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

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ABSTRACT

***Spodoptera frugiperda* (J E Smith) is a major invasive pest that cause a significant threat to cereal crops and global food security. This study is the first field trial in Halabat region/ Jordan to explore some ecological aspects of *S. frugiperda* on corn across two growing seasons during 2022- 2023. Results showed that plant infestation numbers were significantly higher for Quality CV; whereas the lowest value was significantly for Maram CV. The vegetative stage showed the highest larval incidence densities and exhibited two to three peaks. Corn was the most preferred cultivar. Infestation maximum temperature and relative humidity (RH%) during the early 2023 and began in the fourth week of May and the first week of September, continuing until harvest.**

Key words: Peaks, pheromone traps, polyphagous, susceptibility, infestation, invasive, entomology, vegetative, temperature, relative humidity, *Spodoptera frugiperda*, incidence

In September 2020, fall army worm, *Spodoptera frugiperda* (J E Smith) (Lepidoptera: Noctuidae) was recorded in Jordan. It is a pest native to Americas that feeds on large numbers of leaves and stems of many kinds of crops (FAO, 2022). It is one of the major problems for agricultural crop production (Assefa et al., 2019). It is a highly polyphagous and attacks >353 plant species, including corn, sorghum, millet, sugarcane, and vegetable crops (Sisay et al., 2019). The significant harm inflicted by this insect on corn is evident, posing a potential threat to extend this impact to various other vegetable crops. The life cycle of *S. frugiperda* and its ability to spread and reproduce quickly when the climatic is suitable, makes it a successful invasive species (Agboy et al., 2023). *S. frugiperda* caused yield losses, destroying 21-53% of the annual production of corn. The African countries (Day et al., 2017). Initial signs of infestation are typically evident through feeding marks made by first-instar larvae. These larvae engage in superficial feeding on one side of the leaf, resulting in damage resembling pinholes and shot holes, causing a distinctive windowing effect (Du Plessis et al., 2020). Young *S. frugiperda* larvae employ a "ballooning" technique, to move to new host plants by catching the wind on a silk thread. As they grow larger, *S. frugiperda* larvae are often found deep within the whorl, concealed beneath a characteristic "plug" of yellowish-brown frass. This frass acts as a protective barrier, providing some resistance against insecticide applications. A positive correlation was observed between *S. frugiperda* damage and insecticide use, which may increase environmental pollution and affect human health (Abro et al., 2021); (Vatanparast and Park, 2022). Therefore, the aim of this field investigation is to study the population dynamics of this destructive pest and the preference for corn and other neighboring vegetables.

MATERIALS AND METHODS

The study was conducted on a 40 ha semi-arid private farm in the Halabat region of Jordan (N 32.11265, E 36.39958). There were two growing seasons for corn cultivation: the early season from April 25 to July, 2023 and the late season from August 4 to November. The farm was divided into five blocks, each containing 75 plant seedlings. Weekly field scouting was conducted to record the number of plants infested by *S. frugiperda* larvae. The three most commonly planted sweet corn varieties (Quality, Maram, and Aqiq) were evaluated for susceptibility with damage observed after 15 days after sowing. Fifty corn plants were randomly selected and inspected weekly until harvest (Ritchie and Hanway, 1993). Funnel moth catcher traps were hung 1.5 m above ground containing sex pheromone capsules to attract male moths. The number of moths was recorded daily from the pheromone traps. The results were statistically analyzed with correlation and regression to

find out the relationships between weather factors and plant ages (independent variables) and the numbers of moths in the traps (as dependent variables). The data was illustrated graphically using Microsoft Excel 2016.

RESULTS AND DISCUSSION

In this study, corn was the most preferable host over five vegetables during April to July 2023 (Fig. 1), which agreed with earlier results Sisay, 2023; Ihsan, 2023; Wang, 2023; and Chakraborty, 2022 on corn, sorghum and wheat. Using *S. frugiperda* for oviposition and larval development in the laboratory experiments indicated that corn cultivars were significantly preferred (Yang et al., 2022). In China, *S. frugiperda* raised on corn showed the highest activity in all biological traits (Fang et al., 2022). Quality Cultivar showed significantly maximum infestation in August. In September too, same trend was observed but without significant differences in quality and Aqiq cultivars (Fig. 2) showed maximum infestation during August-September in sweet corn. The larval infestation started on August 9th, increased slowly and then reached the maximum on August 3rd week, September 1st week, and September 3rd week (Table 1) and showed three generations. The vegetative stage was more favourable. The Quality was the most susceptible cultivar. Ritchie and Hanway (1993) observed that (Linduska and Harrison, 1987) plants between 0 and 40 days after sowing were the most susceptible Maram cultivar showed comparatively higher resistance (Prasanna et al., 2018). Significant differences were found in damage rates between lines as shown earlier (Kumela et al., 2019).

