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POPULATION DYNAMICS OF MAJOR INSECT PEST OF *KHARIF* SORGHUM IN MARATHWADA CONDITION

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ABSTRACT

A field study was conducted during *kharif* 2025 at Parbhani, Maharashtra, to assess the seasonal occurrence of major insect pests and natural enemies in sorghum and their association with weather parameters. Shoot fly egg laying peaked at 8.90 eggs/10 plants in the 32nd SMW, while shoot fly dead hearts reached 29.62% in the 36th SMW. Stem borer incidence increased gradually and attained 12.46% in the 42nd SMW. Aphid infestation appeared during the 41st SMW and reached a maximum damage rating of 2 during the 42nd and 43rd SMWs. Ladybird beetles and *Chrysopa* attained maximum populations of 3 beetle/10 plants during the 43rd to 44th and 36th SMWs, respectively. Most of weather parameters showed non significant relationships with pest incidence; however, bright sunshine hours exhibited a significant positive correlation with aphid damage (r = 0.512).

Key words: Sorghum, Shoot fly, Stem borer, Aphid, Weather parameters.

Introduction

Sorghum (*Sorghum bicolor* L. Moench) is one of the major cereal crops cultivated in tropical and subtropical regions because of its adaptability to drought, high temperature and low input production systems. In India, it is an important food, fodder and feed crop, particularly in the semi arid regions where it contributes significantly to the livelihood of farming communities. However, the productivity of sorghum is seriously constrained by insect pests throughout different crop growth stages. Among them, the sorghum shoot fly, *Atherigona soccata* Rondani, is considered the most destructive pest during the seedling stage, while the spotted stem borer, *Chilo partellus* (Swinhoe) and aphid, *Rophalosiphum maidis*, are important pests causing considerable yield losses in sorghum production. Their incidence and severity vary with crop growth stage, host plant characteristics and prevailing environmental conditions, emphasizing the need for continuous monitoring and timely pest management (Sharma, 1993; Dhillon *et al.,* 2005; Okosun *et al.,* 2021).

Weather parameters play a vital role in regulating the seasonal abundance of insect pests and their associated natural enemies by influencing insect development, survival, reproduction and dispersal. Likewise, predators such as coccinellid beetles, green lacewings (*Chrysopa* spp.) and spiders contribute significantly to the natural suppression of insect pests in sorghum ecosystems. Recent studies conducted in Maharashtra have demonstrated that fluctuations in weather parameters significantly influence the seasonal incidence of sorghum shoot fly, indicating the importance of weather based pest surveillance for effective crop protection. Although several investigations have documented the seasonal occurrence of sorghum insect pests in different agro climatic regions, information on the population dynamics of major insect pests and their natural enemies in relation to weather parameters under the semi arid conditions of the Marathwada region remains limited. Therefore, the present investigation was undertaken to study the population dynamics of major

insect pests and their associated natural enemies in *kharif* sorghum and to determine their relationship with prevailing weather parameters under the agro climatic conditions of Parbhani, Maharashtra (Meena *et al.,* 2022; Meena & Bhamare, 2024; Okosun *et al.,* 2021).

Materials and Methods

Experimental site

The present investigation on the population dynamics of major insect pests of *kharif* sorghum and their natural enemies was conducted during the *kharif* 2025 season at the Sorghum Research Station, Vasantrao Naik Marathwada Krishi Vidyapeeth (VNMKV), Parbhani, Maharashtra, India. The experimental site is situated at 19°16' N latitude and 76°46' E longitude with an altitude of 410 m above mean sea level. The region falls under the semi-arid tropical agro climatic zone and receives an average annual rainfall of approximately 918 mm, of which nearly 85 per cent is received during the southwest monsoon (June to September). The experimental field comprised deep black cotton soil (Vertisol), which is characteristic of the sorghum growing regions of Marathwada.

