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MONITORING OF FALL ARMY WORM *SPODOPTERA FRUGIPERDA* (J E SMITH)

Nirmalsinh Chauhan[1]* and Chandresh Borad[2]

[1]AINP on Pesticide Residues, ICAR Unit-09; [2]Main Vegetables Research Station,
Anand Agricultural University, Anand 388110, Gujarat, India
*Email: nirmalagri83@gmail.com (corresponding author): ORCID ID 0000-0002-9598-8714

ABSTRACT

Study on monitoring of male moth fall army worm, *Spodoptera frugiperda* (J E Smith) was carried out in Agro-climatic zone-III at agricultural landscape of different farms of Anand Agricultural University, Anand during June 2020 to May 2022. A fifteen funnel shaped traps with lure for FAW were installed on border area and army-maize lure of Albero green organicz was suspended. The traps were arranged with at least 50 m distance between two traps which were spread over approximately 83 ha, Data from 104 standard meteorological week (SMW). Observation reveal that the counts ranged from 0.04 to 0.87 moths/ trap/week from 24th SMW of 2020 to 23rd SMW of 2022. Higher numbers of non-target populations were captured in trap than the *S. frugiperda*. FAW moth catches/ week reported low positive correlation with bright sunshine hours (r=0.203) and very low positive correlation with maximum temperature (r=0.098); and markedly low negative correlation with evening relative humidity (r=-0.220), wind speed (r=-0.171) and rain fall (r=-0.126). It exhibited very low negative correlation with morning relative humidity (r=-0.048) and minimum temperature (r=-0.093).

Key words: *Spodoptera frugiperda*, seasonal catches, trapping studies, lure, moth, non-target, funnel shaped trap, temperature, Albero Green, border traps, nontarget speices

The fall army worm (FAW) *Spodoptera frugiperda* (J E Smith) (Lepidoptera: Noctuidae) is a native species of tropical and subtropical regions of the America. It is geographically widespread and feeds on a wide range of cultivated plants (Luginbill, 1928). It has been recently found outside its native range as it was reported in Nigeria in 2016 (Stokstad, 2017). Notorious pestiferous nature with high dispersal ability, wide host range and high fecundity makes this as one of the severe pests. It has super biological characters viz, absence of diapause, short generation time and high fecundity, highly polyphagous, long-distance migration ability and formidable adaptability to adversity (Wan et al., 2021). It has been reported to attack plants 20 families (CABI, 2018; Johnson, 1987). However, *S. frugiperda* has a preference for plants of the family Poaceae and it is most commonly reported on cultivated grasses (maize, rice, sorghum and sugarcane (CABI, 2018). It is primarily a pest of maize but has a wide host range and is capable of feeding on over 80 plant species, causing significant economic damage to maize, rice, sorghum, millet, soybean, wheat, alfalfa, cotton, turf and fodder crops (CABI, 2017; Pogue, 2002). FAW has very wide host range and strong migration ability (Wan et al., 2021). FAW larvae can cause 70% infestation in maize crop (Ayala et al., 2013). As per preliminary report, FAW reduced 33-36% yield in maize (Jagdish et al., 2019; Aruna et al., 2019). Starratt and Mcleod (1982) reported that pheromone traps were more efficient for detecting and monitoring adult male populations of *S. frugiperda* than blacklight traps in south-western Ontario. Silvain and Ti-A-Hing (1985) observed that the highest *S. frugiperda* population was observed during the rainy seasons and poor during dry season in pasture grasses. For developing effective management strategies of FAW in given locality, information on motoring data is necessary required (Rahmathulla et al., 2015). Significant correlation was noted between rainfall and males moth captured. This pest shows fluctuations in its natural environment. The information on monitoring of FAW is very scanty under Anand location. This study is proposed to study the monitoring of male moth of FAW in Anand location.

