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Reproductive Performance of Fall Army Worm, *Spodoptera frugiperda* on some Maize Genotypes

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ABSTRACT: Studies on various reproductive parameters of *S. frugiperda* were carried out on eight maize genotypes, which included pre-oviposition, oviposition and incubation periods, number of egg mass/female, egg hatching and adult longevity. All the reproductive traits differed significantly among the genotypes. The mean fecundity, incubation period and egg hatching was found to be significantly highest on CHH-213 (1043.78 eggs/female, 2.43 days and 97.23%, respectively) and lowest on JM-218 (913.50 eggs/female, 2.97 days and 86.67 %, respectively).

Keywords: *Spodoptera frugiperda*, maize genotypes, reproductive traits, polyphagous.

INTRODUCTION

Zea mays L., a cereal crop of graminae family, is referred to as the "Queen of Cereal" due to its inherent high genetic yield potential. It can be converted through grinding, alkali processing, boiling, cooking and fermenting, into a variety of products such as corn starch, corn flakes and cereals, bioethanol, etc. (Kumar *et al.*, 2013; Malo and Hore 2020).

Maize crop is subjected to attack by over 141 insect pests during different crop growth stages. A host of pests, *viz.* stem borer, pink stem borer, aphids, cob borer *etc*. are found to be causing considerable loss in maize production both qualitatively and quantitatively (Siddiqui and Marwaha 1994). Fall army worm, *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae) is a polyphagous pest native to the America, recently it has been identified causing damage in India (Kalleshwaraswamy *et al.*, 2018; Chaithra *et al.*, 2020; Rajisha *et al*., 2021; Russianzi *et al*., 2021). This pest seemingly prefers a very wide host range, with over 80 plants recorded, but highly prefers the grasses *viz.* field corn, sweet corn, sorghum, bermuda grass and grass weeds such as crabgrass (Jamjanya, 1987; Santos *et al*. (2004); Barcelos *et al*. (2019). Fall armyworm (FAW) larvae feed on young whorls, ears and tassels causing substantial damage to maize crops (Prasanna *et al.*, 2018). Infestations during the mid- to late-whorl stage of maize development caused yield losses of 15-73% (Hruska and Gould 1997).

Studies on the reproductive parameters of insect pests are important as they provide insights for understanding aspects such as damage potential and population dynamics, as well as growth rate, fluctuation and spatial distribution, thus allowing the establishment of methods for control (Santos *et al*., 2004).

The aim of this study was to evaluate the impact of different maize genotypes on the reproductive parameters of adult *S. frugiperda*.

MATERIAL AND METHODS

Seeds of eight maize genotypes were obtained from All India Coordinated Research Project on Maize, Zonal Agriculture Research Station, Chhindwara, M.P. The crop was raised as per the recommended package of practices of the university, except the plant protection measures.

The initial culture of *Spodoptera frugiperda* was made by collecting large number of larvae from the farmers maize fields of Chhindwara. The larvae were reared individually in plastic boxes (3×7 cm) and the maize leaves of each genotypes were provided as food. The boxes were cleaned and fresh food was provided to larvae daily in the morning until pupation. The pupation took place among the leaves provided as food. After pupation, sexing of pupae was done as per Butt and Cantu (1962). The newly emerged, seven pair of male and female moths were released in plastic containers (15×16 cm) covered with muslin cloth held in position by rubber band. Cotton swabs dipped in 5 per cent honey solution were provided as food for adults. The blotting paper strips were hung from the muslin cloth covering at the top with the help of pins to provide a site for oviposition for the female moths. The F_2 generation was used for experimental studies on the respective genotypes (Farahani *et al.*, 2011).

The ovipositional sites were observed daily. Observations on pre-oviposition, oviposition and incubation periods, egg cluster/female, fecundity, hatching and longevity were recorded. The design of the experiment was completely randomized with eight treatments and replicated thrice. The significance of the treatments were computed by applying DMRT test.

Table 1: Maize genotypes.

Treatments Code	Genotypes
T_1	CHH-202
T_2	CHH-213
T_3	CHH-214
T_4	HMM-1018
T_5	HMM-1019
T_6	JM-216
T_7	JM-218
T_8	Pusa Jawahar Hybrid Maize-1

RESULTS AND DISCUSSION

Perusal of the data in Table 1 revealed that the difference in the pre-oviposition period and oviposition periods among different tested genotypes were non-significant and they varied from 3.39 (PHM-1) to 3.57 days (JM-218) and 2.66 (JM-218) to 2.76 days (CHH- 213), respectively. The present findings are in conformity with those by Murua and Virla (2004); Santos *et al.* (2004); Montezano *et al.* (2019); Russianzi *et al*. (2021). It was interesting to note that the genotypes where pre-oviposition period was high, there the ovipositional periods were low. The reduction in the oviposition period may be attributed to the interaction between egg production and metabolism (Montezano *et al.*, 2019).

