

Influence of Abiotic and Biotic Factors on Seasonal Incidence of Key Pests with its Damage Intensity in Pearl Millet

Nitin R. Patange*, Suryakant B. Pawar, Ashish B. Bagade

National Agricultural Research Project (VNMKV, Parbhani), Chh. Sambhajinagar (M.S.)

*Corresponding Author E-mail: dnrp@rediffmail.com

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ABSTRACT

The data on biodynamics of major pests and natural enemies on pearl millet genotype AHB-1200 Fe and its coorelation with weather parameters during nine meteorological weeks i.e. from 29th to 37th SMW indicated that shoot fly and shoot borer incidence was 8.89%. Helicoverpa larval population was 0.03 per panicle; hairy caterpillars were 0.11 per plant. Fall Armyworm damage was observed for the first time i.e. 7.22% with a population of 0.03 larvae per plant. Chaffer beetles were 0.06 per plant while Blister beetles were 0.03 per plant. The natural enemies i.e. Coccinellids (LBB) were 0.05 per plant, Chrysopids (GLW) were 0.04 per plant and Entomopathogenic Fungi were found to infect 0.02 larvae per plant.

The analysis with weather parameters revealed that fall armyworm, its damage, blister beetles and entomopathogenic fungi had significant coorelation with weather parameters i.e. rainfall, temperature (maximum and minimum) and relative humidity (morning and evening). Fall armyworm and its damage, blister beetles as well as entomopathogenic fungi had moderate negative coorelation with rainfall and strong negative coorelation with temperature (maximum and minimum); while moderate positive coorelation with morning relative humidity and strong positive coorelation with evening relative humidity was observed.

Keywords: Abiotic and biotic factors; seasonal incidence; key pest's damage; pearl millet.

INTRODUCTION

Pearl millet [*Pennisetum glaucum* (L.) R. Br.; Poales: Poaceae] is grown extensively on 5 continents including Asia, Africa, North America, South America and Australia. It is estimated that 26 million hectares of pearl millet are grown in Africa and India as food grain (Gulia et al., 2007). In the United States, about 607,000 hectares of pearl millet are

cultivated annually mostly in North Dakota, Nebraska, South Dakota and in some southeastern states including Georgia and Florida where it is used as hay and a summer grazing crop (Dewey et al., 2009). Pearl millet is also grown for other purposes such as pasture, silage, food, building material, seed crop and fuel (Baker, 1993).

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The commercial use of pearl millet in the United States began in early 1990s, although the crop was introduced in South Dakota during the early 1980s (Sedivec and Schatz 1991). The crop has nutritional benefits and is a good source of protein, crude fiber, calcium and phosphorous for animal feed. The protein content of pearl millet is higher than that of maize (*Zea mays* L.; Poales: Poaceae); it ranges from 27% to 32% and also has a higher energy content (Ejeta et al., 1987; Davis et al., 2003) compared to wheat (*Triticum aestivum* L.; Poales: Poaceae), maize and sorghum (*Sorghum bicolor* (L.) Moench; Poales: Poaceae) (Hill and Hanna 1990). Pearl millet and sorghum, being C4 species, have high photosynthetic efficiencies, high dry matter production ability (Rai et al., 1999) and closely related developmental stages (Maman et al. 2004). It is estimated that 30% of yield loss in sorghum is due to insect pest and pathogen attack (Reddy and Zehr, 2004). Nwanze and Harris (1992) reported that less than 12 insect species are of economic importance on pearl millet, although millet can attract up to 150 insect species. Pearl millet is attacked by various insects at all stages of growth and development; little is specifically known of how yields of this important crop are affected by insect herbivory and how the abiotic factors play role here.

Insect damage in pearl millet can occur on foliage, flowers as well as seeds, and has been recorded across all plant growth stages, i.e., 3rd leaf stage, 5th leaf stage, head initiation, flag leaf stage, boot stage, 50% stigma emergence, milk stage and dough stage (Maiti and Bidinger, 1981). Before any insect control strategy is implemented, an assessment of insect occurrence and impact needs to be conducted to establish the economic threshold of the insect damage (Youm and Owusu, 1998). Therefore, with increased interest in growing pearl millet because of its broad uses, the objectives of this study were to determine occurrence of insect pests from emergence to physiological maturity, and to identify and assess potential damage of major species on pearl millet with the role played by weather

parameters. This study was conducted at National Agricultural Research Institute, Chh. Sambhajinagar (M.S.) to determine insect occurrence on pearl millet with the role of weather parameters and to determine the levels of damage caused by insects feeding on pearl millet.

MATERIALS AND METHODS

A Bio-fortified pearl millet hybrid AHB:1200-Fe was sown on 09.07.2019 to know the biodynamics of pests. The sowing was made on an area of 200 m² with a spacing of 50cm X 15cm. All the recommended cultural and agronomic practices were followed to raise a good crop. None of the insecticides were applied to protect the crop from infestation by pests. The population of pest stages and that of natural enemies occurred was recorded at weekly interval on randomly selected 20 plants, commencing from germination till harvest of the crop. The crop was harvested on 19.10.2019. As such observations were recorded and the data was processed for obtaining results.

