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Influence and Mechanism of Different Host Plants on the Growth, Development and, Fecundity of Reproductive System of Common Cutworm *Spodoptera litura* (Fabricius) (Lepidoptera: Noctuidae)

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Abstract: The present study was aimed to explore the influence and mechanism of different host plants on the growth, development and fecundity of the reproductive system of the common cutworm *S. litura* to understand host suitability of plant infesting insect species to make progress in efficient strategies to control this economic pest. The influence of different host plants on larval, pupal developmental duration, adult life (longevity) and fecundity of the *Spodoptera litura* were investigated in the laboratory. The results revealed that the larval development was significantly ($p<0.05$) decreased to (15.55) days when larvae fed on cabbage while it was significantly ($p<0.05$) prolonged to (19.55), (20.18) days when larvae fed on cowpea and alligator weed. Pupal duration was significantly ($p<0.05$) reduced to (7.54) days and increased to (9.13) days when larvae fed on cabbage and alligator weed respectively. When larvae fed on different host plants adult duration (longevity) was not significantly different, only when *S. Litura* larvae fed on sweet potato and cowpea the adult longevity was significantly ($p<0.05$) different and it was about (6.92), (5.64) days when larvae fed on sweet potato and cowpea respectively, Pupal weight was significantly ($p<0.05$) increased to (0.28) g when the larvae fed on cabbage while it was significantly ($p<0.05$) decreased to (0.16) g when larvae fed on cowpea. Our results found when both 1st and 3rd day age of adult female dissected ovarian length was significantly ($p<0.05$) increased when larvae fed on cabbage, cotton, sweet potato, while it was significantly ($p<0.05$) reduced when larvae fed on soybean and cowpea and alligator weed respectively. Ovarian weight was also significantly ($p<0.05$) influenced by the different host plants at both 1st and 3rd day age. As well as the male accessory gland length for both age was significantly ($p<0.05$) increased to (5.45), (5.62) cm when larvae fed on cabbage while it was significantly ($p<0.05$) reduced to (3.20), (3.73) when larvae fed on cowpea .the results also showed that the 3rd day age mating insects its accessory gland length was shorter. Similarly we found that the ovarian weight has the same trend for both age where the weight was significantly ($p<0.05$) influenced by different host plants however at the paired of 3rd day age insects the weight was lower. In addition spermary fresh weight for both age was also significantly increased to (3.23), (2.83) mg while it was reduced (2.17), (1.63) mg when larvae fed on cabbage and alligator weed respectively .Similarly the spermary weight was more reduced at the mated of 3rd day age adult .We conclude that cabbage and cotton and sweet potato were found to be more preferred for *S. litura* life than soybean and cowpea and alligator weed however; the implications for these findings need to be more discussed to control *S. litura.*

Key word: Development, growth, fecundity, reproductive system, *Spodoptera litura*

INTRODUCTION

Spodoptera litura (Fabricius) (Lepidoptera: Noctuidae) is polyphytophagous, damaging numerous vegetables and field crops in China and many other Asian countries (Shu, 1959; Hill, 1975; Shivayogeshwara, 1991). Although it had been a sporadic pest of tobacco in northern China for many years, it has been becoming gradually a very important insect pest in recent years (Guan and Chen, 1999; Gao *et al*., 2004; Qin *et al*., 2004). The leafworm, *Spodoptera litura* causes economic losses of crops from 25.8-100% based on crop stage and its infestation level in the field (Dhir *et al*., 1992). It has a large host range of more than 120 host plants including crops, vegetables, weeds and ornamental plants (Ramana *et al*., 1988). It feeds gregariously on leaves leaving midrib veins only. It also becomes resistant to many commonly used insecticides, particularly pyrethroids and carbamates, resulting in failure of effective controls (Wu *et al*., 1995; Kranthi *et al*., 2002; Ahmad *et al*., 2007;

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Huang and Han, 2007). An effective time and money saving management practice adopted by the farmers is the utilization of insecticides to control which needs right time, doses and application tools for its proper control. therefore the knowledge of the life parameters of S. *litura* and understanding components of its fundamental life history on different host plant species may will help to make progress in efficient strategies to control this economic pest (Greenberg *et al*., 2001; Tisdale and Sappington, 2001).

In regard to insect-host plant interactions, it is very useful to determine the influence of different host plants/cultivars on the performance of herbivores (Azidah and Sofian-Azirun, 2006; Saeed *et al*., 2009).

