increased rapidly in first week of August by 47.63 percent over the preceding week and reached up to 55.99 percent. Nagare R. D. (2016) [4] observed that incidence of shoot fly dead hearts showed negatively non-significant correlation with rainfall and Max. Temp. Rainy days, Min. Temp. morning RH, evening RH and BSS has non significant positive correlation.

3.14 Population dynamics of aphids

There was no incidence of Aphids on sorghum during *kharif* 2016-17.

3.1.5 Population dynamics of *H. armigera*

The data on population dynamics of *H. armigera* larvae is presented in table 4. The dead hearts percentage ranged between 2.10 to 3.59 larvae $earhead^{-1}$. The occurrence *H. armigera larvae* started from 38^{th} MW (2.10 larvae $earhead^{-1}$) and increased gradually to reach its peak in 39^{th} MW (3.59 larvae $earhead^{-1}$). The incidence of *H. armigera* was more on the crop sown during June second fortnight as compared to the crop sown on July first fortnight (Sharma *et al*, 2002) [9]. Nagare R. D. (2016) [4] observed that correlation of ear head worm correlated with negatively significant with Min. temperature.

3.2 Population dynamics of natural enemies

During *kharif* 2016-2017 the natural enemies found in sorghum were Lady bird beetle and chrysopa and their population dynamics is shown in table-1.

3.2.1 Lady bird beetle

The data in respect to lady bird beetle population were recorded on ten plants per quadrate at weekly interval. The occurrence of lady bird beetle started from 35^{th} MW and fluctuated in population. The incidence of lady bird beetle was upto 42^{th} week and maximum during 35^{th} MW.

3.2.2 Chrysopa

The data on population dynamics of chrysopa ranged between 7.10 to 16.92 eggs per ten plants. The incidence of egg started from 38^{th} MW and was upto 42^{th} MW. The incidence was highest during the 40^{th} MW.

Table 1: Population dynamics major pests of sorghum and their natural enemies correlation with weather parameters

MW	Av. SF eggs/ 10p	Av. SF dead hearts	Av. Stem borer dead hearts	*H. armigera* larvae earhead^{-1}	Lady bird beetle / 10 Plant	Chrysopa eggs/10P	Rainfall (mm)	Rainy days	Temperature ^{0}C		Humidity (%)		BSS
									Max.	Min.	AM	PM	
27	6.20	0.00	0.00	0.00	0.00	0.00	80.20	5.00	30.10	23.90	85.00	73.00	1.00
28	8.90	12.10	0.00	0.00	0.00	0.00	143.80	3.00	28.80	22.40	93.00	76.00	2.90
29	8.70	8.90	0.00	0.00	0.00	0.00	12.90	2.00	32.50	22.90	86.00	61.00	5.10
30	7.50	9.50	0.00	0.00	0.00	0.00	65.60	3.00	30.70	22.90	93.00	68.00	4.10
31	6.80	15.01	3.31	0.00	0.00	0.00	117.00	4.00	28.20	22.60	96.00	81.00	2.40
32	0.00	7.03	4.13	0.00	0.00	0.00	0.00	0.00	31.70	22.10	84.00	56.00	5.90
33	0.00	6.90	4.87	0.00	0.00	0.00	11.20	1.00	31.80	21.40	85.00	58.00	6.60
34	0.00	7.05	6.44	0.00	0.00	0.00	13.00	2.00	32.40	21.40	87.00	52.00	8.00
35	0.00	0.00	7.31	0.00	4.10	0.00	71.50	5.00	31.00	22.50	92.00	68.00	4.20
36	0.00	0.00	8.75	0.00	4.09	0.00	1.50	0.00	30.90	20.70	80.00	58.00	8.80
37	0.00	0.00	9.77	0.00	3.09	0.00	101.60	3.00	29.30	22.40	88.00	78.00	1.70
38	0.00	0.00	9.67	2.10	3.09	8.90	109.10	4.00	29.60	22.30	96.00	85.00	2.50
39	0.00	0.00	10.13	3.59	4.00	7.10	96.90	4.00	30.20	21.70	91.00	73.00	3.70
40	0.00	0.00	10.16	3.01	0.00	16.92	109.50	3.00	29.40	21.30	93.00	72.00	5.30
41	0.00	0.00	11.06	3.02	0.00	10.06	56.90	2.00	32.00	21.20	88.00	52.00	7.50
42	0.00	0.00	11.29	0.00	1.00	8.00	0.00	0.00	32.20	16.90	77.00	33.00	9.60
43	0.00	0.00	11.42	0.00	0.00	0.00	0.00	0.00	32.30	16.10	74.00	31.00	9.00

