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Effect of Three Wheat Varieties on Life Tables Data of *Shizaphis graminum* (Rond.) and the Predator, *Hippodamia variegata* Goeze

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***Abstract* – Life tables data of *Shizaphis graminum* and *Hippodamia variegata on* three wheat varieties, Debeira, El nilein and Baladi were studied under laboratory condition. The results show that the net rate of reproduction (R0) was 17.25, 14.05 and 12.87 in Debeira, El nilein and Baladi respectively. The highest innate capacity for numerical increase (rm) was noticed in Debeira variety (0.20) and the lowest one was reported in Baladi and El nilein variety (0.18). The doubling time (DT) was 3.40 days in Debeira, 3.82 days in El nilein and 3.88 days in Baladi. The weighted generation time (T) was 14.01 in Debeira, 14.62 in El nilein and 14.38 in Baladi variety. The life tables data of *H. variegata* raized on *S. graminum* in three wheat varieties illustrated that the figures for net rates of reproduction (R0) were 82.48, 82.79 and 81.42 and those of the intrinsic rate of increase were 0.18, 0.19 and 0.18 for the beetles fed on *S. graminum* raized on Debeira, El nilein and Baladi varieties respectively. The weighted generation time (T) was slightly higher in Debeira (24.45) than the other two varieties. The lowest doubling time DT (3.63 and 3.75) were reported from beetles fed on *S. graminum* reared on El nilein and Baladi varieties respectively. The results indicated that the buildup of *S. graminum* population was low in Baladi and El nilein variety.**

***Keywords* – *Shizaphis Graminum*, *Hippodamia Vareigata*, Wheat Varieties and Life Tables Data.**

I. INTRODUCTION

Aphids are the main insect pest attacking wheat in Sudan. The greenbug, *S. graminum* is the most important species (Schmutterer, 1969). The greenbug together with the less important black olive green aphid, *Rhopalosiphum maidis* Fitch, caused about 25 - 30% of grain losses (Sharaf Eldin *et al*., 1996). The species also transmit virus diseases (Schumtterer, 1969; Frohlich and Rodewald (1970) and Mirshekar *et al* (2013) . The greenbug is controlled annually by insecticides (Sharaf Eldin *et al*., 1996). Thus, chemical application has been the only control measure against wheat aphids. This reliance on a single management tactic worsens the problem (Kannan, 1999). Recently trends emerged aiming to reducing reliance on chemical control and exploring other measures to minimize or to eliminate the hazards resulted from the continuous use of chemicals. Areas relevant in this respect are production of host resistance varieties, rationalization the use of insecticides and initiation of biological control programs(Sharaf Eldin *et al*., 1996). In general aphids are found to be amenable to control by natural enemies. In nature aphids are prone to attack by many natural enemies and are easy to control due to their non-flying habits, sluggish movement and sedentary way of feeding (Sharaf Eldin *et al.*, 1996). In the Sudan, predators are the effective group against aphids (Shmutterer, 1969; Sharaf Eldin *et al*., 1996; Dabrowski *et al*., 1997; Abdalla and Beije, 1997). The predators prevalent in the Sudan are coccinellids, chrysopids, and syrphids. The objective of this study was to determine the life tables data of *S. graminum* and the predator *H. variegata* on three different wheat varieties.

II. MATERIALS AND METHODS

All laboratory experiments were conducted with the facilities of the department of Biological Fertilizers and Pesticides of the Environment, Natural Resources and Desertification Research Institute, National Center for Research. The experiments were carried out at average temperature 25. 5ºC and average relative humidity 60%.

Studies on S. graminum

Newly born nymphs were picked from the aphid culture and caged each separately in cages containing seedlings of Debeira plant. Nymphs in the cages were observed daily to follow the development and the duration of each. The observations continued and the data was recorded until adult emergence. Ten newly viviparous females obtained from nymphs reared on Debeira seedlings were selected. Each one was placed separately in cage containing seedling of Debeira plants. Daily records of the number of offsprings produced were reported until the death of the female. The daily born nymphs were continuously removed leaving only the adults. The same method was repeated following the same procedure except that the seedlings used were of El nilein and Baladi varieties. Data was analyzed according to Birch (1948) formulae.

