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Fecundity Study of *Spodoptera exigua* (Hübner) (Lepidoptera: Noctuidae) on Various Host Plants

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Abstract: This study has shown that the *S. exigua* female fecundity was influenced by the host plant which was fed during the larval stage. The number of eggs laid by the female when larvae were fed on shallot was higher than lady's finger. Whereas *S. exigua* reared on cabbage and long beans laid intermediate number of eggs. Further, the female pupal weight was also influenced by the host plant which was fed during the larval stage. The female pupal weight was heavier when larvae were fed on shallot than on cabbage and lady's finger, whilst long beans was intermediate. Furthermore, there are significant relationships between female pupal weight and adult fecundity.

Key words: *S. exigua*, fecundity, host plant, pupal weight

Introduction

A phytophagous insect's development, longevity and fecundity may be affected by the species and condition of host plant on which the insect feeds (Andrewartha and Birch, 1954). Undoubtedly, that the host plant and fecundity relationship is the basic and an important component for understanding the *S. exigua* population dynamic. Nevertheless, few information on *S. exigua* fecundity on a particular host plant were reported in the literature despite of its status of being a serious pest of numerous cultivated and wild plants throughout the world. Some examples of individual reported fecundity are 52 to 1631 eggs with 630.8 per female when reared on castor bean (Afify *et al.*, 1970); an average of 520 eggs per female when reared on citrus (Atkins, 1960); ranged from 1019.8 in pepper to 1310.3 in pigweed (Greenberg *et al.*, 2001); 282 to 1307 eggs when reared on chilly (Khalid Ahmed *et al.*, 1997); an averaged of 472.5 eggs per female when reared on soybean (Abdullah *et al.*, 2000) and a largest number of eggs laid by a single female of *S. exigua* was 1171 and the smallest number was 18, with an average number of eggs deposited by 45 females was 516.55 eggs per female (Wilson, 1932). However, Wilson (1932) did not stated the host plant species, as some others (Huffman *et al.*, 1996; Capinera, 1999).

There is not much information on the effect of host plant on the pupal weight of *S. exigua* except by Greenberg *et al.* (2001). Besides that, female pupal weight was strongly influenced the fecundity (Beckwith, 1976; Brewer *et al.*, 1985; Greenberg *et al.*, 2001; Hough and Pimentel, 1978). Where, regression analysis have indicated a significant relationship between pupal weight and adult fecundity (Greenberg *et al.*, 2001). Hence, objectives of the present study are to determine (a) the fecundity of *S. exigua* on various host plants, (b) the effect of host plant on the female pupal weight and © the relationship between female pupal weight and fecundity.

Materials and Methods

The fecundity of females was study in a laboratory condition with the temperature and relative humidity ranged from 24-26°C and 56-84%, respectively. Pupae developed from larvae reared on a

tested host plant (i.e., cabbage, shallot, long beans and lady's finger) were sexed and kept in a plastic container [9.5 cm (top diam) × 6.5 cm (bottom diam) × 12.5 cm] with a hole (4 cm diam) on the top which was cover with muslin cloth individually until their emergence. The male pupae were distinguished by a pair of prominent protuberances on the ventral midline of the ninth sternite, which female lack. The female pupae were weighted using an electronic analytical balance (Mettler Toledo- Dragon 204) to the nearest 0.0001 g. Newly emerged females and males from the same host plant were confined as a pairs in a rearing jar with a muslin top. The adults were fed with 10% of honey which was soaked in a cotton ball. The rearing jars were examined daily to record the number of eggs laid until the death of the female. Whereas the male was removed at death and not being replaced. This experiment was repeated 12 times for shallot and lady's finger, 13 times for cabbage and 14 times for long beans.

Data Analysis

One way ANOVA (STATISTICA 6.0; StatSoft Inc., 1984-2001) were performed to detect effects of host plant on fecundity of *S. exigua* females. When significant F-values were obtained, means were separated using the Duncan's multiple range test. Data for the number of eggs and female pupal weight were square-root and double square-root transformed, respectively before the ANOVA in order to homogenize the variance.

For each of the host plant, a simple linear regression analyses was used to examine the relationship between female pupal weight and its fecundity.

Results

There was a significant difference ($F = 3.76$; $df = 3,46$; $p < 0.05$) in the fecundity of *S. exigua* female among treatments (Table 1). The number of eggs laid by the female when larvae were fed on shallot was significantly higher ($p < 0.05$) than lady's finger. Whereas *S. exigua* reared on cabbage and long beans laid intermediate number of eggs. Relatively, larvae reared on shallot have the highest minimum and maximum number of eggs produced compared to the other host plants (Table 2). The highest maximum number of egg clutch was produced by female when larvae were reared on shallot, while the highest minimum number of egg clutch was produced by female when larvae were reared on long beans relatively (Table 2).