Significant differences were observed in mean number of egg masses per female among the genotypes. It was highest on CHH-202 and CHH-213 (both registered 6.67 egg masses/female) followed by PHM-1, CHH-214 and JM-216 (6.17, 6.00 and 5.33 egg masses/female, respectively), but they did not differ significantly from each other. These were followed by HMM-1018, JM-12 and lowest on JM-218 (4.50, 4.17 and 3.83 egg masses/female), but statistically all were at par with each other. Similar findings have been reported by Santos *et al.* (2004) as they also reported that *S. frugiperda* larvae, when reared on maize cultivar ELISA, recorded 6.33 egg masses/female.

The data presented in Table 1 showed that difference in the mean number of eggs/egg mass among different genotypes were significant. It was highest on CHH-213 (369.20 eggs/female/cluster), but was statistically at par with CHH-202 and CHH-214 (325.57 and 305.38 eggs/female/cluster, respectively). These were followed by PHM-1 and JM-216 (278.43 and 254.16 eggs/female/cluster, respectively), but they did not differ significantly from each other. The next genotype was HMM-1018 (215.33 eggs/female/cluster) and was significantly higher than JM-12 (188.64 eggs/female/cluster). However, lowest was recorded on JM-218 (162.16 eggs/female/cluster).

The total number of eggs laid per female significantly ranged from 713.50 (JM-218) to 1043.78 (CHH-213). Genotype CHH-213 was followed by CHH-202, CHH-214 and PHM-1(1002.86, 946.88 and 906.85 eggs/female, respectively), but they did not differ significantly from each other. These were followed by JM-216, HMM-1018, JM-12 and JM-218 (853.93, 807.12, 760.31 and 713.50 eggs/female, respectively), but non-significant differences were observed among them. The present findings corroborates the findings of Santos *et al.* (2004) , as they also recorded an average of 1141 and 1106 eggs per female on maize cultivars BR-400 and BR PAMPA, respectively. The variability in the number of eggs laid per female may be due to the quantity and quality of food ingested and also the inherent natural fecundity of each individual female moth (Luginbill, 1928).

Data on incubation period given in Table 1 revealed that it differed significantly among the genotypes. Longest incubation period was observed on JM-218 (2.97 days), followed by JM-12, HMM-1018, JM-216 and PHM-1(2.86, 2.84, 2.76 and 2.69 days, respectively), but there was no significant difference among them. While, it was shortest on CHH-213 (2.43 days), but was at par with CHH-202 (2.56 days) and CHH-214 (2.61 days). The present findings are in conformity with those of Motezano *et al.* (2019); Rajisha *et al.* (2021) as they also recorded an average incubation period ranged from 2-3 days, similar to the values found in the present study as observed on the genotypes PHM-1 and CHH-214.

Data depicted in Table 2 exhibited that the mean egg hatching differed significantly among the genotypes. It was maximum on CHH-202 and CHH-213 (both recorded 97.23 %), followed by PHM-1 and CHH-214 (both registered 93.89%), but all were at par with each other. While, it was lowest on JM-218 (86.67%) but did not differ significantly with JM-12, JM-216 and HMM-1018 (89.45, 91.50 and 91.67%, respectively). In the present studies the mean egg hatching was slightly higher than the findings of Melo and Silva (1987) as they reported 94.7, 87.66 and 77.37 % on maize genotypes AG-28, P- 6872 and AG-64, respectively. The results of the present study indicates negative influence of the test genotype JM-218 on the egg hatching percentage, which may indicate slower.

Table 2: Influence of different maize genotypes on *S. frugiperda* reproductive traits.

