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GROWTH AND DEVELOPMENT OF FALL ARMY WORM *SPODOPTERA FRUGIPERDA* ON CEREALS

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ABSTRACT

This laboratory study was conducted to evaluate the growth and development of fall army worm *Spodoptera frugiperda* (J E Smith) on four cereal host plants. It was observed that the significantly least total lifecycle duration of male was on maize (27.61± 0.60 days) followed by pearl millet (30.85± 0.46 days), sorghum (31.31± 0.77 days). It was maximum on sugarcane (34.36± 0.80 days). As regards female *S. frugiperda*, the least was on maize (29.78± 0.66 days) followed by sorghum (32.52± 0.44 days), pearl millet (33.34± 0.52 days) and maximum on sugarcane (36.04± 0.51 days). Likewise maximum fecundity was observed on maize (436.44± 22.44) followed by sugarcane (248.08± 15.54), pearl millet (139.30± 13.02) and the least was on sorghum (106.44± 11.18). Male to female sex ratio was highest in sorghum (1:1.31) followed by pear millet (1:1.26), maize (1:1.20) and the least on sugarcane (1:1.19).

Key words: *Spodoptera frugiperda*, maize, pearl millet, sorghum, sugarcane, fecundity, egg hatching, larval instars, larval, pupal, adult periods, growth index, pupation, longevity

Fall army worm, *Spodoptera frugiperda* (J E. Smith) (Lepidoptera: Noctuidae) is a dreaded insect pest native to tropical and subtropical America (Luginbill, 1928; Sparks, 1979) spread all over the globe and assumed the position of level A1 threat. Short development cycle (Sharanabasappa et al., 2018), wide host range (EPPO, 2019), high prolificacy (Sparks, 1979) and high dispersal ability (Westbrook et al., 2016) make it a potentially dangerous. In India, the invasion of *S. frugiperda* was reported first in May 2018 on maize from Shivamogga, Karnataka (Sharanabasappa and Kalleshwaraswamy, 2018). It has been known to be polyphagous, gregarious and destructive and attacks 353 plant species from 76 families, principally of Poaceae (106), Asteraceae (31) and Fabaceae (31) (Montezano et al., 2018). The growth, development and reproduction of insects are directly influenced by the quality of the host plant. The responses of insect herbivores to changes in host plant quality vary within and between feeding guilds (Awmack and Leather, 2002). Hence, the biological studies of insect pest on different food sources are important for addressing the effect of the nutritional composition on growth and development of *S. frugiperda*. Hence the present study on growth and development of *S. frugiperda* on different cereals.

MATERIALS AND METHODS

The study on the growth and development of *S. frugiperda* was carried under laboratory conditions at a constant temperature and humidity. Four cereal host plants viz., maize (*Zea mays* L.) variety Narendra (M909), sorghum (*Sorghum bicolor* (L.) Moench) variety Parbhani Shakti (ICSR 14001), pearl millet (*Pennisetum glaucum* (L.) R. Br. (1810)) variety ABPC-4-3 and sugarcane (*Saccharum officinarum* L.) variety Nira (Co 86032) were included. These cereal host plants were grown by an adopting recommended package of practices as per V N M K V, Parbhani (Anonymous, 2016), except plant protection on the Research Farm of Department of Agricultural Entomology, College of Agriculture, Latur, during kharif 2019.

The initial culture of *S. frugiperda* was developed by collecting large sized larvae from maize crops cultivated on the research farm. The collected larvae were reared individually in clean round plastic vials (3.5 cm dia x 4 cm). Daily larvae were fed on unsprayed field collected leaves, stems and whorls of respective host plants during the morning hours till pupation. After pupation, the sexes of pupae were also determined on the basis of the distance between the two apertures. In males, the distance between genital and anal aperture was less, while it was more in females (Luginbill, 1928). The adults that emerged on the same day were sexed. Then one male and one female adult were paired together in an oviposition cage for copulation and egg laying. A cotton swab dipped in 50% honey solution was provided as food to the adults in the oviposition cage. The fresh leaves of respective host plants were also placed as an oviposition substrate. After every 24 hr, the leaves were examined for presence of eggs or egg masses and replaced with fresh ones. Thus, the freshly laid eggs were used for the study.