The trends of natural enemies are more or less similar to earlier researcher like Tripathi and Singh (1995) [11] who reported 25 species of aphid were feeding on number of food plants and available for parasitization by the cereal pest, *R. maidis*. The highest level of parasitization was recorded on *R. maidis* followed by *M, sacchari* and *S. gramimum*. Nagare R. D. (2016) [4] observed that the pest showed negative correlation with Max. Temperature whereas the rest of parameter i.e. rainfall, rainy days, morning RH, evening RH has positively non significant correlation and Max. Temperature and Min. Temperature has negatively non significant influence on lady bird beetle. Nagare R. D. (2016) [4] observed that the correlation of chrysopa eggs correlated with rainfall, morning RH, evening RH has positive non significant correlation whereas, rainy days, Max. Temperature, Min. temperature and BSS showed non-significantly negative correlation.

3.3 Simple correlation and regression between weather parameters and shootfly, stem borer, earhead caterpillar and natural enemies

The data pertaining to population dynamics of major pests and natural enemies of sorghum were compared with various environmental factors. The relation between weather parameters and major pests of sorghum was studied. Simple correlation and regression studies were worked during *kharif* 2016-17.

3.3.1 Shootfly egg counts

The data pertaining to simple correlation and regression are presented in table-5. The findings are as under.

3.3.2 Simple correlation studies

The data presented in table-2 showed that on sorghum the correlation of *Atherigona soccata* egg population with weather parameters Max. Temperature (r = 0.309) and Min. Temperature (r = 0.367) were positively non significant. Whereas Morning RH (r= -0.521*), evening RH (r= -0.548*) and rainfall (r= -491*) was negatively significant. The association of eggs of *Atherigona soccata* population with, rainy days, were negatively non- significant and BSS were positively non- significant.

3.3.3 Shoot fly dead hearts: Simple regression studies

The simple regression was worked out between weather parameters and incidence of eggs of *A. soccata* population along with the regression coefficient ‘b’ and constant ‘a’ and their equations were setup.

The regression equation on sorghum were Y= 0.840 - 0.024x which indicated that for every unit increase in rainfall eggs of shootfly decrease by -0.024, Y= -13.84 - 0.183x which indicated that for every unit increase in morning RH eggs of shootfly decrease by -0.183, Y= -2.937 - 0.081x which indicated that for every unit increase in evening RH eggs of shootfly decrease by -0.081.

Table 2: Simple correlation and regression of weather parameter with shootfly eggs

Sr. No.	Parameters	Intercept (a)	Slope (b)	‘r’ value
X1	Rainfall	0.8401	-0.02404	-0.491*
X2	Rainy days	0.5916	-0.6840	-0.327
X3	Max. Temperature	0.2735	0.8161	0.309
X4	Min. Temperature	-15.69	0.8357	0.367
X5	Morning RH	-13.84	-0.1837	-0.521*
X6	Evening RH	-2.937	-0.08188	-0.548*
X7	BSS	5.542	0.6356	0.474

Table 3: Simple correlation and regression of weather parameter with shoot fly dead hearts population