There was a significant difference ($F = 3.69$; $df = 3,47$; $p < 0.05$) in the female pupal weight among treatments (Table 1). The female pupal weight was significantly heavier ($p < 0.05$) when larvae were fed on shallot than on cabbage and lady's finger, whilst long beans was intermediate.

Table 1: Fecundity and pupal weight of *S. exigua* female reared on various host plants

Host plant	No. of eggs laid (Mean±SE)	Pupal weight, g (Mean±SE)
Cabbage	499.0±68.32ab	0.0408±0.0041 a
Shallot	629.5±73.16b	0.0567±0.0056b
Long beans	442.7±65.58ab	0.0456±0.0036ab
Lady's finger	320.8±41.99a	0.0386±0.0020a

* Mean accompanied by the same letter within test or column are not significantly different

Table 2: Number of eggs laid and number of clutch produced by *S. exigua* female reared on various host plants

Host plant	Total No. of eggs laid		Total No. of egg clutch	
	Min.	Max.	Min.	Max.
Cabbage	210	866	3	72
Shallot	241	1022	15	116
Long beans	76	934	20	46
Lady's finger	59	549	9	57

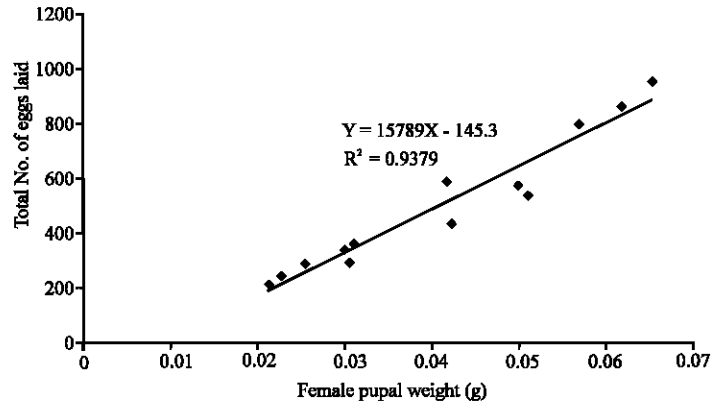


Fig. 1: Female pupal weight vs number of eggs laid for larvae feed on cabbage

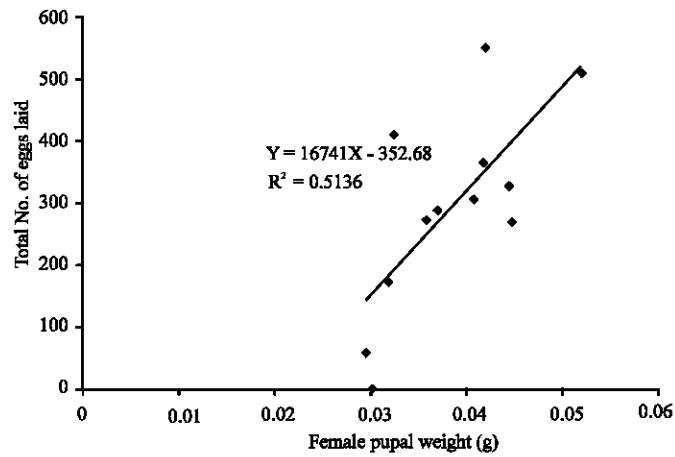


Fig. 2: Female pupal weight vs number of eggs laid for larvae feed on lady's finger

