

INFLUENCE OF HOST PLANT ON LIFE AND FERTILITY TABLES FOR *Scymnus coccivora* AYYAR.

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ABSTRACT

Studies on the life and fertility tables of the coccinellid predator, *Scymnus coccivora* Ayyar. were conducted to estimate some of its biological aspects on four different host plants (hibiscus, Sprouted potatoes, Grape and Japanese pumpkins) infested with hibiscus mealybug, *Maconellicoccus hirsutus* (Green).

The stage duration, survival rate, the net reproductive rate and the intrinsic rate of natural increase were examined. The developmental periods were significantly affected by host plant. The mean duration of the larval stage on hibiscus, Sprouted potatoes, Grape and Japanese pumpkins were 10.51, 11.65, 11.82 and 11.86 days, respectively. The total developmental period of immature stages lasted by 19.88, 21.6, 21.9 and 20.28, respectively.

The stage specific survival of life table data indicated that the mortality factor operated mainly during larval stage. The highest larval survival of $78.9 \pm 7.0\%$ was recorded on potatoes followed by $73.8 \pm 12.0\%$ on pumpkin and $64.4 \pm 5.1\%$ on hibiscus; while the least ($61.1 \pm 3.8\%$) occurred on grape.

The fertility of *S. coccivora* females was relatively high on potatoes followed by hibiscus, grape and pumpkin. The net reproductive rate was 47.81 ± 17.09 , 35.84 ± 2.76 , 22.70 ± 4.64 and 22.55 ± 4.53 females/ female, respectively. The intrinsic rate of increase (r_m) was 0.097 ± 0.005 , 0.088 ± 0.015 , 0.083 ± 0.005 and 0.082 ± 0.006 females/ female/ day, on potatoes, hibiscus, grape and pumpkin, respectively. In the same order, the time of generation was 39.39 ± 3.25 , 41.32 ± 6.35 , 37.69 ± 2.49 and 38.06 ± 5.10 days, respectively.

INTRODUCTION

Mealybugs comprise some of the worst pests of fruit and shade trees in many parts of the world especially in tropical and subtropical countries (Abd-Rabou, 2001). Hibiscus mealybug, *Maconellicoccus hirsutus* (Green) at outbreak densities can be quite extensive actually killing hibiscus and ornamental landscape planting (Meyerdik, 1999 and Kairo *et al.*, 2000). According to Pollard (1995) *M. hirsutus* attacks a wide variety of host plants. It attacks grapes (Mani *et al.*, 1987), guava (Mani and Krishnamoorthy, 2001) and it was recorded on the roots of some date trees (Elwan, 2000).

In the last few years, the Ministry of Agriculture aims to minimize the use of insecticides in integrated pest management programs. To maintain the natural balance, it must be raising the use of native or imported natural enemies. In order to achieve a successful biological control in any area, searching for the well established and most efficient biological agents should be involved (Abd El-Kareim, 2002).

Several studies drew attention to the importance of the coccinellid species as a predators throughout the world on many economic crops. *Nephus includens* (Kirsch) (Coleoptera: Coccinellidae) is an important indigenous predator of mealybugs (Homoptera: Pseudococcidae) (Kontodimas *et al.*, 2007). It has a good search activity and a high

consumption rate (Izhevsky and Orlinsky, 1998; Kontodimas *et al.*, 2004 and 2007) In the absence of other criteria, the species with the greatest natural increase (r_m) is usually selected (Birch, 1948; Hulting *et al.*, 1990.; Roy *et al.*, 2003; Lanzoni *et al.*, 2004).

The intrinsic rate of natural increase (r_m) can be used for predator's selection. Moreover, r_m is suitable for evaluation of the mass rearing quality of biological control agents. It can be determined by its developmental time and reproduction rate. It has been used to compare a species under different environmental conditions and as an index of population rate response to selected preys (Birch, 1948; Hulting *et al.*, 1990.; Roy *et al.*, 2003; Lanzoni *et al.*, 2004).

Therefore, the objective of this study was to assess some biological properties of the coccinellid predator, *Scymnus coccivora* Ayyar on four host plants to serve as a basis for the use of this predatory coccinellid in a biological control program.

MATERIALS AND METHODS

Insect sources:

The coccinellid predator, *Scymnus coccivora* Ayyar adults were collected from hibiscus *Hibiscus rosa-sinensis* L. at the Experimental Research Station, Faculty of Agriculture, Mansoura University.

To have an initial population of *S. coccivora* eggs homogenous in age, pairs of male and female adults were introduced into plastic screen-cages (15 cm diameter x 25 cm in length and 10 cm height) and provided with preys (the pink hibiscus mealybug, *Maconellicoccus hirsutus* (Green)). The eggs of *S. coccivora* were collected daily, and monitored until hatching. To avoid cannibalism, hatched larvae were reared individually in Petri dishes (9 cm in diameter) in the laboratory conditions. A piece of filter paper was placed on the bottom of each dish to provide a walking surface for the larvae.