Host plant quality is a key determinant of the fecundity of herbivorous insects.also affects insect reproductive strategies: Egg size and quality, the allocation of resources to eggs, and the choice of oviposition sites may all be influenced by plant quality, as may egg or embryo resorption on poor-quality hosts (Caroline *et al*., 2002). Therefore study of the influence of different host plants on the growth and development and fecundity of insects is very useful to understand host suitability of plant infesting insect species. Therefore the knowledge of ovarian development can help us to better forecast a pest's potential for crop damage and use the information obtained on ovarian dynamics to improve our ability to predict a pest insect population's attack potential over time and space. Information on egg production is pertinent to construction of population models that aid in the development of management strategies such as pesticide spraying and trap deployment schedules. It has implications for sterile release programs, as well as the design and implementation of plant- or crops-mimicking traps for monitoring or suppressing populations.

There have been a number of studies on the biological parameters of *S. litura* on different host plants under different environmental conditions, particularly in India (Patel *et al*., 1986, 1987), Pakistan (Ahmad *et al*., 2007), China (Guan and Chen, 1999; Zhu *et al*., 2000; Qin *et al*., 2004; Zhu *et al*., 2005; Bae *et al*., 1997; Bae, 1999a, b; Bae and Park, 1999), and other Asian countries (Etman and Hooper, 1979; Holloway, 1989) where *S. litura* has been an important pest on various crops. However, not all of these studied the effects of the same host plants on growth, development, fecundity, survival, pupal weight and oviposition of *S. litura* under the same environmental conditions. Many factors including adult immigration and emigration, quality and availability of different host plants, especially alternate hosts, and distribution and community composition of natural enemies contribute to fluctuations in *Spodoptera species* such *S. exigua* population (Tisdale and Sappington, 2001). Larval survival and development can be reduced on poor-quality hosts due to nutritional composition and/or secondary plant metabolites (Herms and Mattson, 1992; Slansky, 1992). Nutritional composition and secondary plant metabolites vary among different plants, plant parts and developmental stages (Nelson *et al*., 1981; Brower *et al*., 1982). Different host plants can also play an important role in population increase and outbreaks of polyphagous insect pests (Singh and Parihar, 1988). Population parameters are important in the measurement of population growth capacity of species under specified conditions (Southwood and Henderson, 2000). Very few studies have been evaluated on the influence of different host plant on growth and development and fecundity of *S. litura* while several researches have evaluated about host plant influences on life history traits of *S. exigua* (Azidah and Sofian-Azirun, 2006; Saeed *et al*., 2009). However, published information by above-mentioned researchers has been variable. Therefore, the objectives of the present study were to investigate these life parameters of *S. litura* reared on different host plants.

MATERIALS AND METHODS

Tested insects: Insect use in the research where from a laboratory culture *S.litura,* which established from adults collected from the Institute of Plant Protection (IPP), Chinese Academy of Agricultural Science (CAAS)

Tested host plant: Cabbage: *(Brassica oleracea var. capitata*), Soybean (*Glycine max*), Cowpea (*Vigna unguiculata*), Sweet potato (*Ipomoea batatas*), Cotton (*Gossypium* spp.), alligator weed; Alternative (*Alternanthera philoxeroides*).

Rearing conditions: The culture was routinely maintained on soybean based artificial diet at standard conditions, of 27±5ºC, 75±5ºC% r.h. and 12:12 (L.D) photoperiods in growth chambers using LRH-250-G illumination incubators in the laboratory of Plant Protection Faculty of Horticulture and Plant Protection, Yangzhou University in 2009.

After the pupation, pupae were collected and Put in four walls wooden cage (40×40×cm) covered by thin gauze, each cage put 40-50 pupa, as soon as the adults emerged, wax paper was used around the internal wall cage to let the adults copulate and oviposit freely, 10% honey water solution was used when the nutrition was needed, the egg masses oviposited on the paraffin wax papers collected and put in the culture dishes in illumination incubator under the above conditions, hatched larvae were put in fresh host leaves culture dishes (diameter 10 , 15 cm), each culture dish put about 20-30 larva, every day at the at the same time replace the host plant leaves by fresh leaves and observe the larva growth

situation and record the details for larvae development duration and latter when larvae grown up each culture dish maintained five larva, until pupation, the pupal duration also observed and the pupae weighed using electronic scale then put each one in toothpick box (4 cm diameter, 6cm height) then put them in plastic tray in constant temperature . After the emergence each male and female were put in glass jar (10 cm diameter, 12 cm height) and allowed to copulate, the glass jar was covered by thin gauze, and the circular wall was lined by paraffin wax papers. Absorbent cotton ball dipped with 10% honey water solution and put on the gauze upper extreme to allow them to take the diet supplement and have a good nutrition, to copulate and oviposit freely. Every day the insects were observed and the oviposited egg masses were collected and put in culture dishes again, the adults allowed to continue the copulation until the female stopped the oviposit and ault life also observed.