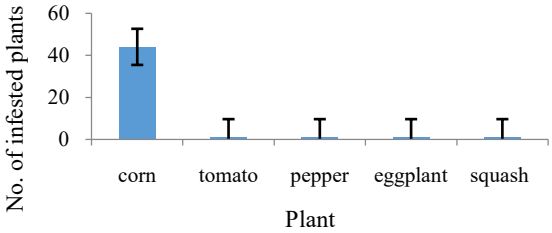

Fig. 1. Incidence of *S. frugiperda* (April to July 2023, Halabat)

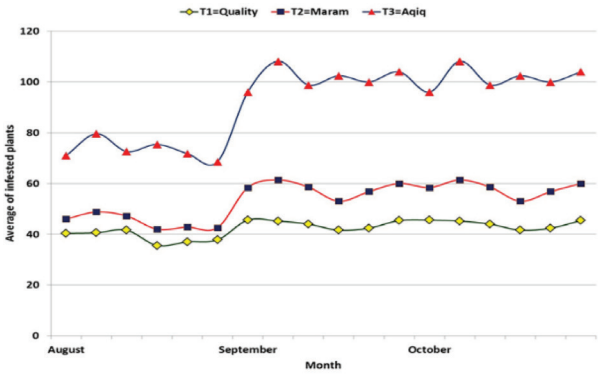

Fig. 2. Incidence of *S. frugiperda* in sweet corn (Halabat, August 20- September 17, 2022)

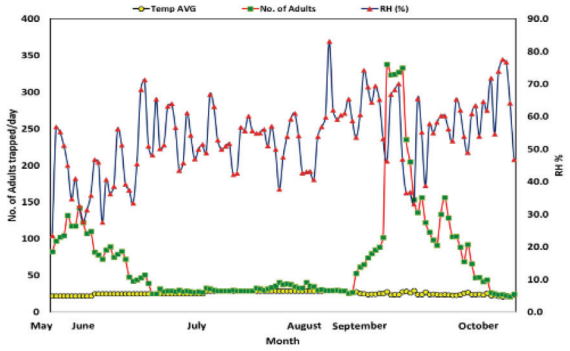

Fig. 3. Trap catches of adults of *S. frugiperda* (Sweet corn, Halabat, weather data from May to October 2023

The effects of temperature and plant age on *S. frugiperda* showen in Fig. 3 reveals *S. frugiperda* infested plants from the 3rd week of May and from 1st week of August and until harvest. On the other hand, results showed the high number of trapped moths was in May 4th week, June 1st week and July 4th week in the early season. Whereas in the late season, the higher trapped moth numbers were in September 1st, 3rd and 4th weeks as shown in (Fig. 3). Statistically, the simple

Table 1. Incidence of *S. frugiperda* larvae (August to September, 2022)

Sampling date	Plant age	Growth stage	No. of larvae (50 plant/ 5 lines)		
			Quality	Maram	Aqiq
August 1st	4	V2	50	26	30
August 8th	14	V5	35	25	14
August 15th	28	V8	32	9	7
August 21	42	V12	21	11	21
August 30	56	VT	15	7	14
September 9th	66	R1	4	7	15

Season 2023	Tested variable	Simple correlation and (regression values ** highly significant)			
		r	R^2	SE	F
Early May - August	Max. temp.	0.777	0.604	1.536	1.58E-15**
	RH.	0.765	0.586	1.046	1.19E-14**
Late August-October	Max. temp.	0.014	0.0002	2.6226	0.94
	RH.	0.111	0.0123	5.920	0.51

correlation showed significant positive relationship between the maximum temperature and trapped moths in the early season (r = 0.777), while it was positive and weak (r = 0.0136) in the late growing season. The correlation coefficient between relative humidity and the number of trapped moths in the early season was positive and significant (r =0.765) while it was 0.111 in the late corn growing season (Fig. 3). The present results revealed that maximum temperature and relative humidity showed positive correlation between moth numbers trapped during the early season. These findings agreed with those of Dent (1991). According to Murúa et al. (2006) adult populations of *S. frugiperda* were found to be active, primarily consuming a large leaf mass. Willink et al. (1993) observed that larvae scratch leaves, which reduces the photosynthetic area during the vegetative growth stages, which indirectly decreases yield. The present study showed that *S. frugiperda* has three peaks /season. This trend is very well known (Valdez-Torres et al., 2012; Abdel-Rahman et al., 2023),

Temperature plays a crucial role in influencing the life-history traits and development of the fall armyworm. Studies have shown that temperature directly impacts the geographic distribution, phenology, and natural enemies of the *S. frugiperda*. The heat requirements for *S. frugiperda* development has been extensively studied, with significant effects on fecundity, longevity, and developmental cycles observed at varying temperatures (Dahi et al., 2020 and Huang et al., 2021). Higher temperatures generally accelerated developmental rates but may also lead to changes in gene expression, potentially increasing the threat of invasion by *S. frugiperda* (Garcia et al., 2018). According to Du Plessis (2020) temperature thresholds from egg to adult was between 26 -30 ^{o}C. Temperature and humidity are the main factors that influence the longevity of adults, which was about 10 days, but may range between 7 and 21 days (Schlemmer, 2019).

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AUTHOR CONTRIBUTION STATEMENT

WI, TM and MS developed the theory and idea of the present research. WI carried out the experiments. WI and TM wrote the draft manuscript. WI and MS verified and analyzed data. All authors discussed the results and contributed to the final manuscript. All authors contributed to the final version, read and approved the manuscript.

CONFLICT OF INTEREST

No conflict of interest.

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