One hundred freshly laid eggs in a group of 20/ replication were kept in the petridish for recording observations in respect of incubation period and % egg hatching. The newly hatched larvae were reared individually on leaves and slices of the stem of respective host plants in round plastic vials (3.5 cm dia x 4 cm). While rearing due care was taken to transfer the larvae into a clean plastic vial. Fresh food was provided daily and old food was removed. The observations on the larval duration, % pupation, growth index, pupal duration, total development period (egg to adult emergence), % adult emergence, adult longevity and total lifecycle duration were recorded on respective host plants. The adults that emerged on the same day were sexed and one male and female were paired together for copulation and egg laying in an oviposition cage. A cotton swab dipped in 50 % honey solution was provided as food to the adults. The fresh and tender leaves of respective host plants were provided as a substrate for egg laying in each oviposition cage. The number of eggs laid by each female was counted daily till the death of the female moth. The observations on initiation of oviposition, last oviposition and death of female were recorded. From this, preoviposition, oviposition and post-oviposition periods were worked out on respective host plants. The data collected were analysed using descriptive statistics. The growth index was calculated by using Howe's (1953)- Growth Index = % larvae pupated/ Mean larval duration (days).

RESULTS AND DISCUSSION

The data on the growth and development of *S. frugiperda* on cereals are presented in Table 1. The fecundity was observed to vary significantly- maximum of 436.44 eggs/ female was observed on maize followed by sugarcane (248.08 eggs/ female). These observations agree with those of Maruthadurai and Ramesh (2020) on fodder maize. Hutasoit et al. (2020) and Sharanabasappa et al. (2018) observed the fecundity as 1064- 1662 eggs/ female on maize. The incubation period varied significantly with cereal hosts, minimum (2.00 days) was on maize and pearl millet. Guo et al., (2020) observed this as two days on maize, potato and tobacco, while Maruthadurai and Ramesh (2020) observed it as 2.20, 2.80, 2.80, and 2.40 days on fodder maize, Guinea grass, para grass and green amaranth, respectively. Egg hatchability was significantly maximum of 94%, on maize and sugarcane, while Montezano et al. (2019) noticed this as 97.40 % on an artificial diet; and Sharanabasappa et al. (2018) as 96.6 % on maize. Total larval duration ranged 12.58 to 19.17 days in different cereals, with shortest being on maize (12.58 days) followed by sorghum (15.93 days). Plessis et al. (2020) observed the mean developmental period on sweet corn as 10.45 to 34.39 days at varying temperatures; Maruthadurai and Ramesh (2020) observed this as 13.80, 17.30, 18.60 and 17.10 days on fodder maize, Guinea grass, para grass and green amaranth, respectively; and Kalyan et al. (2020) as 16.97 days, Tendeng et al. (2019) as 14 days and Sharanabasappa et al. (2018) as 15.9 days.

There were six larval instars irrespective of the host plants, with a duration from 2.46 to 3.32, 2.05 to 3.06, 2.01 to 3.07, 2.00 to 3.20, 2.02 to 3.29 and 2.04 to 3.23 days, respectively on different cereal host plants; significantly minimum and maximum I, II, III, IV, V and VI instar larval duration were to the extent of 2.46, 2.05, 2.01, 2.00, 2.02 and 2.04 days and; 3.32, 3.06, 3.07, 3.20, 3.29 and 3.23 days was recorded on maize and sugarcane, respectively. Guo et al. (2020) observed the developmental time for I, II, III, IV, V, VI larval instars as 2.62, 2.94, 3.06, 3.23, 3.28 and 2.88 days, respectively on maize; Sharanabasappa et al. (2018) found these as 2.60, 2.20, 2.00, 2.00, 2.40 and 4.50 days, respectively. Pupation was significantly more with sorghum (91%) followed by maize (88 %). Barros et al. (2010) observed this as 16.9, 33.8, 18.0 and 32.5% on cotton, millet, corn and soybean, respectively. Significantly maximum growth index was in the case of larvae fed on maize (6.99) followed by sorghum (5.71), and it was maximum with sugarcane; while the pupal duration was significantly minimum on maize (6.74 days). Kalyan et al., (2020) observed this as 8.96 days on maize, and Hutasoit et al., (2020) as 6.31and 6.76 days for male and female, respectively on maize. The total developmental period thus was significantly lowest on maize (21.32 days), and maximum on sugarcane (30.18 days). Montezano et al. (2019) and Sharanabasappa et al. (2018) observed this to be 27.09 and 28.9 days on artificial diet and on maize, respectively.

