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The Possibility of Rearing the Grasshopper, *Heteracris littoralis* (R.) on Semi Synthetic Diet

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ABSTRACT: The grasshopper, *Heteracris littoralis* (Rumbur) was reared in the laboratory on two diets as follows: Diet No.1 composed of dried powder of kidney beans, soya flour, wheat bran, moistened wheat, dried clover (*Trifolium alexandrinum*), sorbic acid, ascorbic acid, benzoic acid, brewer's yeast, agar, folic acid, vitamin B_{12}, egg yolk and water. Diet No.2 contained the same ingredients of diet No. 1 but the dried plant of clover was replaced by fresh minced clover, while the control diet was only fresh and green clover plant. Different biological aspects of artificially reared grasshopper were assessed. The results indicated that the tested biological parameters such as incubation period, nymphal period, female fecundity, oviposition period, postoviposition period, percent of egg hatchability and life span showed no differences between diet No.1 and diet No.2 but some differences between the two artificial diets and the control diet were observed. A prolongation in the female longevity by about six days was noticed in the artificially reared hoppers than normal clover plant reared ones. An increase in the preoviposition period by about three days in the artificially reared adults was also observed. Results cleared the efficiency of the semi synthetic diets that were equivalent to the green clover plant to survival of the insect and production of fertilized eggs for continuation maintenance. Moreover, semi synthetic diet could be useful if we don't prepare the green plant in the laboratory, it is easy to prepare, retain moisture for a long time so consumed and not contaminated. This is the first time for rearing the grasshopper on artificial diet.

Keywords: Grasshopper, *Heteracris littoralis*, artificial diet, biology.

INTRODUCTION

The grasshopper, *Heteracris littoralis* (R.) is considered one of the most harmful pests to different cultivated crops in Egypt. Its economic importance comes from attacking many cultivated crops, vegetables and even trees, feeding on it and causing great losses in quantity and quality of the attacked crop. In some cases, thousands of cultivated hectares may be attacked by the swarms of grasshoppers leaving it as a divested desert. The economic injury of *H. littoralis* in Egypt had been documented by Mistikawy (1929) and Nakhla (1967) [1, 2].

The development of suitable artificial diets for maintaining laboratory colonies of insects became of great importance for facilitating different investigations of the biology and behavior of insect, especially, if the green plants were not available.

Till now, there is no published data about artificial rearing of *H. littoralis* in the laboratory, hence, the present research is an attempt for testing semi artificial diets with different additives in rearing *Heteracris littoralis* as compared with green clover plant as a natural diet.

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MATERIALS AND METHODS

Adults and nymphs of *H.littoralis* were collected from the field (Giza Governorate), Egypt. The colony was raised as mentioned by Ghazawy (2005) [12] at a laboratory stock reared in electrically heated wooden cages (Fig. 1) measured (40x40x50cm), the front side was made of wire screen, at constant temperature 30 ± 1°C with fluctuating relative humidity (50-70%). The experiment was conducted at L.D. 12:12. The adults were fed on green clover or artificial diet (Fig.2), for oviposition, cages were supplied with suitable ovipositional pots (Fig.3). These pots were examined every day, when laid in, and removed to glass jars (1 litre capacity) covered with muslin cloth tied with rubber bands.

Fig.1: Rearing cage for rearing *Heteracris littoralis* in laboratory, electric lamp (a), wire screen (b), the hoppers(c).

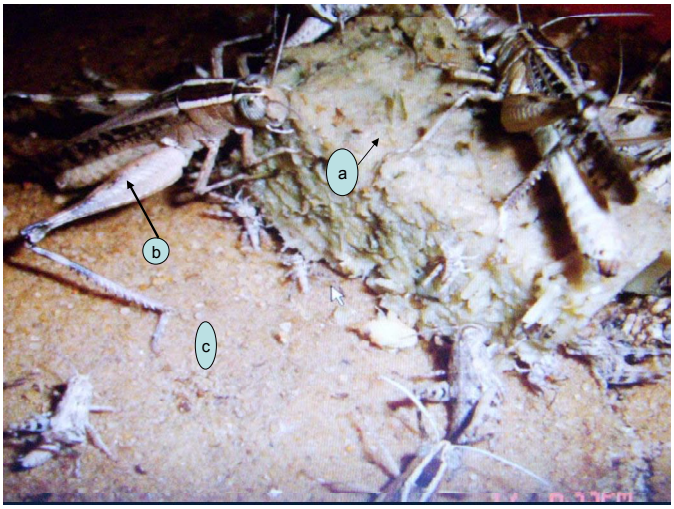

Fig. 2: Artificial diet (a), *Heteracris littoralis* (b) aggregated on the diet for feeding, sand (c).