Adult female ovary dissection: Anatomical lens changed continuously, dissection cake wax, dissection tweezers, insect needle, dissecting needle and dissecting scissors have been used in the experiments. *Spodoptera litura* adult were taken and fixed with the needles on the cake wax, the wings were fixed by needles or pins then the adult was dissected. The clear water was poured into the cake wax to immerse the insect body, then use the scissor to cut longitudinally, after that the rear part of *Spodoptera litura* adult was opened to the chest making shape aperture. Then the body wall was pulled out with the needles and both sides were fixed to reveals the reproductive system, and process the body fats as far as possible. then the ovary's trachea was destroyed by the needles, and the ovarian tube was pulled outside the abdomen gently and divided into two parts on the cake wax, the moisture was removed carefully using filter paper then the mature egg grains conditions were observed and the ovary length and fresh weight for adult female 1st day age, 3rd day age were measured after dissection to determine the ovary development progress classification.

Adult male reproductive accessory glands and spermary dissection: Followed method on the adult male of *S. litura* were conducted where the reproductive system was gently pulled out to separate the accessory gland and spermary carefully. The water was absorbed carefully by filter paper to remove the moisture, then the accessory gland length and weight as well as the spermary fresh weight for adult male 1st day age, 3rd day age and 3rd day age mated adult were determined.

Data analysis: All the life parameters of *S. litura* obtained data have been carried on the variance analysis one-way with the DPS data analysis system Means associated with host plants for each variable were separated using the least significant difference test when significant values were obtained

RESULTS

Influence of different host plant on the growth and development:

Influence of different host plant on the growth and development duration of *Spodoptera litura*: Our results showed that the different host plants on the growth and development of *Spodoptera litura* had a significant ($p<0.05$) influence, where the larva duration was significantly ($p<0.05$) decreased when the larvae fed on cabbage leaves and it was about (15.55±0.16) days. during the feeding of *S. litura* larvae on the cotton and sweet potato development duration was significantly ($p<0.05$) short, and it was an average (15.73± 0.24), (15.82±0.18) days respectively, when *S. litura* larvae fed on cowpea and alligator weed, larval development duration was prolonged to (19.55±0.3) and (20.18±0.12) daysrespectively. When the larvae were fed on cabbage and alligator weed there was significant ($p<0.05$) difference between larval development duration for both of them and it was (4.63) days. After the feeding on different host plants, larval development of *S. litura* from the long to short was as follow: Alligator Weed > Cowpea > Soybean> Sweet Potato> Cotton > Cabbage. Also when the larvae fed on cabbage, *S. litura* pupal duration was only (7.54± 0.14) days, while when larvae fed on alligator weed, pupal duration was significantly ($p<0.05$) increased to (9.13±0.24) days. After the feeding on different host plants, *S. litura* pupal developmental duration from the long to short was as follow: Alligator weed> Cowpea> Soybean> Cotton> Sweet Potato> Cabbage. When larvae fed on different host plants *S. litura* adult development duration (longevity) was not significantly different, only when *S. litura* larvae fed on sweet, potato and cowpea the adult longevity was significantly ($p<0.05$) different and it was about (6.92±0.18) days when larvae fed on sweet potato, meanwhile cowpea was significantly ($p<0.05$) reduced adult life to the shortest duration with an average (5.64±0.32) days , and the adult life from the long to the short was as follow: Sweet Potato> Cotton> Cabbage> Soybean> Alligator Weed >Cowpea as shown in the Table 1.