Crop establishment and field observations

The sorghum variety PBN Shakti was sown by dibbling on 18 July 2025 at a spacing of 45 × 15 cm in a non replicated field plot (10 × 10 m) following the recommended agronomic practices of VNMKV, Parbhani. No insecticidal treatment was applied during the crop season to permit the natural occurrence of insect pests and their associated natural enemies.

Weekly observations were recorded from the 29th to the 44th Standard Meteorological Week (SMW) commencing seven days after crop emergence. The observation plot was divided into four quadrats (10 × 10 m) and ten plants were selected randomly from each quadrat for recording observations throughout the crop season. The incidence of major insect pests, namely shoot fly (*Atherigona soccata* Rondani), stem borer (*Chilo partellus* Swinhoe), shoot bug (*Peregrinus maidis* Ashmead) and aphids (*Rophalosiphum maidis*), together with two important natural enemies, *viz.,* ladybird beetles (Coccinellidae) and green lacewings (*Chrysopa* spp.), was monitored at weekly intervals. Shoot fly and stem borer incidence were assessed based on the percentage of plants exhibiting dead heart symptoms, whereas shoot bug incidence was recorded as the number of nymphs and adults/plant. Aphid infestation was assessed using the standard visual rating scale adopted in the experiment. The observations were recorded following standard procedures employed in sorghum entomological investigations (Sharma, 1993; Dhillon *et al.,* 2005).

Weather data

Weekly meteorological data on maximum temperature (°C), minimum temperature (°C), morning relative humidity (%), evening relative humidity (%), rainfall (mm), number of rainy days and bright sunshine hours corresponding to each Standard Meteorological Week were obtained from the Agrometeorological Observatory, VNMKV, Parbhani. These weather parameters were used to determine their relationship with the seasonal population dynamics of insect pests and natural enemies.

Statistical analysis

The weekly mean population of insect pests and natural enemies was subjected to Pearson's correlation analysis to determine their association with individual weather parameters. Further, simple linear regression analysis was performed to quantify the influence of weather variables on pest incidence (Gomez & Gomez, 1984).

Results and Discussion

Population dynamics of major insect pests and natural enemies

Shoot fly (*Atherigona soccata*) egg laying:

Shoot fly egg laying was not recorded during the 30th SMW and commenced in the 31st SMW with 6.20 eggs/10 plants. The egg load increased to a maximum of 8.90 eggs/10 plants in the 32nd SMW, followed by a decline to 8.50 and 7.60 eggs/10 plants during the 33rd and 34th SMWs, respectively, after which no egg laying was observed. The peak egg load in the 32nd SMW coincided with 30.3°C maximum temperature, 22.9°C minimum temperature, 20.7 mm rainfall, 92 per cent morning relative humidity, 70 per cent evening relative humidity and 2.0 hours of bright sunshine. Egg laying showed negative correlations with maximum temperature (r = -

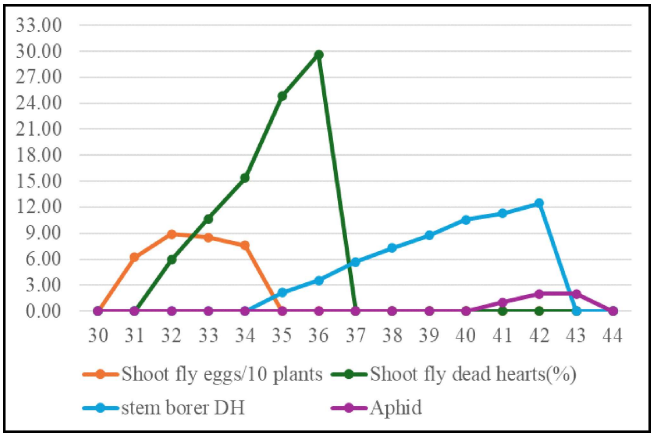


Fig. 1: Population dynamics of major insect pest of sorghum.

Table 1: Population dynamics of major insect pest of Sorghum (Shoot fly, Stem borer and Aphid) and natural enemies (Lady bird beetle and *Chrysopa*).