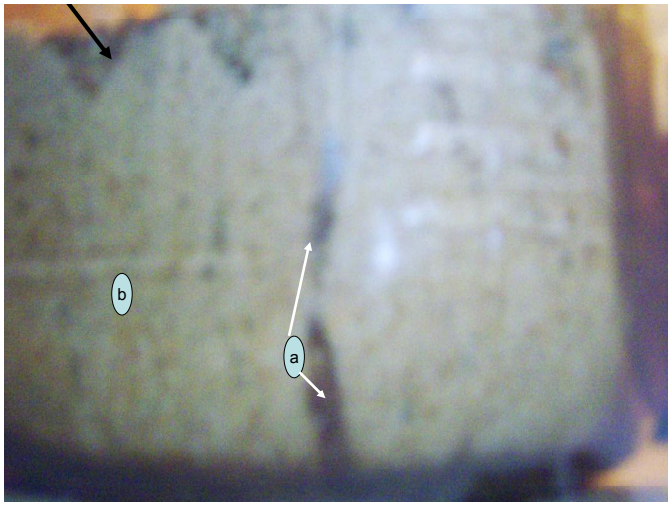

Fig. 3: Oviposition jar filled with moistened sand for egg laying, egg mass inside the sand (a) white arrows, surface of the sand inside the jars indicated with black arrow.

Detailed description of rearing techniques was given by Ibrahim (1983) [3] and was tested in relation to standard (natural) diet (green clover plants), Ghazawy *et al.*, (2007) [4]. The ingredients of the two semi artificial diets in grams are given below:

Diet No. 1	
Powder of kidney beans	25 gm
Dried soya flour	25 gm
Wheat bran	25 gm
Moistened wheat	25 gm
Dried powder of clover plant	7 gm
Sorbic acid	2 gm
Ascorbic acid	2 gm
Benzoic acid	2 gm
Brewer's yeast	16 gm
Folic acid	0.5 gm
Vitamin B12	500 mcg
Egg yolk	1 egg
Dist. Water	**850 ml**

Diet No. 2

The components of diet No.2 are the same diet in No. 1, replacing the dried powder of clover plant in the diet No. 1 by fresh green minced clover plant.

Preparation of the semi-artificial diet:

The components with exception of agar were blended with water. The agar was separately dissolved in water at 100°C, cooled to 60°C and then mixed with other blended ingredients. The diet was poured in plastic cups, leaved at room temperature for solidification and then kept in the refrigeration till using.

RASULTS AND DISCUSSION

The data in (Table 1) show the effect of the two semi-artificial diets compared with natural diet (green clover plant) which is used as a control on different biological aspects of *H.littoralis* such as, incubation period, nymphal period, longevity of both males and females, pre oviposition period, oviposition period, postoviposition period, fecundity of females and percent of egg hatchability besides life span of both males and females.

Table (1) Biology of *H. Littoralis* on two semi-artificial diets and green clover plant.