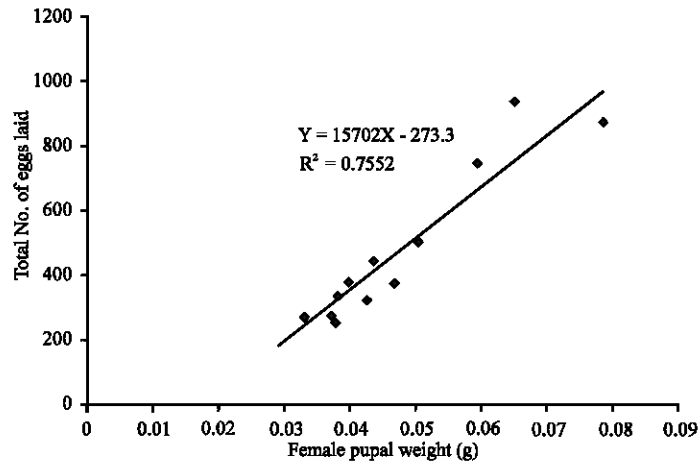


Fig. 3: Female pupal weight vs number of eggs laid for larvae feed on long beans

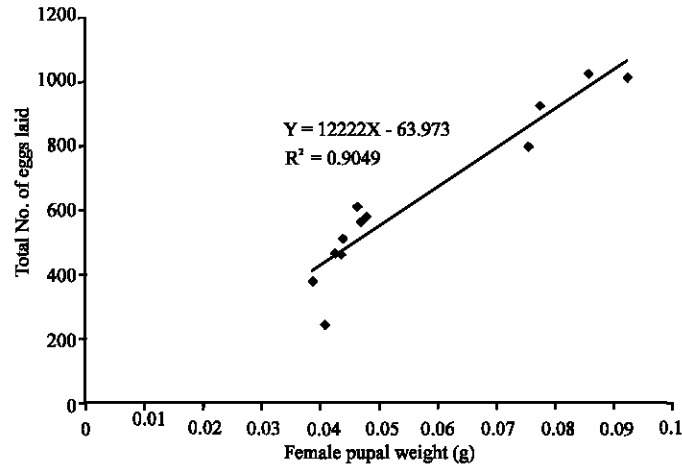


Fig. 4: Female pupal weight vs number of eggs laid for larvae feed on shallot

Regression analyses also showed that there are significant relationships between female pupal weight and adult fecundity (Fig. 1-4). This shows that the female pupal weight strongly influenced the fecundity and explained 51 to 94% of the variance in fecundity. Furthermore, this study has found that when a larva was fed on shallot, its pupal weight was heavier compared to the other larvae that were fed on cabbage and lady's finger, while long beans was intermediate. Hence, it is coherent that the female reared on shallot laid more eggs, whilst female from lady's finger laid the least eggs. Nevertheless, female reared on cabbage laid intermediate number of eggs.

Discussion

This study has shown that the *S. exigua* female fecundity was influenced by the host plant species eaten during its larval stage. Besides that, the host plant also affects the female pupal weight. Moreover, the female pupal weight was found affecting the adult fecundity. This occurrence was supported by Meade and Hare (1991) who stated that because the larval host can effect pupal weight and because the pupal weight has some influence on the initial complement of the oocytes (Tisdale and Sappington, 2001), the quality of the larval diet is likely affects the adult fecundity (Tisdale and Sappington, 2001). However, Greenberg *et al.* (2001) reported that there was no significant different in fecundity when *S. exigua* larvae were reared on cabbage, cotton, pepper, pigweed and sunflower. Nevertheless, we can presumed that the number of eggs laid by the female of *S. exigua* relatively varies with their larval host plant or diet, as being stated earlier Thus, this contradiction needs further investigation.

Since there is scarce or no information on the fecundity of *S. exigua* reared on the studied host plants, it is difficult to make a comparison. The only comparable data on *S. exigua* fecundity is from Greenberg *et al.* (2001), i.e., an averaged of 1125 eggs reared on cabbage. Their result was much higher than the result of this study (i.e., an averaged of 499 eggs). Thus, the result of this study could be additional information for further exploration.

The female pupal weight of *S. exigua* also was influenced by the host plant species as shown in this study. This occurrence was supported by Greenberg *et al.* (2001) who reported that the pupal weight was highest on pigweed, followed by cabbage, cotton and pepper and lowest on sunflower. Further, Berdegué *et al.* (1998) also have found that pupal weight was significantly heavier on celery (*Apium graveolens*) than common weed (*Chenopodium murale*). However, the pupal weight on

cabbage in this study (i.e., an averaged of 40.8 mg) was lower compared to Greenberg *et al.* (2001) (i.e., an averaged of 103 mg). The difference could be due to the cultivar or variety of the cabbage plant used. This was supported by Meade and Hare (1991), Yoshida and Parrella (1992), Syed and Abro (2003), who demonstrated that pupal weight was found to vary with cultivar.

Greenberg *et al.* (2001) also reported that within each host plant treatment (i.e., cabbage, cotton, pepper, pigweed and sunflower), increased pupal weight resulted in increased fecundity, which is compatible with the present study. This phenomenon is also supported by Syed and Abro (2003) who have found a significant relationship between the number of eggs per female and pupal weight of *Plutella xylostella* on different host plants.

Besides that, Leather (1988) affirmed that in Lepidoptera, increased fecundity is correlated with increased longevity, which in turn affected by extrinsic factors such as adult food supply and temperature. Tisdale and Sappington (2001) also stated that fecundity was affected by the adult diet. Adult diet significantly affected beet armyworm female longevity, the duration of the oviposition period and both realized and potential fecundity. Carbohydrates in the diet significantly increased these parameters over a water only diet. Female longevity was greatest among those fed the honey solution (17 days) (Tisdale and Sappington, 2001). In this study, the adult diet was honey solution. So, there should not be any influenced on the fecundity based on the adult diet.

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