SMW	Period	SFE	SFD	SB	AP	LBB	CS	MaT	MT	Rain	Rh1	Rh2	BSS
30	23 July – 29 July	0.00	0.00	0.00	0.00	0.00	0.00	28.16	22.39	121.00	93.00	78.86	1.63
31	30 July – 05 Aug	6.20	0.00	0.00	0.00	0.00	0.00	31.34	22.79	1.00	88.86	62.71	3.31
32	06 Aug – 12 Aug	8.90	5.92	0.00	0.00	0.00	0.00	30.30	22.89	20.70	92.00	69.71	2.01
33	13 Aug – 19 Aug	8.50	10.66	0.00	0.00	1.00	0.00	26.26	22.19	145.70	94.00	84.71	1.46
34	20 Aug – 26 Aug	7.60	15.40	0.00	0.00	1.00	0.00	30.20	21.40	0.00	88.29	64.71	5.49
35	27 Aug – 02 Sep	0.00	24.80	2.13	0.00	2.00	1.00	28.10	22.39	111.80	93.71	84.57	1.64
36	03 Sep – 09 Sep	0.00	29.62	3.55	0.00	2.00	3.00	30.44	21.66	9.30	90.86	67.29	3.76
37	10 Sep – 16 Sep	0.00	0.00	5.68	0.00	1.00	2.00	29.79	22.74	123.50	94.00	75.29	2.47
38	17 Sep – 23 Sep	0.00	0.00	7.31	0.00	1.00	1.00	30.56	21.86	135.30	95.14	72.14	4.89
39	24 Sep – 30 Sep	0.00	0.00	8.76	0.00	1.00	1.00	28.33	21.34	124.10	92.43	75.29	2.57
40	01 oct – 07 Oct	0.00	0.00	10.56	0.00	0.00	0.00	31.19	21.39	98.60	92.29	58.00	6.59
41	08 Oct – 14 Oct	0.00	0.00	11.30	1.00	2.00	1.00	31.67	17.70	0.00	88.29	41.57	8.23
42	15 Oct – 21 Oct	0.00	0.00	12.46	2.00	2.00	1.00	32.84	20.07	0.00	87.86	44.29	6.74
43	22 Oct – 28 Oct	0.00	0.00	0.00	2.00	3.00	0.00	31.44	21.40	6.10	92.29	55.14	6.49
44	29 Oct – 04 Nov	0.00	0.00	0.00	0.00	3.00	0.00	30.80	21.59	38.00	91.71	63.00	5.14

SFE: Shoot fly eggs/10 plants; SFD: Shoot fly dead hearts (%); SB: Stem borer DH; AP: Aphid; LBB: Lady bird beetle; CS: *Chrysopa*; MaT: Max temp.; MT: Min temp

0.257), rainfall (r = -0.169), morning relative humidity (r = -0.164) and bright sunshine hours (r = -0.331), while minimum temperature (r = 0.346) and evening relative humidity (r = 0.235) showed positive associations; however, none of these correlations were significant. The corresponding regression coefficients were -0.547, 0.960, -0.010, -0.252, 0.065 and -0.541, respectively. The negative association with maximum temperature was in agreement with Karibasavaraja and Balikai (2006), who reported a negative correlation (r = -0.514) between maximum temperature and shoot fly egg load.

Shoot fly (*Atherigona soccata*) dead hearts:

Shoot fly dead hearts first appeared during the 32nd SMW (5.92%) and increased progressively to 10.66, 15.40 and 24.80 per cent during the 33rd, 34th and 35th SMWs, respectively, attaining a maximum of 29.62 per cent during the 36th SMW. No fresh dead hearts were recorded thereafter. At peak incidence, the weather conditions were 30.4°C maximum temperature, 21.7°C minimum temperature, 9.3 mm rainfall, 91 per cent morning relative humidity, 67 per cent evening relative humidity and 3.8 hours of bright sunshine. Dead heart incidence was negatively correlated with maximum temperature (r = -0.318), rainfall (r = -0.186), morning relative humidity (r = -0.173) and bright sunshine hours (r = -0.384), whereas minimum temperature (r = 0.401) and evening relative humidity (r = 0.267) showed positive correlations; none of the associations were significant. The respective regression coefficients were -1.043, 1.862, -0.017, -0.409, 0.143 and -1.056. The negative association with maximum temperature was comparable with the findings of Keerthi *et al.,* (2017), whereas Bhuyan and Kumar (2023) also reported a negative relationship with maximum temperature and positive relationships with minimum temperature and relative humidity.

