

Studies on different methods of communications in insects

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STUDIES ON DIFFERENT METHODS OF COMMUNICATION IN INSECTS The work reported here was carried out at the Plant Protection Department, Faculty of Agriculture, El-Qalbiah, El-Azhar, El-Azhar University, Benha-branch. Selected insect for these studies were moths of the Egyptian cotton leafworm *Spodoptera littoralis* (Boisduval) (Lepidoptera: Noctuidae) is a well-known pest on cotton plants, and various vegetable crops. The main objective of these experiments was to indicate the different methods of communication between moths of *Spodoptera littoralis* and some host plants. In addition to investigate the method of communication between males and females of the same insect. 1. a. Preference to oviposition on whole plants. Some host plants (Cotton, Cowpea, Bean, Jowar, Small, okra and soybean) were cultivated under semi-field conditions. Planting date, soil type, fertilizer, irrigation times and planting density were the same for all cultivated plants. Investigated plant species were exposed to the insects at two times throughout the experimental period, where the first and second ones were at 60 and 100 days plant ages, respectively. Not only mean number of eggs laid on each host per female, but also chlorophylls (a and b), total chlorophyll and carotenoid content were calorimetrically determined. At 60 days plant age, soybean was the highest one in chlorophyll (a) content (723.552 µg/100 gm. fresh wt.), while cotton was the lowest one in its content of chlorophyll (a and b), total chlorophyll and carotenoid. The highest average number of eggs per female was present on soybean (197 eggs/female). Results recorded at 100 days plant age revealed that the highest average number of eggs per female (458.333 eggs) was oviposited on soybean plants, in spite of decrement in their content of chlorophyll (a and b), total chlorophyll and carotenoid content. Generally, it could be said that obvious and highly significant increase in average egg number laid per female on each plant species was increased as plants grew older, presumably due to increment in compound or category of compounds may dominate the chemical composition of a plant and may contribute the sensory cue that forms the basis for oviposition preference. 1. b. Preference to oviposition on host plant extracts At the end of experimental period, leaves of different host plant were collected, dried, then extracted by different solvents (ethanol, chloroform, and petroleum ether,) for isolating the ovipositional stimulant. Extracts were offered for the insects on tissue papers, while control one was sprayed with a solvent. Ethanol is more efficient solvent for extracting more active compounds which induce oviposition. Ethanolic extracts of soybean resulted in inducing the moths to oviposit the highest average number of eggs per female (338 eggs). The highest ovipositional responses of *S. littoralis* to extracts of soybean seem to mimic their response to whole plant. Therefore, it could be concluded that a chemical composition of host plant plays an important role in communication between the insect and the investigated plant. Species-Different levels of bilateral amputation or cauterization of males antennae, which mated with untreated females, resulted in various averages of egg numbers per female, but egg hatching percentages were (0.000). It is evident that no communication or mating occurs between two sexes. The female moth easily identifies about oviposition site *Nerium oleander*, in spite of the presence of 1B-papers on the bottom of cage. Singular antennectomy or covering by nitrocellulose lacquer for one antenna of males then copulated with normal females. These females laid their eggs on *Nerium oleander*, where egg hatching percentages were ranged (99-100%). It is obvious that mating takes place and the female chooses its oviposition site. Different degrees of

bilateral amputation or coating by nitrocellulose lacquer of female antennae then copulated with untreated males. These treatments resulted in fertile eggs laid on tissue papers. In spite of the presence of *Nerium oleander*. Singular cutting or coating for one antenna of female moth then mated with untreated male. These treatments indicated that communication takes place, where the female laid fertile eggs on *Nerium oleander* in spite of the presence of tissue papers on the bottom of the cage. Generally, it could be summarized that the coating of antennae with nitrocellulose lacquer found to be equivalent to amputation in male and female moths of *S. littoralis*. Eventually, it could be concluded that male antennae and its sensillar structures together play or considered as a physical apparatus responsible about the choice of egg-laying place.

3. Some morphological studies on the antennae and its sensilla of *S. littoralis* moth.

3.a. Light microscopy investigation.

Mean diameter and mean length were measured per each flagellar segment of the 401h. terminal flagellum segments of both male and female III, Qths. Also, surface area and volume were calculated for these segments. The average length of the first flagellum segment of male was the longest of all in both sexes. Averages surface area and volume per each segment in both sexes were gradually increased from the apex of an antenna to the base until it reached the maximum at the 361h. segment, then began in decrement. Also, increment in male was higher than in female.