Incubation period (days)	Sex	Mean ± S.E			F-value
		Diet No.1	Diet No.2	Green clover	
	Male	17.26 ± 0.25a (14-20)	17.41 ± 0.27a (14-2)	17.31 ± 0.29a (14-20)	0.080 NS
	Female	16.86 ± 0.21 (14-20)	17.26 ± 0.31a (14-20)	16.39 ± 0.30a (14-20)	2.414 NS
Nymphal period (days) 1st instar	Male	6.94 ± 0.16a (6-9)	6. 72 ± 0.13a (508)	6.79 ± 0.15a (6-9)	0.573 NS
	Female	8.00 ± 0.19a (7-9)	8.11 ± 0.16a (7-9)	7.90 ± 0.10a (7-9)	0.481 NS
2nd instar	Male	7. 42 ± 0.10a (7-9)	7.34 ± 0.16a (5-9)	7.52 ± 0.14a (6-9)	0.408 NS
	Female	805 ± 0.19a (7-9)	8.22 ± 0.15a (7-9)	8.24 ± 0.12a (7-9)	0.434 NS
3rd instar	Male	7.84 ± 0.10a (7-9	7.78 ± 0.12a (6-9)	7.86 ± 0.12a (7-9)	0.128 NS
	Female	8.16 ± 0.14a (7-9)	8.11 ± 0.11a (7-9)	8.05 ± 0.08a (7-9)	0.255 NS
4th instar	Male	7.81 ± 0.12a (7-9)	7.88 ± 0.13a (6-9)	7.83 ± 0.10a (7-9)	0.090 NS
	Female	8.21 ± 0.16a (7-9)	8.56 ± 0.12a (8-9)	8.29 ± 0.12a (7-9)	1.681 NS
5th instar	Male	7.74 ± 0.13a (7-10)	7.91 ± 0.11a (7-9)	7.83 ± 0.11a (7-9)	0.488 NS
	Female	8.84 ± 0.27a (8-9)	8.67 ± 0.11a (7-11)	8.52 ± 0.11a (7-9)	0.824 NS
Total nymphal period (days)	Male	37.74 ± 0.21a (34-39)	37.63 ± 0.26a (34-39	37.83 ± 0.21a (34-39)	0.202 NS
	Female	41.32 ± 0.25a (40-43)	41.67 ± 0.22a (40-43)	41.00 ± 0.18a (40-43)	2.274 NS
Longevity (days)	Male	74.48 ± 1.73a (52-95)	74.94 ± 1.42a (58-86)	71.79 ± 1.60a (53-91)	1.122 NS
	Female	92.63 ± 1.77a (80-107)	87.56 ± 1.78b (75-104)	87.29 ± 0.99b (81-99)	3.909 **
Preoviposition period (days)	Female	18.42 ± 0.44a (14-21)	16.00 ± 0.29b (14-18)	15.76 ± 0.31b (14-18)	17.354 **
Oviposition period (days)		38.42 ± 0.73a (33-45)	36.78 ± 1.20a (29-45)	36.62 ± 0.68a (32.42)	1.517 NS
Postoviposition period (days)		35.79 ± 1.28a (25-42)	34.78 ± 1.14a (26-45)	34.90 ± 0.78a (29-45)	0.260 NS
Fecundity		149.21 ± 4.59a (100-190)	137.56 ± 5.54a (98-190)	140.67 ± 4.49a (96-170)	1.500 NS
% Egg hatch		97.74%	98%	97.27%	
Life span	Male	112.19 ± 1.77a (90-133)	112.63 ± 1.34a (96-123)	109.52 ± 1.59a (92-130)	1.104 NS
	Female	**133.95 ± 1.75a (123-147)**	**129.22 ± 1.75a (117-145)**	**130.05 ± 1.89a (122-162)**	**1.904 NS**

Mean in the same row followed by the same letter are not significantly different at 0.05% level of probability. ** = Highly significant NS= Not significan

The data show that, there were no differences between the three tested diets in case of the incubation periods of eggs, they were 17.26, 17.41 and 17.31 days for diet No.1, diet No.2 and control, respectively. Also, the total nymphal period collectively (including five nymphal stages) didn't differ with different feeding diets compared to control diet in both males and females. It recorded 37.74 and 37.63 days for males in diet No.1 and diet No.2, respectively, compared to 37.83 days in control (green clover diet), while female nymphal periods were 41.32 and 41.67 days, respectively compared to 41.00 days in the control diet. It is noticed that, there were low differences in the total nymphal period between males and females in all tested diets where females increased with 3 days than males.

These results is agree with that obtained by Ohabuike (1979) [5] who found that the type of food was of minor importance in the development during the very early life (first and second nymphal instars) of *Locusta migratoria*, while El-Shazly (1991) [6] indicated that the length of nymphal period of *H.littoralis* varied significantly with the type of food supplied where the author fed the hopper on eight fresh natural plants.