Sr. No.	Parameters	Intercept (a)	Slope (b)	‘r’ value
X1	Rainfall	3.137	0.01328	0.128
X2	Rainy days	3.747	0.06820	0.023
X3	Max. Temperature	2.691	-0.7474	-0.199
X4	Min. Temperature	-15.41	0.9008	0.453
X5	Morning RH	-21.32	0.2882	0.354
X6	Evening RH	-0.7515	0.07374	0.220
X7	BSS	5.973	3.969	0.208

Table 4: Simple correlation and regression of weather parameter with stem borer dead hearts population

Sr. No.	Parameters	Intercept (a)	Slope (b)	'r' value
X1	Rainfall	7.074	-0.01205	-0.137
X2	Rainy days	8.004	-0.6768	-0.267
X3	Max. Temperature	-9.367	0.5115	0.160
X4	Min. Temperature	35.79	-1.372	-0.633**
X5	Morning RH	23.54	0.1962	0.284
X6	Evening RH	12.54	0.09760	0.343
X7	BSS	2.499	0.7456	0.495*

Table 5: Simple correlation and regression of weather parameter with *Helicoverpa armigera* larvae earhead^{-1}

Sr. No.	Parameters	Intercept (a)	Slope (b)	'r' value
X1	Rainfall	0.1102	-0.009938	-0.379
X2	Rainy days	0.2100	-0.1988	-0.263
X3	Max. Temperature	5.699	0.1628	0.171
X4	Min. Temperature	0.2182	-0.02197	-0.634**
X5	Morning RH	-5.851	-0.07472	-0.362
X6	Evening RH	-0.5286	-0.01926	-0.227
X7	BSS	0.8552	0.03192	0.066

3.3.4 Simple correlation studies

The data presented in table-3 showed that on sorghum the correlation of shootfly dead hearts with weather parameters, Morning RH (r = 0.354), evening RH (r = 0.220), rainy days (r=0.023), rainfall (r=-0.128), minimum temperature (r = 0.453) and BSS (r = 0.208) were positively non-significant. were maximum temperature (r = -0.199) was negatively non significant.

3.3.5 Stem borer dead hearts: Simple correlation studies

The data on simple correlation indicated that the impact of weather parameters minimum temperature(r = -0.633**) was highly negative significant and BSS (r = 0.495*) was positively significant. Whereas, rainfall (r = -0.137) and rainy days (r= -0.267) was negatively non significant. The rest of the parameter i.e. maximum temperature (r = 0.160), morning RH (r = 0.284) and evening RH (r = 0.343) has positively non significant correlation.

3.3.6 Simple regression studies

The simple regression studies were found out between weather parameters and stem borer dead hearts. The correlation coefficient 'b' and constant 'a' were worked out and their equation were set up as Y= a± bX.

The regression equation on sorghum were Y= 35.79 – 1.372x which indicated that for every unit increase in Min. temperature stem borer dead hearts decrease by -1.372, Y= 2.499-0.745x which indicated that for every unit increase in BSS stem borer dead hearts increase by 0.745. The present findings are in confirmation with earlier researchers like Shekhar (1995) [10] observed that correlation studies between larval counts as the boost leaf stage and minimum temperature indicated a significant positive relationship suggesting that the lower temperature positively influenced larval diapauses. Kandalkar *et al*. (2002) [3] observed that the minimum temperature showed significant and negative correlation with stem borer leaf injury with an 'r' value of -0.1734. Maximum temperature, morning and evening RH and rainfall did not influence stem borer incidence significantly. Raigar *et al*. (2002) [6] revealed that increase in the infestation of shoot infesting insect pests shows positive correlation with mean relative humidity and negative with the mean temperature.

3.3.7 Simple correlation studies *H. armigera*

The data on simple correlation indicated that the impact of weather parameters minimum temperature (r= -0.634**) was highly negative significant. Whereas, the rest of the parameter i.e. rainfall, rainy days, morning RH, evening RH was negatively non-significant and maximum temperature and BSS was positively non-significant correlation.

3.3.8 Simple regression studies

The simple regression studies were found out between weather parameters and *H. armigera* hearts. The correlation coefficient 'b' and constant 'a' were worked out and their equation were set up as Y= a± bX.