Influence of different host plant on the pupal weight of *Spodoptera litura*: When *S. litura* fed on different host plants, the pupal weight was significantly ($p<0.05$) different, when larvae fed on cabbage pupal weight was significantly ($p<0.05$)

Table 1: Influence of different host plant on the development duration of *Spodoptera litura*

Host plant	Larva duration /d	Pupa duration/d	Adult life /d
Cabbage	15.55±0.16dc	7.54±0.14dD	6.33±0.31abcAB
Cotton	15.73±0.24dC	8.00±0.11cdCD	6.62±0.24abAB
Soybean	17.09±0.16cB	8.43±0.14BbcC	6.07±0.27bcAB
Cowpea	19.55±0.34bA	8.71±0.19abAB	5.64±0.32cB
Sweet potato	15.82±0.18dC	8.08±0.14BcCD	6.92±0.18aA
Alligator Weed	20.18±0.12aA	9.13±0.24Aa	5.93±0.18bcB

*: The data in the table are means ± SE, and the different small and capital letters followed indicate siganificant difference at p<0.05 and p<0.01 by LSD test, respectively

Table 2: Influence of different host plant on the pupa weight of *Spodoptera litura*

Host plant	Pupa weight /g/ head
Cabbage	0.2798±0.0067aA
Cotton	0.2365±0.0085bB
Soybean	0.1866±0.0063cC
Cowpea	0.1602±0.0039dD
Sweet potato	0.2369±0.0057bB
Alligator weed	0.1648±0.0061dCD

*: The data in the table are means ± SE, and the different small and capital letters followed indicate siganificant difference at p<0.05 and P<0.01 by LSD test, respectively

increased to (0.2798±0.0067) g, while the weight was significantly (p<0.05) decreased when larvae fed on cowpea where the weight reduced to (0.1602± 0.0039) g only. During the feeding of *S. litura* on different host plants, the pupal weight according to the severity feeding was as follow: Cabbage> Sweet Potato> Cotton> Soybean> Alligator Weed> Cowpea (Table 2)

Influence of different host plants on the fecundity of *Spodoptera litura*:

Influence of different host plants on the reproductive system of *Spodoptera litura* Female:

Influence of different host plants on the ovary length of *Spodoptera litura*: The different host plants on the ovarian tube of the adult female of *S. litura* has a significant (p<0.05) influence. When larvae fed on different host plants, the 1st day age of *S. litura* ovarian tube length from the long to short was as follow : Cabbage> Cotton> Sweet Potato>Cowpea>Soybean> Alligator, while the 3rd day age ovarian tube length from the long to the short was as follow: Cabbage> Cotton>Sweet Potato> Soybean> Alligator Weed > Cowpea. During the feeding of *S. litura* on the host plants such as cabbage, cotton, sweet potato, soybean and cowpea and alligator weed ovarian tube length at 3rd day age after the emergence was generally higher than the length of the 1st day age but the difference was not significant (Table 3)

Influence of different host plants on the ovary fresh weight of *Spodoptera litura*: The different host plants on the ovary fresh weight of *S. litura* adult female has a significant (p<0.05) influence. When larvae fed on different host plants, at 1st day old ovarian fresh weight

Table 3: Influence of different host plants on the ovary length of *Spodoptera litura*

Ovary tube length / Cm	1st day age	3rd day age
Cabbage	3.10±0.15aA	3.53±0.15aA
Cotton	2.93±0.19aA	3.13±0.03abAB
Soybean	1.64±0.07bcBC	2.56±0.10BcC
Cowpea	1.92±0.04bB	1.99± 0.06dC
Sweet potato	2.87±0.14aA	3.03±0.13bAB
Alligator weed	1.37±0.12cC	2.16±0.20cdC

*: The different small and capital letters indicate significant difference at p<0.05 and p<0.01 by LSD test, respectively

Table 4: Influence of different host plants on the ovary fresh weight of *Spodoptera litura*

Ovary fresh weight / g	1st day age	3rd day age
Cabbage	0.0753±0.0022aA	0.0870±0.0069aA
Cotton	0.0670±0.0024bA	0.0701±0 .0040bAB
Soybean	0.0422±0.0017cB	0.0485±0.0035cBC
Cowpea	0.0273±0.0024dC	0.0338±0.0044dC
Sweet Potato	0.0673±0.0059abA	0.0682±0.0037bB
Alligator weed	0.0217±0.0022dC	0.0300±0.0026dC

*: The different small and capital letters in the fig indicate significant difference at p<0.05 and p<0.01 by LSD test, respectively

classified according to the big weight as follow: Cabbage>Sweet Potato> Cotton> Soybean> Cowpea> Alligator Weed, while the 3rd day age female ovarian tube fresh weight ordered from the big to small weight as follow : Cabbage> Cotton> Sweet Potato> Soybean> Cowpea> Alligator Weed (Table 4).