Studies on H. variegata

Adults of *H. variegata* a were collected from the wheat field and reared. The adults were checked daily for eggs. The collected eggs were transferred to clean Petri-dishes lined with moist filter paper. The development of eggs was followed until hatching, and then the newly hatched larvae were caged in a new cage each contains seedlings of either Debeira or El nilein or Baladi infested by the aphid. The larvae were examined daily until the emergence of adults. Newly emerged adults from the above experiment were paired (males and females) and each pair was caged separately. Number of eggs laid by each female was

recorded daily until the death of the last one. The data were analyzed by the methods described by Birch (1948).

III. RESULTS

The results indicated that the greenbug nymphs moulted three times. The average development period for the first instar were 1.91 ± 0.52, 1.81 ± 0.50 and 1.65 ± 0.49 days when the species was fed on Debeira, El nilein and Baladi respectively. The average development period for the second, third and fourth nymphal instars were 1.52 ± 0.59, 1.52 ± 0.51 and 2.04 ± 0.56 days respectively when the nymphs were reared on Debeira variety, 2 ± 0.59, 1.55 ± 0.51 and 1.77 ± 0.44 days respectively when reared on El nilein variety and 1.57 ± 0.51, 1.60 ± 0.50 and 1.90 ± 0.45 days when *S. graminum* nymphs were reared on Baladi variety. The total nymphal duration of the greenbug took 7 ± 0.27, 6.93 ± 0.20 and 6.72± 2.26 days when it was raised on Debeira, El nilein and Baladi varieties respectively (Table 1). The net rate of reproduction (Ro) was 17.25, 14.053 and 12.864 in Debeira, El nilein and Baladi respectively. The weighted generation time (T) was 14.01 in Debeira, 14.623 in El nilein and 14.38 in Baladi variety, and the average generation time was 14.34. The highest innate capacity for numerical increase (rm) was noticed in Debeira variety (0.20) and the lowest one was reported in Baladi and El nilein varieties (0.18) and the average of the innate capacity for numerical increase (rm) of the three varieties was 0.19. The doubling time (DT) was 3.40 days in Debeira 3.82 days in El nilein and 3.88 days in Baladi. The average doubling time of the pest was 3.70 days (Table 2).

Table 1: Nymphal duration of *S. graminum* when raised on three wheat varieties under laboratory conditions

Stage / Wheat varieties	Average duration of *S. graminum* nymphs				
	First instar	Second instar	Third instar	Fourth instar	Total
Debeira	1.91 ± 0.52	1.52 ± 0.59	1.52 ± 0.51	2.04 ± 0.56	7 ± 0.27
El neilin	1.61 ± 0.50	2 ± 0.59	1.55 ± 0.51	1.77 ± 0.44	6.93 ± 0.20
Baladi	1.65 ± 0.49	1.57 ± 0.51	1.60 ± 0.50	1.90 ± 0.45	6.72 ± 2.26

Table 2: Summary of the life tables data of *S. graminum* when raised on three wheat varieties Debeira, El nilein and Baladi

Parameter / Wheat varieties	Ro*	T*	rm*	DT*
Debeira	17.25	14.01	0.20	3.40
El neilin	14.05	14.62	0.18	3.82
Baladi	12.86	14.38	0.18	3.88
Average	14.72	14.34	0.19	3.70

*Ro = The net rate of reproduction; *T = Weighted generation time 4
*rm = The innate capacity of numerical increase; *DT = Doubling generation time