Adult emergence was again significantly more as 92% with maize, and the least with pearl millet (86 %) as has been shown by Barros et al. (2010) as 77.0, 80.0, 71.0 and 72.0% on cotton, millet, corn and soybean, respectively. The preoviposition was significantly the least on sugarcane (3.24 days) followed by pearl

Table 1. Growth and development of *S. podoptera frugiperda* on cereal hosts

S. No.	Parameters	Host plants			
		Maize (Mean± SD)	Sorghum (Mean± SD)	Pearl millet (Mean± SD)	Sugarcane (Mean± SD)
1.	Fecundity (no/female)	436.44± 22.44	106.44± 11.18	139.30± 13.02	248.08± 15.54
2.	Incubation period (days)	2± 0.33	2.26± 0.21	2± 0.43	2.52± 0.30
3.	Egg hatchability (%)	94± 1.05	89± 1.82	84± 1.33	94± 1.56
4.	Larval period (days)	12.58± 0.75	15.93± 0.94	16.93± 0.61	19.17± 0.51
5.	Instar period (days)				
	I	2.46± 0.06	3.17± 0.05	3.11± 0.03	3.32± 0.06
	II	2.05± 0.03	2.31± 0.03	2.60± 0.13	3.06± 0.06
	III	2.01± 0.04	2.46± 0.02	2.67± 0.03	3.07± 0.02
	IV	2.00± 0.03	2.62± 0.02	2.81± 0.05	3.20± 0.04
	V	2.02± 0.03	2.69± 0.02	2.88± 0.04	3.29± 0.04
	VI	2.04± 0.02	2.68± 0.03	2.86± 0.05	3.23± 0.03
6.	Pupation (%)	88± 0.84	91± 1.17	71± 1.06	85± 0.74
7.	Growth ratio (days)	6.99± 0.26	5.71± 0.22	4.19± 0.27	4.43± 0.25
8.	Pupal period (days)	6.74± 0.44	7.99± 0.24	7.61± 0.38	8.49± 0.42
9.	Total developmental period (days)	21.32± 0.07	26.18± 0.05	26.54± 0.06	30.18± 0.05
10.	Adult emergence (%)	92± 0.49	91± 0.69	86± 0.50	87± 0.37
11.	Pre-oviposition period (days)	4.22± 0.17	3.80± 0.29	3.76± 0.88	3.24± 0.35
12.	Oviposition period (days)	1.88± 0.04	1.14± 0.05	1.20± 0.03	1.36± 0.04
13.	Post-oviposition period (days)	2.36± 0.02	1.40± 0.04	1.84± 0.04	1.26± 0.03
14.	Adult longevity (days)				
	Male	6.29± 0.09	5.13± 0.07	4.31± 0.05	4.18± 0.09
	Female	8.46± 0.03	6.34± 0.03	6.80± 0.06	5.86± 0.04
15.	Total life cycle duration (days)				
	Male	27.61± 0.60	31.31± 0.77	30.85± 0.46	34.36± 0.80
	Female	29.78± 0.66	32.52± 0.44	33.34± 0.52	36.04± 0.51
16.	Male: Female ratio	1:1.20	1:1.31	1:1.26	1:1.19

Mean± SD (n=100/ host); SD - Standard deviation

millet (3.76 days), and maximum with maize (4.22 days). Kalyan et al. (2020), Hutasoit et al. (2020) and Sharanabasappa et al. (2018) observed this as 3.33 to 3.6 days on maize; and the oviposition period was significantly more on maize (1.88 days) and the least on sorghum (1.14 days). Kalyan et al., (2020) and Sharanabasappa et al., (2018) found this as 2.96 and 2.8 days on maize; and Marua et al. (2008) as 5.31 to 7.44, days on various hosts. The post oviposition period was again more with maize (2.36 days) and lowest on sugarcane (1.26 days), agreeing with Kalyan et al. (2020) and Sharanabasappa et al., (2018) as regards maize. Maximum adult longevity of male was noticed on maize (6.29 days) and the least on sugarcane (4.18 days); and with female also it was on maize (8.46 days); females lived longer irrespective of host plants. Lekha et al. (2020) observed an adult male and female longevity of 4.50-8.00 and 7.00-10.33 days on different hosts; while Kalyan et al. (2020) observed this as 10.67-13.00 days. The lifecycle occupied the least duration with maize (27.61 days) followed by pearl millet (30.85 days), sorghum (31.31 days) and maximum being with sugarcane (34.36 days). Similar was the trend with female indicating that total lifecycle of male and female got shortened on maize and extended on sugarcane. Females lived longer than males irrespective of host plants. Plessis et al. (2020) observed a developmental time for the egg to adult as varying between 71.44 and 20.27 days at varying temperature. Maruthadurai and Ramesh (2020) observed a lifecycle duration of 24.60, 29.70, 30.60 and 30.20 days on fodder maize, Guinea grass, para grass and green amaranth, respectively. Kalyan et al. (2020) observed this to be 37.68 days on maize.

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