Influence of different host plants on the reproductive system of *Spodoptera litura* male:

Influence of different host plants on the male reproductive accessory gland length of *Spodoptera litura*: The results revealed that at the 1st and 3rd day age of *S.litura* accessory glands were significantly (p<0.05) the longest when larvae were fed on cabbage, sweet potato and cotton respectively and they were longer than the accessory glands when the larvae were fed on soybean, cowpea and alligator. at the 1st and 3rd day age when larvae fed on the cabbage the accessory gland has reached to the highest length (5.45±0.13), (5.62± 0.07) cm for both age respectively, while at the alligator weed the accessory glands were significantly (p<0.05) the lowest with average (3.20± 0.09), (3.73±0.26) cm respectively. Also our data reveled that the insects which fed on different host plant for the 3rd day age its reproductive

Table 5: Influence of different host plants on the male reproductive Accessory glands length of *Spodoptera litura*

Accessory glandlength / cm	1st day age	3rd day age	Pairs of 3rd day age
Cabbage	5.45±0.13aA	5.62±0.07aA	4.13±0.23aA
Cotton	4.98±0.41abA	5.22±0.14abA	3.98±0.29abAB
Soybean	4.60±0.26bcA	B4.90±0.21bcAB	3.83±0.15abAB
Cowpea	3.97±0.20cBC	4.38±0.09cBC	3.38±0.09bcAB
Sweet potato	5.37±0.09aA	5.48±0.25aA	4.10±0.25aA
Alligator weed	3.20±0.09dC	3.73±0.26dC	2.97±0.19cB

*: The different small and capital letters in the fig indicate significant difference at p<0.05 and p<0.01 by LSD test, respectively.

Table 6: Influence of different host plants on the male reproductive accessory glands fresh weight of *Spodoptera litura*

Accessory glandsfresh weight mg	1st day age	3rd day age	Pairs of 3rd day age
Cabbage	4.80±0.17aA	7.90±0.62aA	4.67±0.09aA
Cotton	4.17±0.15bA	7.00±0.80abAB	4.20±0.15aA
Soybean	3.27±0.12cB	5.50±0.40bcBCD	3.17±0.20bB
Cowpea	2.70±0.15dBC	4.33±0.44cCD	2.76±0.22bcB
Sweet potato	4.13±0.20bA	6.50±0.21abABC	4.17±0.20aA
Alligator weed	2.57±0.12dC	4.00±0.53cD	2.53±0.15cB

*: The different small and capital letters in the fig indicate significant difference at p<0.05 and p<0.01 by LSD test, respectively

Table 7: Influence of different host plant on the spermary fresh weight of *Spodoptera litura* Adult male

Spermary fresh weight / mg	1st day age	3rd day age	Pairs of 3rd day age
Cabbage	3.23±0.17aA	2.83±0.20aA	1.93±0.09aA
Cotton	3.00±0.14aAB	2.47±0.09abAB	1.73±0.07abcAB
Soybean	2.57±0.14bBC	2.40±0.06bAB	1.47±0.12bcAB
Cowpea	2.53±0.07bC	1.93±0.09cBC	1.37±0.09cB
Sweet potato	3.18±0.10aA	2.63±0.12abA	1.77±0.20abAB
Alligator weed	2.17±0.06cC	1.63±0.15cC	1.43±0.12bcAB

*: The different small and capital letters indicate significant difference at p<0.05 and p<0.01 by LSD test, respectively

accessory gland was more growing compared to 1st day age, but the difference was not significant (p>0.05), also we have found that the mating of 3rd day age insect, the length of reproductive accessory gland was shorter than 1st and 3rd days age as shown in the (Table 5).

Influence of different host plants on the male reproductive accessory gland fresh weight of *Spodoptera litura*: The results disclosed that the different host plants on male reproductive accessory gland fresh weight has a significance (p<0.05) influence. After the feeding on different host plant *S. litura* accessory gland fresh weight for both 1st and 3rd day age was from the big to small as follow Cabbage>Cotton>Sweet Potato> Soybean>Cowpea> Alligator Weed. The results here indicated that the influence of different host plants on the male reproductive accessory glands fresh weight for both age has the same tendency However; the 3rd days age insect without mating, the accessory glands fresh weight was greater than 1st day age, Also our data showed that the 3rd days age male mating accessory gland fresh weight was lower than unmated males as shown in the Table 6.