MATERIALS AND METHODS

Present study on monitoring of male *S. frugiperda* was carried out in Agro-climatic zone-III at agricultural landscape of different farms of Anand Agricultural University, Anand during June 2020 to May 2022. The meteorological data was collected from the Department of Agriculture Meteorological, B. A. College of Agriculture, AAU, Anand. Funnel shaped traps (15 no.) were installed on border area of different research

station farms of AAU campus. Lures for *S. frugiperda* monitoring of Albero Green Organicz, Bengaluru were used. Distance between traps were kept approximately more than 50 m. Total approx. 83 ha of AAU campus was covered. Different crops sown during the study period on different farms are mentioned in Table 1. All traps were kept six feet from the ground level. Need based damaged collection devices (non collapsible polyethylene bag) were changed. Trapped moths were collected and transferred in plastic jar, labelled it with number and date. All specimens were brought to laboratory for further investigation. All suspended lures were changed after 90 days, regularly. Meteorological data like, bright sunshine hours, rainfall, wind speed, temperature (maximum and minimum) and relative humidity (morning and evening) were correlated with the trapped moth catches, for study their specific impact on the moth counts of *S. frugiperda* (Steel and Torrie, 1980). The weather data as per standard meteorological week of 2020, 2021 and 2022 were obtained from the Department of Agriculture Meteorological, Bansilal Amrutlal College of Agriculture, A A U, Anand.

RESULTS AND DISCUSSION

Population fluctuation was determined by recording the male counts of *S. frugiperda* at weekly interval from 15 funnel shaped traps. Activity of moths and other non-target and role of physical factors of environment in fluctuation of the population was determined. Data from 104 standard meteorological week (SMW) of year 2020-21 and 2021-22 were observed. During the first year FAW male moth was first observed in 26th SMW (0.20 moths/ trap/ week), thereafter male population had not observed upto 38th meteorological week (Fig. 1). Higher number of male moth was observed during the 41st SMW (1.60 moths/ trap/ week). Population ranged between 0.07 to 1.60 moths/ trap/ week. Non-target moths like, microlepidopteran, *Mythimna separata* and Oriental armyworm were also caught in the traps. Population of microlepidopteran was ranged in between 0.07 to 2.40 moths/ trap/ week with highest peak in 4th SMW (2.40 moths/ trap/ week). Whereas, moths of *M. separata* were observed in between 0.07 to 10.33 moths/ trap/ week with highest peak in 11th SMW (10.33 moths/ trap/ week) (Fig. 2). During the second year FAW male moth was first observed in 32th SMW (0.20 moths/ trap/ week), thereafter male population had not observed upto 35th meteorological week. Higher number of male moth was observed during the 14st SMW (1.73 moths/ trap/ week); counts ranged between 0.07 to 1.73 moths/ trap/ week. Non-target moth populations like,

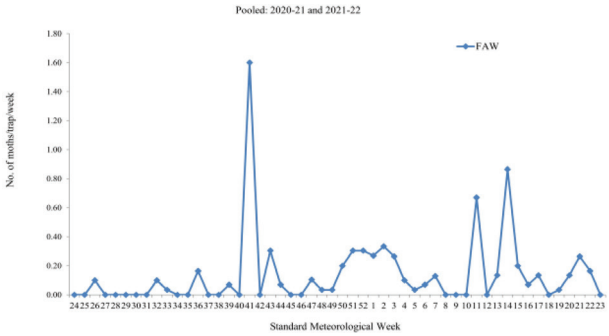

Fig. 1. Monitoring of fall armyworm

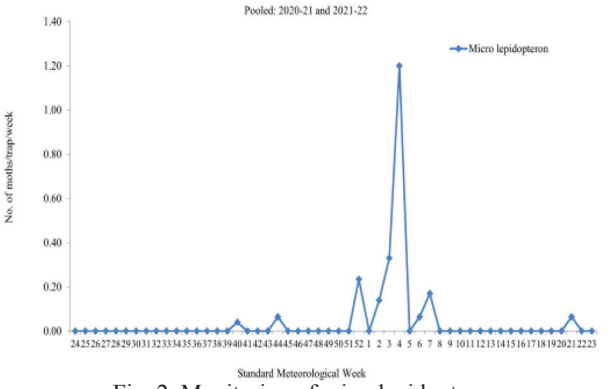

Fig. 2. Monitoring of microlepidopteran

microlepidopteran, *Mythimna separata* and oriental armyworm were also caught in the traps. Population of microlepidopteran ranged in between 0.13 to 0.47 moths/trap/week with highest peak in 52th SMW (0.47 moths/ trap/ week). Whereas, moths of *M. separata* were observed in between 0.13 to 22.73 moths/ trap/ week with highest peak in 48th SMW (22.73 moths/ trap/ week) (Fig. 3).