3.b. Scanning electron microscopy studies (SEM).

Scanning electron micrographs of the antennae of *S. littoralis* show that the most sensilla are found on the ventral and lateral surfaces of the flagellum with the dorsal surface covered by overlapping scales are similar to those on the scape and pedicel. All sensillar structures occur on the reticulated area of *S. littoralis* antennae are sensilla auricillica, sensilla trichodae (type 1, type 2 and type 3), sensilla styloconica, small chemoreceptor pegs, sensilla chaetica, sensilla coeloconica and sensilla squamiformia. Sexual dimorphism is mainly restricted in: Sensilla auricillica have a mean length of 9.8 U in males, mean length of 7.9 U in females. Sensilla trichodae (type 1, type 2 and type 3) are shorter on the female than on the male antennae. The average lengths of type 1, type 2 and type 3 were (43.2, 16.17 and 9.8 U in respectively) in males, while in females were (31.6, 16.6 and 9.6 U, respectively). The apical subsegment of the female antennae bears no sensilla styloconica, while in male it bears more than one. Only three small chemoreceptor pegs were found on the narrowed tip of terminal subsegment of the female antenna, while there are more than five on the male antenna. The terminal segment of the antenna bears many of the sensilla chaetica, where 10 and 12 hairs were found in the apical subsegment in female and male, respectively.

3.b. Histological studies using transmission electron microscopy (TEM).

Transmission electron microscopy sections in the antennae of both male and female moths of *S. littoralis* were made in attempt to determine the histology and the innervation pattern of some sensory receptors. Of particular interest the sensilla which were known to respond to the sex pheromone (sensilla trichodae, sensilla chaetica and antennal sensory cone). The antennal lumen in both sexes consists of a large haemocoel containing the paired antennal nerves, one trachea and one thin-walled blood vessel. Pat bodies are often found in the haemocoel. Therefore, it could be said that the contents of the antennal lumen indicated no sexual dimorphism between two sexes. Around the whole surface of the antenna, there are branched and unbranched projections originate from the antennal cuticle. According to the literature, the description of these projections had not been reported previously. The name of wavy shape projection (hairs) was given for them according to their shape. The dermal glands are situated just below basement membrane of the epidermal layer. Each dermal gland is composed of 1 to 4 large closely associated cells. Perforation through centre of these cells is a semicircular cuticular canal ending in a small bulb. These glands were more noticeable in males than females of *S. littoralis* moth. The hypodermal gland is closely associated with male antennal sensory cone and the cell body of the gland shares the cuticular invagination of the sensillum which is one of the main characters of this type of glands. The opening of this gland is cone-shaped with a ridge of cuticle extending along one side. Specialized enveloping hypodermal cell was found in one of the lateral side of sensillum trichodum type A. According to the literature, no reference showed the presence of the hypodermal cell in any order, also in *Lepidoptera*. There is no sexual dimorphism in the fine structure of triehoid type A sensillum, sensillum chaeticum and antennal sensory cone on male or female antennae of *S. littoralis* moth.

4. Ultrasonic waves and its role in communication between the two sexes of *S. littoralis* moths.

The effect of different treatments

of ultrasonic waves on *S. littoralis* moth fecundity, hatchability percent and sterility by making different copulations between treated and untreated males and females. [16]--Both males and females were received the same dose of ultrasonic waves including, power (20 in db.) and frequency (2 in MHz) for 30 minutes as exposure time, was the best of all for reducing insect fecundity (350 eggs/female) and increasing the percent of sterility (71.2~5 %) in addition to reduce the egg hatching percent (93.625 %). Treatment of both male and female by similar conditions of power (50 db) and frequency (2 MHz) for a period of 30 minutes, resulted in the lowest of egg hatchability (92 %) and percent of sterility (69.064 %). Exposing the female only for these conditions then copulated with untreated male resulted in high percent of sterility (41.337 %) than case in which male were treated by the same previous dose then copulated with untreated female (sterility % = 23.031).--Previously mentioned results leading us to postulate that ultrasonic waves not prevent communication between males and females of *S. littoralis* moths, but reduced insect fecundity, lowered percentage of egg hatching and raised the sterility percent.