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IMPACT OF MAIZE GENOTYPIC VARIABILITY ON MORPHOMETRIC TRAITS OF FALL ARMYWORM (*SPODOPTERA FRUGIPERDA*)

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ABSTRACT

The Fall army worm, *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae), an important polyphagous insect pest, attacks 350 plant species in dozens of countries. In this study 50 larvae of *S. frugiperda* were measured on JM 218 (Highly susceptible) and CHH 213 (least susceptible genotype) maize genotypes. Results showed that the existence of six larval instars on both genotypes. The progressive growth in head capsule width (HCW) during successive instar follows Dyar's law, whereas the progressive growth in body length (BL) and body width (BW) showed deviation from the theory of Przibram and Megusar. In conclusion, progressive development in the *S. frugiperda* morphometric traits (HCW, BL and BW) were not affected by tested maize genotypes.

Key words : *Spodoptera frugiperda* larvae, Morphometric traits, Maize genotypes, Genotypic susceptibility.

Introduction

Determination of instar distribution can provide important information for pest management (Calvo and Molina, 2009). Spray applications usually are done during a particular stage of larval development to be effective. For example, Neem seed kernel extract a generalized botanicals against lepidopteran pests, generally is applied to coincide with population at the peak frequencies of 1st and 2nd instar larvae, to maximize treatment effects (Wakil *et al.*, 2012). Accurate determination of population age and phenology not only provide a tool for timing spray application, but also for explaining the reasons for treatment failures (Mc clellan and Logan, 1994). Morphometric methods are powerful research tools when used in the context of biological knowledge. According to Dyar (1980), head capsule width measurement provides a reliable estimate of the age of the larvae, because it shows minimal variation during intermolt.

Spodoptera frugiperda (FAW) is the most important noctuid pest in the Americas; recently it has been detected in Asian countries including India. It was first detected in India on 18th May 2018 in maize fields at the College of Agriculture, Shivamogga, Karnataka

(Sharanabasappa *et al.*, 2018) and later in Madhya Pradesh in March 2019 (Vishwakarma *et al.*, 2020). Since then, it has rapidly spread across all maize-growing states (Suby *et al.*, 2020). However, information about this invasive insect-pest is scarce in Indian condition. Currently, brief morphometric descriptions of the *S. frugiperda* larvae are available in the literature (Sharanabasappa *et al.* 2018 and Motezano *et al.* 2019), but no detailed morphometric studies have been found on different maize genotypes.

Hence, in the present study the morphometric variation of *S. frugiperda* larval exoskeleton was examined on JM-218 and CHH-213 maize genotypes under laboratory conditions.

Materials and Methods

Insect mass culture : Initially, late larval instars of *S. frugiperda* were collected from unsprayed maize fields of College of Agriculture, Jabalpur. Larvae were individually transferred to transparent plastic containers (3.5×2) and provided fresh maize leaves till pupation. Pupae were sexed and separated. Seven pair of male and female moth were placed in ovipositional plastic

Biometrical observations : Freshly moulted 30 larvae were killed in hot water (60°C temperature) HCW, BL and BW of each larva instar was measured with the help of ocular micrometer.

$$1). \text{ Growth ratio} = \frac{\text{Value of succeeding instar}}{\text{Value of preceeding instar}}$$
$$3). \text{ Difference (\%)} = \frac{\text{Difference}}{\text{Estimated value}} \times 100$$

Least susceptible genotype JM 218

The growth ratio in successive instar was also computed and the mean observed and estimated progression factors were 1.51 and 1.53, respectively. The

Table 1 : Comparison of the progressive development of *S. frugiperda* HCW on the highly and least susceptible maize genotypes.

Head capsule width for <i>S.frugiperda</i>											
JM-218 (Least susceptible)						CHH-213 (Highly susceptible)					
Instar	Observed	Growth ratio	Estimated	Difference	Difference %	Instar	Observed	Growth ratio	Estimated	Difference	Difference %
I	0.329	-	0.311	0.018	5.79	I	0.34	-	0.325	0.015	4.62
II	0.439	1.33	0.478	-0.039	-8.16	II	0.454	1.34	0.508	-0.054	-10.63
III	0.738	1.68	0.732	0.006	0.82	III	0.761	1.68	0.792	-0.031	-3.91
IV	1.084	1.47	1.122	-0.038	-3.39	IV	1.43	1.88	1.235	0.195	15.79
V	1.948	1.80	1.720	0.228	13.26	V	2.216	1.55	1.927	0.289	15.00
VI	2.473	1.27	2.636	-0.163	-6.18	VI	2.637	1.19	3.006	-0.369	-12.28
Progression factor	-	1.51	1.537	-	-	Progression factor	-	1.53	1.563	-	-

estimated and observed value of progression factors were very close to each other indicating that growth of larvae was in a definite progression factor. When log HCW plotted against number of instars, almost straight regression line was obtained, and the following regression equation was fitted:

$$\log_{10} Y = 0.185x - 0.691$$

It is evident from the data Table 2 that the BL increased from 1.61 to 32.46 mm in six instars. The observed and estimated progression factors were 1.84 and 1.79, respectively. The regression equation was:

$$\log_{10} Y = 0.254x + 0.012$$

The data presented in Table 3 showed that the mean BW for the first instar was 0.32 mm and it increased to 4.18 mm in the sixth instar. The geometrical progression factor was estimated 1.61 and regression equation obtained was:

$$\log_{10} Y = 0.208x - 0.521$$

The mean progression factor of observed and estimated BL and BW had shown a deviation from the value of 1.26 as required by Przibram's rule. Thus, the data obtained in the present investigation did not support Przibram and Megussar theory (Tables 2 and 3).

Highly susceptible genotype CHH-213

Data in Table 1 indicated that the average observed and estimated progression factor which was computed by taking the mean growth ratio which were observed to be 1.63 and 1.56, respectively. The observed head capsule width of 1st to 6th instar was 0.34, 0.45, 0.76, 1.43, 2.21 and 2.63 mm, respectively. The approximation of the data on observed and estimated head width as well as progression factors is evidence that no moult has been accidentally missed through the life cycle of this pest. The following regression equation was fitted:

$$\log_{10} Y = 0.193x - 0.680$$

Data depicted in Table 2 exhibited that the average body length for first to sixth instar larvae ranged from 1.72 to 34.74 mm, respectively. The mean observed and estimated progression factor obtained from the mean growth ratio for different instars was 1.85 and 1.78, respectively. The regression equation was fitted:

$$\log_{10} Y = 0.251x + 0.077$$

The observed and estimated geometrical progression factors were 1.82 and 1.60, respectively. Data on mean body width ranged from 0.33 to 4.34 mm with the calculated value 0.52 to 5.54 mm, respectively (Table 3). The regression equation for the six larval instars was:

$$\log_{10} Y = 0.204x - 0.480$$

Conclusion

In the present study, six larval instar of *S. frugiperda* noticed on tested genotypes. The sequential increase in HCW across instars exhibited a consistent geometric progression, in accordance with Dyar's Law. In contrast, the growth patterns of BL and BW did not align with Przibram's and Megusar rule, suggesting non-isometric development in these parameters. These findings indicate that the morphometric progression of *S. frugiperda* larvae was not influenced by the maize genotypes.

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