Influence of different host plant on the spermary fresh weight of *Spodoptera litura* adult male: The results reveled that the different host plant on the spermary fresh weight of *S. litura* has a significance (p<0.05) influence, After the feeding on different host plants for both 1st and 3rd day age, spermary was ordered from the big to the small weight as follow : Cabbage> Sweet Potato> Cotton>Soybean> Cowpea> Alligator Weed. The feeding on the cabbage, cotton, sweet potato at 1st day and 3rd day age spermary fresh weight was higher than the weight when the larvae fed on soybean, cowpea and alligator. As well as when larvae fed on the cabbage at the 1st and 3rd day age the spermary weight was significantly (p<0.05) the highest withaverage (3.23±0.17),(2.83±0.20) mg, respectively, while the weight was significantly (p<0.05) reduced to (2.17±0.06), (1.63±0.15) mg when the male larvae fed on Alligator weed. Generally the spermary fresh weight was more decreased at the pairs of 3rd day age compared to the 1st and 3rd day age (Table 7).

DISCUSSION

The role of host plant is an im portant factor in regulating insect population (Umbarihowar and Hastings, 2002) as the life cycle characteristics of herbivores may be affected by variation in host plant traits, for example the life history parameters longevity, fecundity and survival may be influenced by the variation in host plant quality (Awmack and Leather, 2002). The present study demonstrated that the life parameters of *Spodoptera litura* were significantly (p<0.05) differed on the six host plants tested. The results showed that the development time of *S. litura* which had been fed during the larval stage in different host plant was affected by host plant species where the larva duration was significantly (p<0.05)

decreased to the shortest (15.55 days) when larvae fed on the cabbage leaves, as well as during the feeding on the cotton and sweet potato larval duration was significantly ($p<0.05$) short, while the duration was prolonged to (19.55, 20.18 days) when the larvae fed on the cowpea and alligator weed respectively, Qin *et al*. (2004) used cowpea but they found that the developmental time of *S. litura* larvae was (12.8) days at 29ºC , which was (6.75) days shorter than in this study while Xue *et al*. (2010) found that the larval developmental time was (15.8) days on cowpea .Also we found that the duration was (15.82) days when larvae fed on sweet potato while Xue *et al*. (2010) found that the larval period was (17.5) days when larvae fed on sweet potato. Zhu *et al*. (2005) found that *S. litura* larvae needed (10.1) days to finish the larval development on cowpea while it was (19.55) days in our study. This difference (9.45 d) could be caused by higher temperature (28.1ºC) or different cowpea variety. Elbadry *et al*. (2009) found that the tlarval duration, took (19) days approximately to develop on sweet potato and cotton while in our study the larvae finished theirs developmental time with (15.82) days, (15.73) days for both host plants, respectively. The previous results revealed that the larval development of *S. litura* varied greatly by using different host plants and under low-high temperature, (Zhu *et al*., 2000; Chen *et al*., 2002; Seema *et al*., 2004), Also reported that the variations might be due to either the variability of nutritional quality and quantity of the host plant species which also explained by Bernays and Chapman, (1994). Our resultes showed that the pupal duration was also affected by the different host plant; for example when the larvae fed on cabbage, *S. litura* pupal duration was only (7.54) days while when larvae fed on alligator weed, *S. litura* pupal duration was significantly prolonged to (9.13) days.The pupal period was also affected by host plant which has been observed by Azidah and Sofian-Azirun (2006). However, it is not in consistency with the results of Berdegue *et al*. (1998) and Idris and Emelia (2001). Samira *et al*. (2011) found that when *S.exigua* larvae fed on cotton (*Gossypium hirsutum)* and soybean (*Glycine max*) the pupal duration was (8.70), (6.66) days respectively while we found that the pupal period was (8.0), (8.43) days for cotton and soybean respectively. They also found that the pupal duration for male was (9.11), (7.00) days and for female (8.32),(6.37) days when larvae fed on cotton and soybean respectively .These minor differences might be because of different host plants or different plant parts consumed by the larvae, which might be very different in primary and secondary biochemicals (Samira *et al*., 2011).