The data also show that, longevity of male *H.littoralis* showed no significant differences between the two artificial diets (diet No.1and No. 2) compared to control diet (fresh clover diet), it recorded 74. 48 and 74.94 days compared to 71.79 days in control diet, respectively. In contrast, female longevity showed moderate significant differences among the three tested diets. An obvious increase in the female longevity occurred when fed on the diet No.1 by about five days than the control diet, it recorded 92.63, 87.56 and 87.29 when fed on diet No.1, diet No. 2 and control, respectively. This might indicate that the effect of food supplied on the adult longevity of grasshopper was probably influenced by sex. El-Shazly (1991) [6] stated that the maximum longevity of *H.littoralis* adult was obtained when fed on *Vicia faba,* also, adults raised on *Sesbania sesban* and *Trifolium alexandrinum* showed fairly great longevity. The effect of food on adult longevity has been indicated in other accredities rather than *H.littoralis* include *Pyrgomorpha conica* Ibrahim, (1971) [7], *Trilophidia annulata* Moonis, (1979) [8] and *Schistocerca gregaria,* Manchanda *et al*., (1982) [9].

For oviposition period, data in the present table show that there are high significant differences among the three tested diets, fairly increase in the preoviposition period was noticed where the female fed on both two artificial diets. It recorded 18.42 and 16.00 days for diet No. 1 and diet No.2, respectively, while it was 15.76 days in the control (fresh green clover) diet.

On the other hand, oviposition period of female *H.littoralis* was't by the type of food supplied to the female grasshopper. No significant differences in the oviposition period between the two tested diets and the controlwas 38.42 and 36.78 days in diet No.1 and No.2, respectively in relation to 36.62 days in the control (fresh green clover diet). No significant differences were also noticed in the postoviposition period between the two tested diets and control diet. It is approximately the same in the three diets; it recorded 35.79, 34.78 and 34.90 in the diet No. 1, No.2 and control, respectively.

On the same line, female fecundity (number of deposited eggs) follow the same behavior of oviposition period, it was't by the type of the tested diets, it recorded 149.21, 137.56 and 140.67 eggs/female in diet No.1, No. 2 and control, respectively.

Results obtained by El-Shazly (1991) [6] on *H.littonalis*, found that the rate of sexual maturity (pre-oviposition period) was adversely affected by the type of food supplied to the adult grasshopper and the female fecundity of *H.littonalis* varied significantly with the food type.

Generally, the effect of food type on the female fecundity is independent of its effect on the rate of sexual maturation. Thus, the difference in the preoviposition period of adults fed on the two artificial diets (diet No.1

and No.2) was highly significant, although no significant difference in the fecundity of female hopper wasfed on the same diets.

Effect of food type supplied to the female on the female fecundity varies among different acridid species. Pickford (1962) [10] found cereals such as *Triticum* to be among the more favourable food for fecundity in *Melanoplus bilaturatus*. Ibrahim (1968) [11] found that *Vicia faba* gave the highest fecundity in *Pyrgomorpha conica,* while the same plant permitted moderate fecundity in *Chrotogonus lugubris* Ibrahim, (1971) [7], the effect of food type on the female fecundity was reported also in *Schistocerca gregaria* by Manchanda *et al*., 1982 Manchanda *et al*., (1982) [9].

The data also indicated that, the percent of egg hatching is food independent, it is approximately the same in the two tested diets besides the control, it was 97.74% in diet No.1, 97.27% in diet No.2 and 98% in fresh clover diet (control).

Similarly, the life span of both male and female didn't differ with food supplied to the adult grasshopper where no significant difference between the two artificial diets and control diet for both male and female was noticed. The life span of male was 112.19, 112.63 and 109.52 days for diet No. 1, diet No.2 and control, respectively and 133.95, 129.22 and 130.05 days for female, respectively.

From the previous results we can conclude that the different biological aspects of the grasshopper, *Heteracris littoralis* didn't weren't by the food supplied to the adults either this food is fresh such as green clover plant or artificial as diet No.1 and diet No.2, so, raising the artificial diet gives a high chance for keeping the grasshopper's culture around the year especially in case of adverse needing to high number of individuals for laboratory experiments with normal biological behavior.

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