The egg incubation periods of *H. variegata* were 2.95 ± 0.55, 2.94 ± 0.32 and 3 ± 0.16 days when the beetle adults were fed on *S. graminum* raised on Debeira, El nilein and Baladi plants. The average larval periods of the predator was 6.55 ± 0.23, 6.28 ± 0.28 and 6.50 ± 0.20 days when the beetle was raised on infested wheat varieties of Debeira, El nilein and Baladi respectively. The total development period of the beetle from egg to adult in Debeira, El nilein and Baladi varieties was 14.09 ± 2.19, 13.98 ± 2.03 and 14.36 ± 2.11days respectively (Table 3). The results illustrated that the net rates of reproduction (R0) were 82.48, 82.79 and 81.42 for the beetles fed on *S. graminum* raised on Debeira, El nilein and Baladi varieties respectively. The weighted generation time (T) was slightly higher in Debeira (24.45) than the other two varieties. The intrinsic rate of increase of the predator was 0.18, 0.19 and 0.18 when the predator was raised on Debeira, El nilein and Baladi wheat varieties infested by *S. graminum*. The lowest doubling time DT (3.63 and 3.75) were reported from beetles fed on *S. graminum* reared on El nilein and Baladi varieties respectively (Table 4).

Table 3: Duration of the immature stages of *H. variegata* when fed on *S. graminum* raised on Debeira, El nilein and Baladi wheat varieties under laboratory conditions

Stage / Wheat varieties	Egg	Larva					Pre-pupa	Pupa	Total
		First instar	Second instar	Third instar	Fourth instar	Total			
Debeira	2.95±0.55	1.87±0.55	1.73±0.46	1.32±0.47	1.64±0.49	6.55±0.23	1.32±0.48	3.27±0.46	14.09±2.19
El neilin	2.94±0.32	1.91±0.29	1.52±0.51	1.24±0.44	1.62±0.59	6.28±0.28	1.43±0.48	3.33±0.48	13.98±2.03
Baladi	3±0.16	1.83±0.38	1.68±0.48	1.36±0.49	1.62±0.50	6.50±0.20	1.48±0.51	3.29±0.56	14.26±2.11

Table 4: Summary of life tables data of *H. variegata* fed on *S. graminum* raised on three wheat varieties Debeira, El nilein and Baladi under laboratory condition

Parameter / Wheat varieties	Ro*	T*	rm*	DT*
Debeira	82.48	24.45	0.18	3.83
El neilin	82.79	23.13	0.19	3.63
Baladi	81.42	23.90	0.18	3.75

*Ro = The net rate of reproduction; *T = The weighted generation time
*rm = The intristic rate of increase; *DT = Doubling time

IV. Discussion

The greenbug reproduced parthenogenetically and no sexual forms were reported from Sudan. The total development period of the nymphal stages of the greenbug on the different wheat varieties namely Debeira, El nilein and Baladi were approximately similar. However nymphs reared on Baladi variety have short development period and those reared on Debeira variety have relatively longer development period. This may be justified by the fact that Baladi variety leaves contain tannins, which is unpalatable and toxic to the aphid so the nymphs moulted rapidly to avoid this effect. Ryan *et al*., (1987) stated that the dry weight of greenbug was reduced on resistant plants. This may have resulted from the small size of the individuals reared on resistant varieties. Life tables data analysis of greenbug aphid showed that the highest numbers of nymphs produced by adults raised on Debeira variety and the lowest one was reported from Baladi variety. The buildup of the greenbug population was fast and high in the Debeira variety than El nilein and Baladi as indicated by the higher innate capacity of numerical increase (rm). This may be due to the high fecundity of the adults when raised on the Debeira variety and consequently the population doubling time was shorter compared to the other two varieties. Variation of the population densities among the wheat varieties were mentioned by several authors Aheer *et al*., (2007) and Mohamed (2001) Saikia *et al*., (1998), Ryan *et al*.(1987) and Sumner *et al*., (1986). The developmental period of the immature stages and the life tables of *H. variegata* were studied on three wheat varieties. The results indicated that no single wheat varieties of Debeira, El nilein and Baladi has clear influence on the duration of all immature stages of the predator when the beetle fed on *S. graminum* raized on different wheat. The effect of the wheat varieties on the life tables parameters of the predator was not clear. Yousif (2005) reported that the life tables parameters of *H. variegata* were different when the beetle fed on *A. gossypii* raized on different crops okra, eggplant and potato. The fecundity of *H. variegate* was effected by pry density (Adam 1979,Sharaf El-Din,1963 kual,2003 and Yousif 2005).

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