Patel *et al*. (1986) reported that pupal development was not influenced by host plants on which their larvae fed however; we found that pupae developed faster on cabbage than soybean, cowpea and alligator weed, also Xue *et al*., (2010) found that pupae developed faster on cowpea than on Chinese cabbage, sweet potato and tobacco, the different in the results may due to the different environmental factors such as temperature that plays a vital role on pupal development (Bae and Park, 1999). Adult longevity was not influenced by the host plant but there was a difference between longevity among the host plants. Sweet potato found to be the most suitable host plant and provide the best food quality for *S. litura* adult life compared to the other host plants, when *S. litura* larva fed on sweet potato the adult longevity was significantly ($p<0.05$) the highest with an average (6.92) days , meanwhile cowpea was reduced *S. litura* life to the shortest duration with an average (5.64) days, in contrast the results here was not in agreement with the findings of some researchers (Azidah and Sofian-Azirun,2006) who reported that the cowpea (*Vigna unguiculata subsp. sesquipedalis*) was found to be the most suitable host plant for *S. exigua* compared to the other host plants. However; they noted that there was no difference in adult longevity reared on different host plants. While; there was a difference in the female and male longevity. Xue *et al*. (2010) found in their study that the larvae of *S.litura* male lived (7.4), (8.8), (8.8) days longer than female life which lived (6.6) days, (7.7) (6.8) days with respect to Chinese cabbage and cowpea and sweet potato respectively while in our study the adult lived (6.33), (5.64), (6.92) days with respect to cabbage and cowpea and sweet potato. Patel *et al.* (1986) found that on cotton, male adults lived (6.3) days as compared with (12.3) days for female adults while in our study the adult was lived (6.6) days on cotton. It has been found that adult longevity became shorter as the temperature increased (Bae and Park, 1999).

Our results showed that When *S. litura* larvae fed on the cabbage pupal weight was significantly ($p<0.05$) increased to (0.2798) g, while the weight was significantly ($p<0.05$) decreased to (0.1609) g when larvae fed on cowpea, Xue *et al*. (2010) reported that pupal size and weight differed significantly depending on the host plants on which the larvae were fed and differed significantly between females and males when they fed on the same host plants and when larvae fed on different host plants where the female pupae on Chinese cabbage were heaviest, followed by those on cowpea and sweet potato and male pupae on Chinese cabbage were heavier than on the other three host plants. Female pupae were generally heavier than their male counterparts, The pupal weights of *S. litura* in their study were (0.32) to (0.36) g, which were generally within a wide range on various host plants, from (0.28) g on sweet potato to (0.40) g on perilla and cowpea which reported by (Bae and Park, 1999; Qin *et al*. 2004). While in our study the pupal weight was ranged from (0.16) g on cowpea to (0.28) g on cabbage where pupal

weight have been arranged according to the higher weight as follow: Cabbage>Sweet Potato> Cotton> Soybean> Alligator Weed > Cowpea, the different results may due to environmental condition witch noted by Bae and Park (1999) who found that pupal weight tended to be 3-13% lower with increasing temperature from 24, to 28ºC, then to 32ºC. which might happen in our study . also the variation might be as a resulted of host plant differences, where the population growth parameters of *S. litura* vary considerably depending on various factors such as host plants and environmental conditions (Greenberg *et al*., 2001; Tisdale and Sappington, 2001). It is well known that the nsects, like all living organisms require energy and nutrient to survive grow and reproduce. The results revealed during this study that cabbage and sweet potato and cotton leaves respectively was the best host for *S. littura* larvae, this might be due to the high levels of total carbohydrates, total protein and nitrogen and the low level of phenolic compounds. This result supported by Mohamed (2003) for *S. littoralis* larvae reared continuously on castor oil, cotton, clover, lettuce and broad bean, by Berlinger (1984) who stated that carbohydrates form a large part of the diet of many insects, although that they are a common source of energy, not always essential, are usually necessary for normal growth. During the present study, we found that cowpea leaves caused a high significant decrease in *S.litura* pupal weight, growth. This might be due to the poor nutritional quality in the cowpea leaves which explained by Slansky and Scriber (1985); or the ability of host plant to manufacture proteinase inhibitors once stimulated by this chewing insect, resulting in an inhibition of insect's digestion of host plant leaves protein (Steinberg *et al*., 1993).

Our study also has been conducted to evaluate the influence of different host plant on on the reproductive system anatomically to provide better knowledge about the effects of different host plant on fecundity of *S.litura*.

Our results presented that the ovarian tube length of *S. litura* adult female at the 1st and 3rd day age was increased with respect to cabbage, cotton and sweet potato while it was reduced with respect to cowpea, soybean and alligator weed, however the ovarian length was higher at the 3rd day age that is might because the ovarian tube developed gradually after the emergence, to mature in 3rd day age.