Nboyine et al. (2019) Barlow and Kuhar (2009) reported that 70 to 100 moth catches per trap per week. Rajisha et al. (2022) noted the maximum FAW moth captured during the SMW of 34th (7.6 moths/ trap) and 48th (8.2 moth/ trap). In present study, we found the

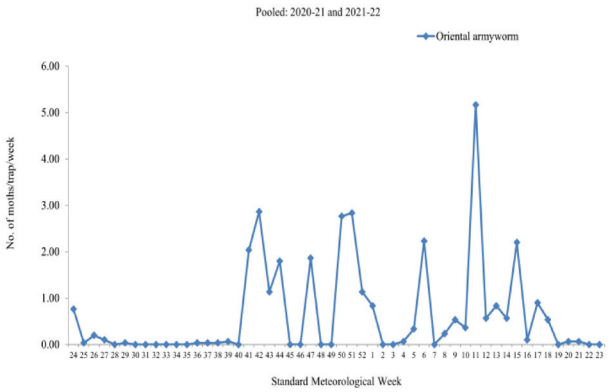

Fig. 3. Monitoring of Oriental armyworm

contradictory result for moth population captured by traps. It might be due to that our field trial site covered different crops like, vegetables, forage, food grains and commercial crops. Male moth attractant efficiency of the lure has also play a significant role for moth captured. Weather of our region was different than the Tamle, Ghana and Coimbatore, Tamilnadu. Malo et al. (2001) reported that 67.7% and 86.6% non-target species were captured out of total insect species captured in FAW pheromone traps during 1998 and 1999, respectively. *Diatraea lineolate* Walker; Hymenoptera (mostly honey bee species, *Apis mellifera* Linnaeus and bumble bees) and species of Diptera, Coleoptera and Homoptera among the captured species found in FAW pheromone traps. Weber and Fero (1991) noticed that noctuids *Leucania phragmitidicola* Guenée, *Sideridis rosea* Harvey and *Eurois occulta* Linnaeus were commonly captured in *S. frugiperda* trap in Massachusetts, USA. Numerous findings documented that baited traps attract beneficial insects and non-target. It was also interesting finding that we had suspended lure containing FAW female pheromone compounds but 6.73 times more number of moth of *M. separata* were captured against the target insect so it is also further create question the quality of lures. It may be unnecessary disturb the biodiversity of our region due to non-targeted insect captured. This finding is also raising the issue regarding the quality of the lure of the different company. It can be also concluded that FAW pheromone compound of the middle Gujarat population somewhat similar to female pheromone compound of *M. separata* in our region. So it is conclude that more number of non-target insects were caught than *S. frugiperda* male moth in pheromone traps. This finding is in accordance with earlier studies.

The correlation of male counts and with weather factors revealed that low positive correlation with bright sunshine hours (r=0.203) and very low positive correlation with maximum temperature (r=0.098). However, these observed a low negative correlation with evening relative humidity (r=-0.220), wind speed (r=-0.171) and rain fall (r=-0.126). It exhibited very low negative correlation with morning relative humidity (r=-0.048) and minimum temperature (r=-0.093) (Table 1). Nboyine et al. (2020) identified that among all climatic parameter, rainfall has a significantly positive impact. Murua et al. (2006) found that high temperature and rainfall affect population Dent (1991) concluded that climatic condition of the particular region impact on pest intensity. Silvain and Ti-A-Hing (1985) observed that maximum incidence of *S. frugiperda* was observed during the rainy seasons, and poor during dry season in pasture grasses. Significant correlation was noted between rainfall and males moth captured; and maximum temperature had some positive impact.