Maize genotypes	Period (days)			Egg masses /♀	Total eggs/mass /♀	Fecundity /♀	Egg hatchbility (%) #	Adult longevity (days)*	
	Pre-oviposition	Oviposition	Incubation					Male	Female
CHH-202	3.43^{ab}	2.74^{a}	2.56^{cd}	6.67^{a}	325.57^{ab}	1002.86^{ab}	97.23^{a}	10.45^{a}	11.05^{b}
	(2.10)	(1.93)	(1.89)	(2.76)	(18.07)	(31.65)	(80.52)	(3.38)	(3.47)
CHH-213	3.41^{ab}	2.76^{a}	2.43^{d}	6.67^{a}	369.20^{a}	1043.78^{a}	97.23^{a}	10.46^{a}	11.44^{a}
	(2.10)	(1.94)	(1.85)	(2.77)	(19.16)	(32.25)	(82.19)	(3.38)	(3.53)
CHH-214	3.49^{ab}	2.74^{a}	2.61^{bcd}	6.00^{ab}	305.38^{ab}	946.88^{abc}	93.89^{b}	9.70^{b}	11.05^{b}
	(2.12)	(1.93)	(1.90)	(2.64)	(17.49)	(30.76)	75.8a	(3.27)	(3.47)
HMM-1018	3.51^{ab}	2.63^{a}	2.84^{ab}	4.50^{bc}	215.33^{cd}	807.12^{bcd}	91.67^{bc}	9.20^{c}	10.29^{c}
	(2.12)	(1.91)	(1.96)	(2.34)	(14.65)	(28.41)	(73.37)	(3.19)	(3.36)
JM-12	3.46^{ab}	2.74^{a}	2.86^{ab}	4.17^{c}	188.64^{d}	760.31^{cd}	89.45^{bc}	8.71^{d}	9.51^{d}
	(2.11)	(1.93)	(1.97)	(2.27)	(13.73)	(27.55)	(71.21)	(3.12)	(3.24)
JM-216	3.44^{ab}	2.74^{a}	2.76^{abc}	5.33^{abc}	254.16^{bc}	853.93^{abcd}	91.50^{bc}	9.58^{b}	10.32^{c}
	(2.11)	(1.93)	(1.94)	(2.51)	(15.97)	(29.19)	(73.22)	(3.25)	(3.36)
JM-218	3.57^{a}	2.66^{a}	2.97^{a}	3.83^{c}	162.16^{d}	713.50^{d}	86.67^{c}	8.69^{d}	9.49^{d}
	(2.14)	(1.91)	(1.99)	(2.20)	(12.76)	(26.73)	(68.61)	(3.11)	(3.24)
PHM-1	3.39^{b}	2.72^{a}	2.56^{cd}	6.17^{a}	278.43^{bc}	906.85^{abcd}	93.89^{ab}	9.70^{b}	11.05^{b}
	(2.09)	(1.93)	(1.89)	(2.67)	(16.71)	(30.09)	(76.12)	(3.27)	(3.47)
SEm±	0.015	0.01	0.02	0.102	0.677	1.026	2.01	0.02	0.01
CD at 5%	NS	NS	0.06	0.306	2.03	3.07	6.02	0.05	0.04

The means followed by the same letters in each column are non-significant (P<0.05, DMRT)
= Figures in parentheses are arcs in transformed values
* = Figures in parentheses are square root transformed values
NS = Non-significant

It is evident from Table 2 that there was a significant difference in the longevity of the male moths among the genotypes. It was maximum on CHH-202 (10.43 days) followed by CHH-213 (10.40 days), but were at par with each other. These were followed by CHH-214 (9.90 days), but they did not differ significantly from PHM-1 (9.64 days). The next two genotypes, JM-216 and HMM-1018 were at par with each other and longevity observed were 9.46 and 9.20 days, respectively. While, it was minimum on JM-218 (8.64 days) but did not differ significantly with JM-12 (8.67 days).

Female longevity was significantly maximum on HMM-1018 (10.55 days), followed by CHH-213, JM-216, JM-218 and CHH-202 (10.48, 10.47, 10.45 and 10.44 days, respectively), but non- significant differences were observed among them. While it was minimum on JM-12 (10.20 days) and was stastically at par with CHH-214 (10.30 days) and PHM-1 (10.39 days). The studies indicate that the longevity of the female moths were more than the males in each of the tested genotypes.

CONCLUSIONS

In vitro studies revealed that *S. frugiperda* successfully developed on some of the selected maize genotypes with varying fecundity which reflects a larger number of generations and consequently increase in the damage quantum.

Taking into account the importance of the promising genotypes identified, they can play an important role in influencing the FAW population. It would be necessary to screen them under natural conditions for confirming their performance.

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Conflict of Interest. None.

REFERENCES

Barcelos, L. M., Fernandes, F. O., Lopes, C., Emygdio, B. M., Valgas, R. and Carvalho, I. F. (2019). Biology and Nutritional Indexes of *Spodoptera frugiperda* (Lepidoptera: Noctuidae) in Saccharine Sorghum. *Journal of Agricultural Science, 11*(4): 126-135.

Butt, B.A. and Cantu, E. (1962). Sex determination of lepidopterous pupae. USDA ARS series, 33-75.