RESULTS AND DISCUSSION

The data on biodynamics of major pests and natural enemies on pearl millet and its correlation with weather parameters during nine meteorological weeks i.e. from 29th to 37th SMW is presented in Table-1. From the data it is clear that on pearl millet genotype AHB-1200 Fe, the incidence of shoot fly as well as shoot borer was 8.89%. The population of *Helicoverpa* larvae was 0.03 per panicle; larvae of hairy caterpillars were 0.11 per plant. The damage due to Fall Armyworm was observed for the first time which was 7.22% with a population of 0.03 larvae per plant. Chaffer beetles were 0.06 per plant while Blister beetles were 0.03 per plant. Among the population of natural enemies observed, Coccinellids (LBB) were 0.05 per plant, Chrysopids (GLW) were 0.04 per plant and Entomopathogenic Fungi were found to infect 0.02 larvae per plant.

The correlation analysis with weather parameters revealed that fall armyworm and its

damage, blister beetles and entomopathogenic fungi had significant correlation with weather parameters i.e. rainfall, temperature (maximum and minimum) and relative humidity (morning and evening). Fall armyworm and its damage, blister beetles as well as entomopathogenic fungi had moderate negative correlation with rainfall and strong negative correlation with temperature (maximum and minimum); while moderate

positive correlation with morning relative humidity and strong positive correlation with evening relative humidity was observed.

The researchers have recorded such findings in the globes against insect pests on pearl millet (Youm and Owusu,1998; Balikai, 2010; Eric Obeng et al., 2015; Parmar et al., 2022; Juneja, et al., 2022; Shrivaya Savithri and Prakash, 2023).

Table-1: Seasonal incidence of key pests and natural enemies on pearl millet and its correlation with weather factors

Date	SMW	Shoot Fly	shoot borer	H. armigera	Hairy caterpillars	FAW Damage	FAW larva	Chaffer beetles	Blister beetles	LBB	GLW	EP Fungi
16/7-22/7	29	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23/7-29/7	30	10.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00
30/7-5/8	31	10.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.05	0.00
6/8-12/8	32	5.00	15.00	0.05	0.15	0.00	0.00	0.10	0.00	0.05	0.10	0.00
13/8-19/8	33	10.00	10.00	0.05	0.30	0.00	0.00	0.15	0.00	0.10	0.10	0.00
20/8-26/8	34	20.00	15.00	0.10	0.35	5.00	0.00	0.05	0.00	0.05	0.05	0.00
27/8-2/9	35	10.00	10.00	0.05	0.15	20.00	0.05	0.20	0.05	0.00	0.00	0.00
3/9-9/9	36	5.00	10.00	0.00	0.00	20.00	0.10	0.00	0.10	0.00	0.00	0.05
10/9-16/9	37	5.00	5.00	0.05	0.05	20.00	0.10	0.05	0.10	0.10	0.05	0.10
Weeks = 9	Mean	8.89	8.89	0.03	0.11	7.22	0.03	0.06	0.03	0.05	0.04	0.02

Correlation with weather parameters

Rainfall	0.238	0.393	-0.204	0.078	-0.722*	-0.73*	-0.036	-0.73*	0.10	0.25	-0.78*
Temp. (Max)	0.339	0.000	-0.288	-0.046	-0.738*	-0.82**	-0.165	-0.82**	-0.14	-0.15	-0.87**
Temp. (Min)	-0.124	-0.365	-0.390	-0.281	-0.809**	-0.75**	-0.352	-0.75**	-0.07	-0.01	-0.58*
Rel. Humidity-1	0.138	0.483	0.556*	0.397	0.814**	0.671*	0.580*	0.671*	-0.04	0.07	0.453
Rel. Humidity-2	-0.176	0.242	0.281	0.024	0.918**	0.912**	0.243	0.912**	-0.01	-0.04	0.77**

** = strong

* = moderate

CONCLUSION

The present investigation on the biodynamics of major insect pests and natural enemies associated with pearl millet during nine standard meteorological weeks (29th to 37th SMW) revealed the occurrence of several economically important pests, namely shoot fly, shoot borer, *Helicoverpa* larvae, hairy caterpillar, chaffer beetles, blister beetle, and fall armyworm. Among these, the incidence of fall armyworm was recorded for the first time on pearl millet under the study conditions, indicating its increasing adaptability and potential threat to the crop ecosystem.

Simultaneously, important natural enemies such as lady bird beetles, chrysopids, and entomopathogenic fungi were also observed, suggesting the existence of natural biological regulation in the field environment.

The correlation analysis between pest incidence and weather parameters demonstrated that fall armyworm population and damage, blister beetles, and entomopathogenic fungi exhibited a moderate negative correlation with rainfall and a strong negative correlation with both maximum and minimum temperature. In contrast, these organisms showed a moderate positive

correlation with morning relative humidity and a strong positive correlation with evening relative humidity. These findings indicate that humid weather conditions favour the development and activity of pests as well as natural enemies, whereas higher temperatures and rainfall suppress their population build-up. Overall, the study provides valuable information on seasonal pest dynamics and weather influence, which can be effectively utilized for forecasting pest outbreaks and developing timely integrated pest management strategies in pearl millet cultivation.

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Conflict of Interest:

The authors declare no conflicts of interest.

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All authors contributed to drafting, reviewing, editing, and final approval of the manuscript.

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