Microlepidopteran moth caches/ week reported highly significantly negative correlation with maximum temperature (r=-0.383)** and minimum temperature (r=-0.393)**. It exhibited low positive correlation with bright sunshine hours (r=0.118) and very low positive correlation with morning relative humidity (r=0.003). However, it markedly showed very low negative correlation with rainfall (r=-0.086) and low negative correlation with wind speed (r=-0.127) and evening relative humidity (r=-0.102). Bahadur et al. (2018) noted that gram pod borer, *Helicoverpa armigera* (Hübner) larval population had positive correlation with maximum and minimum temperature; however, negative non-significant relationship was found with the morning and evening relative humidity and rainfall. Babu and Singh (2021) observed that density of males of *S. litura* showed a significant negative correlation with maximum and wind speed and it was positively correlated with morning and evening relative humidity. Oriental armyworm moth caches/ week showed highly significantly negative correlation with minimum temperature (r=-0.374)**and significantly negative correlation with wind speed (r=-0.351); markedly low negative correlation was observed with maximum temperature (r=-0.162), rainfall (r=-0.172), morning relative humidity (r=-0.217) and evening relative humidity (r=-0.255). Oriental armyworm moth catches/ week showed significantly negative correlation with minimum temperature (r=-0.374)** and with wind speed (r=-0.351)*; however, it had low positive correlation with bright sunshine hours (r=0.174). Sharma et al. (2002) observed that moth captured were higher during the rainy season, lower in summer by light traps. Higher peak of moth catches were observed in September. Pei et al. (2018) noted that total 311 moth of *M. separata* was captured by pheromone traps during total 16 standard meteorological week. In present study moth activity was found throughout the years. It might be due to *M. separata* polyphagous.

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Table 1. Agri-horticultural crops sown at the Research Station farm, AAU campus

S. No.	Research station	2020			2021			2022		
		Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer
1.	Instructional Livestock Farm Complex farm	Maize, Sorghum, Oat	Maize, Oat, Lucerne	Maize, Sorghum	Maize, Sorghum, Oat	Maize, Oat, Lucerne	Maize, Sorghum	Maize, Gajaraj Grass, Sorghum	Maize, Oat, Lucerne	Maize, Sorghum
2.	Main Vegetables Research Station farm	Brinjal, Maize	Cucumber, Tomato, Chilli, Maize	Moong, Maize	Clusterbea, Maize	Tomato,Chilli, Maize	Maize, Okra	Cucumber, Bitter Gourd, Maize, Okra	Pigeon pea, Chilli	Okra, Maize
3.	Regional Research Station farm	Rice, Castor	Wheat	---	Rice, Castor, Groundnut	Gram, Wheat	Ground nut	Maize, Castor	Gram	Cluster bean, Groundnut (Spring)
4.	Main Forage Research Station farm	Maize, Sorghum, Pearl millet, Butterfly pea	Anjan Grass, Hybrid napier grass, Cow pea, Oat, Lucerne	---	Sorguhm, Pearl millet	Oat, Lucerne	---	Sorghum, Pear millet	Sorghum	Maize, Pear millet

Correlation of weather parameter and FAW, micro lepidopteran and Oriental armyworm (AAU campus, Pooled, 2020-21 and 2021-22; n=52)

Weather Parameters	Correlation		
	Fall armyworm	Micro lepidopteran	Oriental armyworm
Bright Sunshine Hours (BSS), hr/ day	0.203	0.118	0.174
Rainfall (RF),mm	-0.126	-0.086	-0.172
Wind Speed (WS), $kmhr^{-1}$	-0.171	-0.127	-0.351*
Maximum Temperature (Max T), ^0C	0.098	-0.383**	-0.162
Minimum Temperature (Min T), ^0C	-0.093	-0.393**	-0.374**
Morning Relative Humidity (MoRH), %	-0.048	0.003	-0.217
Evening Relative Humidity (EvRH), %	-0.220	-0.102	-0.255

*Significant at 5% level, **Highly significant at 1% level

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AUTHOR CONTRIBUTION STATEMENT

Dr N R Chauhan is the main author and did the whole research, under the guidance of Dr C K Borad.

CONFLICT OF INTEREST

No conflict of interest.

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