Chaithra, T. N., Udikeri, S. S ., Hugar, S. V. and Akbar, S. M. D. (2020). Food consumption and utilization pattern of fall armyworm (*Spodoptera frugiperda* J. E. Smith) in different genotypes of cotton. *Journal of Farm Science, 33*(4): 517-521.

Farahani, S. Talebi A. A. and Fathipour, Y. (2011). Life cycle and fecundity of *Spodoptera exigua* on five soybean varieties. *Journal of Entomological Society of Iran, 30*(2): 1-12.

Hruska, A. J. and Gould, F. (1997). Fall armyworm (Lepidoptera: Noctuidae) and *Diatraea lineolata* (Lepidoptera: Pyralidae): Impact of larval population level and temporal occurrence on maize yield in Nicaragua. *Journal of Economic Entomology, 90(*2): 611-622.

Jamjanya, T. (1987). Consumption, utilization, biology, and economic injury levels of fall armyworm, *Spodoptera frugiperda* (J. E. Smith), on selected bermudagrasses. Ph.d Thesis, Louisiana State University, Thailand. 139p.

Kalleshwaraswamy, C. M. Asokan, R. Mahadeva Swamy, H. M. Maruthi, M. S. Pavithra, H. B. Hegde, K. and Goergen G. (2018). First report of the Fall armyworm, *Spodoptera frugiperda* (J. E. Smith) (Lepidoptera: Noctuidae), an alien invasive pest on maize in India. *Pest Management in Horticultural Ecosystems*, *24*(1): 23-29.

Kumar, R. Srinivas, K. and Sivaramane N. (2013). Assessment of the maize situation, outlook and investment opportunities in India. Country Report – Regional Assessment Asia (MAIZECRP), National Academy of Agricultural Research Management, Hyderabad, India, pp:1-2.

Luginbill, P. (1928). The fall armyworm. United States Department of Agriculture. Technical Bulletin No. 34, pp. 94.

Malo, M. and Hore, J. (2020). The emerging menace of fall armyworm (*Spodoptera frugiperda* JE Smith) in maize: A call for attention and action. *Journal of Entomology and Zoology Studies*, *8*(1): 455-465

Melo, M. and Silva, R. F. P. (1987). Influence of three maize cultivars on the development of *Spodoptera frugiperda* (JE Smith, 1797) (Lepidoptera: Noctuidae). *Proceedings of the Entomological Society of Brazil, Porto Alegre, 16*(1): 37-49.

Montezano, D. G. Specht, A. Soja, E. Sosa-Gomez, D. R. Roque-Specht, V. F. Malaquias, J. V. Paula-Moraes, S. V. Peterson, J. A. and Hunt, T. E. (2019). Biotic potential and reproductive parameters of *Spodoptera frugiperda* (J. E. Smith, 1797) (Lepidoptera: Noctuidae). *Journal of Agricultural Science, 11*(13): 240: 252.

Murua, G. and Virla, E. (2004). Population parameters of *Spodoptera frugiperda* (Smith) (Lepdoptera: Noctuidae) fed on corn and two predominant grasess in Tucuman (Argentina). *Acta Zoologica Mexicana, 20*(1): 199-210.

Prasanna, B. M. Huesing Joseph, E. Eddy Regina and Virginia, M. P. (Eds) (2018). Fall armyworm in Africa: A Guide for Integrated Pest Management. First Edition. Mexico, CDMX: CIMMYT, pp: 1-10.

Rajisha, R. S., Muthukrishnan, N., Nelson, S. J., Jerlin S. J., Marimuthu, P. and Karthikeyan, R. (2021). Biology and nutritional indices of the fall army worm *Spodoptera frugiperda* (J E Smith) on maize. *Indian Journal of Entomology, 83*(2): 1-5.

Russianzi, W., Anwar, R. and Triwidodo, H. (2021). Biostatistics of fall armyworm, *Spodoptera frugiperda* in maize plants in Bogor, West Java, Indonesia. *Biodiversitas*, *22*(6): 3463-3469.

Santos, L. M. Redaelli, L. R. Diefenbach L. M. G. and Efrom C. F. S. (2004). Fertility and longevity of *Spodoptera frugiperda* (JE Smith) (Lepidoptera: Noctuidae) in maize genotypes. Rural Science, *34*(2): 345-350.

Siddiqui, K. H. and Marwaha, K. K. (1994). Pests associated with maize in India. In: Vistas of Maize Entomology in India. Kalyani Publishers, Ludhiana, India, pp: 3-16.

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