Stem borer (*Chilo partellus*) dead hearts:

Stem borer dead hearts were absent from the 30th to 34th SMWs and first appeared during the 35th SMW (2.13%). The incidence increased gradually to 3.55, 5.68, 7.31, 8.76, 10.50 and 11.30 per cent during the 36th to 41st SMWs, respectively and reached a maximum of 12.46 per cent during the 42nd SMW, after which no incidence was recorded. The peak incidence coincided with 32.8°C maximum temperature, 20.1°C minimum temperature, 0 mm rainfall, 88 per cent morning relative humidity, 44 per cent evening relative humidity and 6.7 hours of bright sunshine. Stem borer dead hearts showed positive correlations with maximum temperature (r = 0.203), morning relative humidity (r = 0.167) and bright sunshine hours (r = 0.396), while minimum temperature (r = -0.364), rainfall (r = -0.082) and evening relative humidity (r = -0.279) showed negative correlations. None of the relationships were significant. The corresponding regression coefficients were 0.425, -1.075, -0.004, 0.197, -0.106 and 0.622, respectively. The delayed occurrence in the present study differed from Singh *et al.,* (2018), who reported first occurrence during the 30th SMW and maximum incidence during the 34th SMW.

Aphid (*Rhopalosiphum maidis*) damage:

Aphid damage was not observed from the 30th to 40th SMWs and first appeared during the 41st SMW with

Table 2: Simple Correlation and regression of weather parameters with major insect pests of sorghum (Shoot fly, Stem borer and Aphid).

Sl. No.	Parameters	Shoot fly eggs			Shoot fly dead hearts			Stem borer dead hearts			Aphid rating		
		IC	SL	RV	IC	SL	RV	IC	SL	RV	IC	SL	RV
X1	Max. Temp.	18.531	-0.547	-0.257	34.842	-1.043	-0.318	-6.243	0.425	0.203	-6.124	0.237	0.428
X2	Min. Temp.	-18.648	0.96	0.346	-36.418	1.862	0.401	29.154	-1.075	-0.364	10.864	-0.451	-0.471
X3	Rainfall	2.714	-0.01	-0.169	5.832	-0.017	-0.186	7.682	-0.004	-0.082	1.214	-0.009	-0.362
X4	Morning RH	25.122	-0.252	-0.164	42.216	-0.409	-0.173	-12.981	0.197	0.167	-2.943	0.041	0.132
X5	Evening RH	-2.258	0.065	0.235	-5.348	0.143	0.267	13.468	-0.106	-0.279	-1.852	0.037	0.298
X6	BSS	4.331	-0.541	-0.331	8.317	-1.056	-0.384	1.894	0.622	0.396	-0.864	0.302	0.512*
IC: Intercept (a); SL: Slope (b); RV: r' value													

a damage rating of 1. The damage increased to a maximum rating of 2 during the 42nd and 43rd SMWs and was absent during the 44th SMW. The peak damage coincided with 32.8 and 31.4°C maximum temperature, 20.1 and 21.4°C minimum temperature, 0 and 6.1 mm rainfall, 88 and 92 per cent morning relative humidity, 44 and 55 per cent evening relative humidity and 6.7 and 6.5 hours of bright sunshine during the 42nd and 43rd SMWs, respectively. Aphid damage showed positive correlations with maximum temperature (r = 0.428), morning relative humidity (r = 0.132), evening relative humidity (r = 0.298) and bright sunshine hours (r = 0.512), while minimum temperature (r = -0.471) and rainfall (r = -0.362) showed negative correlations. *Bright sunshine hours alone showed a significant positive correlation (r = 0.512)**, with a regression coefficient of 0.302. The present findings were partly comparable with Meena and Bhamare (2023), who reported negative associations of *R. maidis* with rainfall, minimum temperature and maximum temperature.