The regression equation on sorghum were Y= 0.218-0.021 which indicated that for every unit increase in minimum temperature decrease larvae of *H. armigera* population by -0.21.

4. Summer and Conclusion

The population dynamics of major pests and their natural enemies in sorghum in years showed the incidence and peak time of the pests and natural enemies. The initiation of shoot fly eggs, dead heart due to shoot fly, stem borer dead hearts, ear head worm, lady bird beetle and chrysopa eggs was during 27th, 28th, 31th, 38th, 35th, and 38th MW, respectively during 2016. The peak incidence of shoot fly eggs, dead heart due to shoot fly, stem borer dead hearts, ear head worm, lady bird beetle and chrysopa eggs was observed during 28th, 31th, 43^{th,} 39th, 35th, and 41st MW, respectively. The incidence of shoot fly eggs showed positive non significant correlation with Max. Temperature, Min. Temperature whereas morning RH, evening RH and rainfall was negatively significant. Rainy days were negatively non significant correlation and BSS were positively non significant.The incidence of shoot fly dead hearts showed positively non- significant correlation with rainfall, Rainy days, Min. Temperature, moring RH, evening RH and BSS were Max. Temperature. was negatively non- significant correlation. Stem borer showed minimum temperature was highly negative significant and BSS was positively significant. Whereas, rainfall and rainy days was negatively non significant. The rest of the parameter i.e. maximum temperature, morning RH and evening RH has positively non significant correlation.

5. Acknowledgement

I would like to express my sincere heartfelt gratitude to my advisor and department of entomology staff VNMKV, Parbhani for the continuous support to my doctoral study and related research, for his patience, motivation and immense knowledge and I thank my college for fulfilling all my research needs.

6. References

1. Anonymous. Area. production and productivity estimates of sorghum in India during Kharif (monsoon). Indian Economy 2002-2003; c2016. www. indiastat.com.
2. Balikai RA. Seasonal incidence of sorghum shoot fly in Northern Dry Zone Karnataka. Karnataka J Agric. Sci. 2000;13:457-58.
3. Kandalkar HG, Men UB, Atale SB, Kadam PS. Effect of

meteorological factors on incidence of sorghum stem borer, *Chilo partellus* Swin. J Appl. Zoological Res. 2002;3(1):69-70.
4. Nagare RD. Bio-efficacy of different insecticides against sorghum ear head pests M.Sc. Thesis submitted to VNMKV, Parbhani (M.S.); c2016. p. 72-76.
5. Patel ZP, Mittal VP. Avoidable losses due to earhead worm on sorghum hybrid CSH-5. Sorghum News Letter. 1986;29:64.
6. Raigar RA, Ameta OP, Sharma KC, Rana BS. Incidence of shoot infesting insect pests of sorghum. Indian J Appl. Ent. 2002a, b;16(2):47-50.
7. Raju Anaji, Balikai RA. Management of Shoot Bug, *Peregrinus Maidis* (Ashmead) Through Seed Treatment in *Rabi* Sorghum Ann. of Pl. Protec. Sci. 2012;20(1):37-41.
8. Reddy KVS, Davies JG. Pests of sorghum and pearl millet and their parasites and predators recorded at ICRISAT centre upto August, 1977, Cereal Entomology Progress Report-2, Patancheru, India; c1979. p. 58-61.
9. Sharma HC, Sullivan DJ, Bhatnagar VS. Population dynamics and natural mortality factors of the oriental armyworm *Mythimna separata* (Lepidoptera: Noctuidae) in South Central India. Crop protec. 2002;21(9):721-732.
10. Shekhar PR. Seasonal incidence of sorghum shootfly *A. soccata* (Rond.) Diptera, J Insect Sci. 1995;8(1):108-109.
11. Tripathi SK, Singh KP. Litter dynamics of recently harvested and mature bamboo savannas in a dry tropical region in India. Journal of tropical ecology. 1995 Aug;11(3):403-17.