The results showed when of *S. litura* adult female fed on different host plants, at 1st day age fresh ovarian tube classified according to the big weight: Cabbage>Sweet Potato> Cotton> Soybean> Cowpea> Alligator Weed, also the results showed that the 3rd day age fresh ovarian weight was as follow: Cabbage> Cotton> Sweet Potato> Soybean> Cowpea> Alligator Weed. These results indicated the ovary fresh weight can reflect on size of the insect and its fecundity.

It has been reported that the ovarian development responds to variation in the host environment where some host plants defenses block ovarian development, in herbivorous insects (Daniel, 2000).

Taylor and Sands (2009) reported that the ageing and larval dietary nitrogen and adult carbohydrate diets influenced the development of the male and female reproductive systems of *Samea multiplicalis* where females from larvae that fed on the host plant weed *Salvinia molesta* matured fewer oocytes when the plants had lower (0·94% *vs.* 2·74%) levels of nitrogen. Resorbing oocytes were identified in the ovarioles of females 1-3 days old. they also suggested that high levels of larval dietary nitrogen and an intake of adult dietary carbohydrate were both necessary for maximum fecundity where the higher levels of larval dietary nitrogen resulted in greater adult size. It is well known that the maturation of insect eggs is dependent basically on the materials taken up from the surrounding hemolymph and by materials synthesized by the ovary in situ Indrasith *et al*. (1988). These materials include proteins, lipids and carbohydrates, all of which are required for embryogenesis (Kanost *et al*., 1990). We suppose that the preferred host plant could supply the insect by an important material which might increased the fecundity for *S. litura* by accumulation the proteins in the eggs, and consequently produce fertile insects big in size and weight. The higher fecundity point out that increased feeding and/or higher assimilation rate, both of which may be the result of an increased titer of digestive enzymes (Woods, 1999).

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. 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 xylosiella* on different host plants. All these finding may help us to understand the fecundity of *S. lituran* influenced by different host plant .

Our results revealed at the 1st and 3rd day age of *S.litura* accessory glands length were also increased when the larvae were fed on cabbage, sweet potato and cotton respectively, where; when the larvae fed on the cabbage the accessory gland has reached to the highest length (5.45), (5.62) cm for both age respectively and they were significantly ($p<0.05$) longer than the accessory glands when the larvae were fed on cowpea and alligator. Where alligator weed was significantly ($p<0.05$) reduced accessory glands length to the lowest with average (3.20), (3.73) cm, respectively. the results here indicated that the insects that liked to feed on the host plant, its male reproduction accessory glands was generally longer also its male reproductive ability was much strong. This

indicated that the *S. litura* reproductive accessory glands generally after the emergence was growing basically, but the mating of 3rd day age insects, reduced accessory gland to the shortest. The results also disclosed that the influence of host plants on the male accessory glands fresh weight for both age has the same tendency of the length However; our data showed that the 3rd days age male mating reproductive accessory gland fresh weight was lower than unmated males, this might indicated that the accessory gland material transferred to the female can cause reduction in its weight. We suppose that the reduction or increase in length and weight of *S. litura* larvae fed on different host plant may be due to the lack or high level of important elements for reproductive system growing such as nitrogen in the host plant. It has been reported that the high levels of larval dietary nitrogen to the male of *Samea multiplicalis* (Lepidoptera: Pyralidae) the length of seminal vesicles in the male was increased (Taylor and Sands, 2009).

The data clearly showed that *S. litura* performed differently in spermary weight as the follow: Cabbage> Sweet Potato> Cotton> Soybean> Cowpea>Alligator Weed. when larvae fed on the cabbage at the 1st and 3rd day age the spermary weight was significantly ($p<0.05$) the highest with average (3.23),(2.83) mg, respectively, while the weight was significantly ($p<0.05$) reduced to (2.17), (1.63) mg, when the male larvae fed on the Alligator weed, this results indicated that after emergence spermary fresh weight at the 1st day age was higher than the weight at 3rd day age, this might mean after the emergence *S. litura* spermary has been developed completely.

Our data with the results are likely caused by variations in experimental conditions, physiological differences depending on the type of the host plant species, genetic differences as a result of laboratory rearing or variation in strains of S. *litura*

knowledge of the variations in host plants and food quality among different host plants could have useful implication for the management of insect pests (Greenberg *et al*., 2001; Saeed *et al*., 2009). Therefore, future studies should focus on testing a wider range of host plant species for the development of *S. litura* and, also, elucidate the mechanism behind the effects of host plants on the pest suitability.

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