Ladybird beetle population:

Ladybird beetles were absent during the 30th to 32nd SMWs and first appeared during the 33rd SMW with 1 beetle/10 plants. The population increased to 2 beetles/10 plants during the 35th and 36th SMWs, declined to 1 beetle during the 37th to 39th SMWs, disappeared during the 40th SMW, reappeared with 2 beetles/10 plants during the 41st and 42nd SMWs and reached a maximum of 3 beetles/10 plants during the 43rd and 44th SMWs. During the peak period, maximum temperature ranged from 31.4 to 30.8°C, minimum temperature from 21.4 to 21.6°C, rainfall from 6.1 to 38.0 mm, morning relative humidity was 92 per cent, evening relative humidity ranged from 55 to 63 per cent and bright sunshine ranged from 6.5 to 5.1 hours. The population showed positive correlations with maximum temperature (r = 0.221), morning relative humidity (r = 0.118), evening relative humidity (r = 0.336) and bright sunshine hours (r = 0.487), while minimum temperature (r = -0.384) and rainfall (r = -0.142) showed negative correlations. None of the relationships were significant. Bright sunshine hours had the highest positive association, with a regression coefficient of 0.317. Sonawane *et al.*, (2022) also reported seasonal fluctuation in ladybird beetle activity on sorghum, while Patel and Purohit (2014) recorded maximum activity during the 38th SMW.

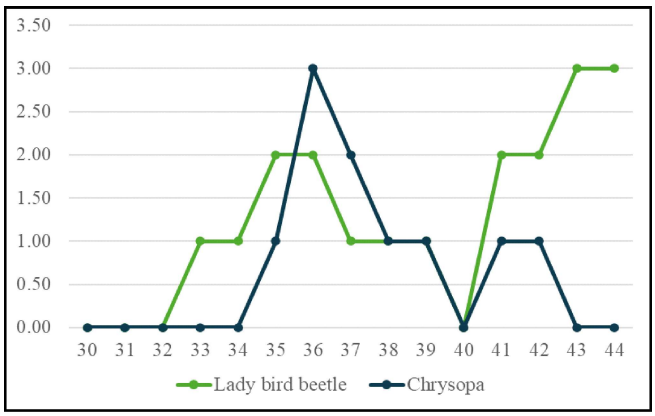


Fig. 2: Population dynamics of natural enemies on sorghum.

***Chrysopa* population:**

No *Chrysopa* population was observed from the 30th to 34th SMWs. The predator first appeared during the 35th SMW with 1 grub and adult/10 plants and attained a maximum of 3 grubs and adults/plants during the 36th SMW. Thereafter, the population declined to 2 during the 37th SMW and 1 during the 38th and 39th SMWs, disappeared during the 40th SMW, reappeared with 1 grub and adult/10 plants during the 41st and 42nd SMWs and was absent during the 43rd and 44th SMWs. The peak population in the 36th SMW occurred at 30.4°C maximum temperature, 21.7°C minimum temperature, 9.3 mm rainfall, 91 per cent morning relative humidity, 67 per cent evening relative humidity and 3.8 hours of bright sunshine. *Chrysopa* population was positively correlated with maximum temperature (r = 0.268), morning relative humidity (r = 0.126), evening relative humidity (r = 0.309) and bright sunshine hours (r = 0.463), whereas minimum temperature (r = -0.423) and rainfall (r = -0.171) showed negative correlations; none were significant. Bright sunshine hours showed the highest positive association,

whereas minimum temperature showed the highest negative association. The corresponding regression coefficients were 0.199, -0.489, -0.005, 0.045, 0.036 and 0.284, respectively. Patel and Purohit (2014) reported maximum *chrysopid* activity during the 45th SMW under kharif sorghum and a positive association with aphid and planthopper populations.

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