Construction of life table for *S. coccivora* on different host plants:

To estimate the influence of host plant on the development and survival rate *S. coccivora*, thirty larvae from the predator were reared on *M. hirsutus* collected from four different host plants (hibiscus, Sprouted potatoes, Grape and Japanese pumpkins). Each larva was considered as a replicate. The developmental time and survival rate of immature stages, from eggs to adult eclosion were recorded.

Construction of fertility table for *S. coccivora* on different host plants:

To construct age-specific fertility table, ten pairs of newly emerged adults (males and females) of the predator on each host plant were introduced in Petri dishes (one pair / dish) and provided daily with preys reared on the previously mentioned host plants until death. The longevity of females (pre-oviposition, oviposition and post-oviposition, periods) was estimated. Also, the females were daily observed until their death and the daily number of eggs laid per female was recorded.

To estimate the stage-specific survival (l_x) and the intrinsic rate of natural increase (r_m), life and age-specific fecundity tables were constructed as follow:

Life table was constructed with the following columns:

x : The pivotal age for the age class in days.

l_x : The number of survivals at the beginning of age class x .

d_x : The number of deaths during the age interval x .

Age specific fertility table was constructed with the following columns:

x : Actual female age (time from eggs).

m_x : The number of living females born per female in each age.

L_x : Represented the fraction surviving of females of an initial population of one.

The parameters, net reproductive rate (R_0), mean generation time (T) and the intrinsic rate of increase (r_m) were calculated according to Southwood (1978) as follow :

$$R_0 = \sum L_x m_x$$

$$T = \sum x (L_x m_x) / R_0$$

$$r_m = \ln (R_0) / T$$

III. Data analysis:

Data of developmental times of immature stages, pre-oviposition, oviposition, and post-oviposition periods, total longevity of females, fecundity, fecundity rate, and the male longevity of *S. coccivora* reared on *M. hirsutus* were subjected for one way analysis of variance (ANOVA), and the means were separated using Duncan's Multiple Range Test (CoHort Software, 2004).

RESULTS AND DISCUSSION

Influence of host plant on the duration of the developmental stages:

The duration of each developmental stage of *S. coccivora* reared on different host plants (hibiscus, Sprouted potatoes, Grape and Japanese pumpkins) infested with Hibiscus mealybug, *M. hirsutus* (Green) are presented in Table 1.

The obtained data in Table (1) indicated that the duration of each developmental stage affected by host plant species. The durations of the larval stage ranged between (12.04—12.32) on potatoes, (9.89- 11.43) on hibiscus, (9.38-13.33) on pumpkin and (9.89- 13.35) on grape. The duration of the pupal stage lasted by 4.3- 5.5, 5.2 – 5.6, 4.6-6.4 and 5.4-7.2 days, on potatoes, hibiscus, pumpkin and grape, respectively.

Table (1): Duration of the immature stages and adult (male and female) longevity (in days) of the coccinellid predator *Scymnus coccivora* Ayyar reared on potatoes, hibiscus, pumpkin and grape infested with Hibiscus mealybug, *Maconellicoccus hirsutus* (Green) under laboratory conditions.

Host plant	Generation	Egg	Larva	Pupa	Total developmental time
Hibiscus	G1	3.37±1.0	11.43±1.12 g	5.57±0.60 e	20.52±1.17 g
	G2	3.13±0.4	9.89±1.37 J	5.26±0.45 h	18.37±1.34 i
	G3	4.2±0.9	10.21±1.18 i	5.58±0.84 e	20.47±1.54 g
	mean	3.56	10.51	5.47	19.78
Pumpkin	G1	3.6±0.6	13.33±1.08 b	6.39±0.70 b	24.74±1.11 a
	G2	3.33±0.9	9.38±0.49 k	4.58±0.58 j	17.42±1.28 j
	G3	3.6±0.8	12.68±1.62 c	6.36±0.58 c	22.68±1.49 d
	mean	3.51	11.86	5.77	21.60
Grape	G1	3.77±0.9	13.35±1.50 a	5.71±0.77 d	23.24±2.08 c
	G2	3.60±0.9	9.89±0.80 j	5.37±0.83 g	18.89±1.27 h
	G3	4.4±0.7	12.22±1.48 e	7.17±0.51 a	23.61±1.46 b
	mean	3.92	11.82	6.08	21.90
Potatos	G1	4.0±0.8	12.04±2.44 f	5.48±0.51 f	21.74±2.51 e
	G2	3.53±0.5	10.58±0.90 h	4.31±0.98 k	18.38±1.50 l
	G3	3.5±0.5	12.32±1.43 d	5±0.44 i	20.73±2.45 f
	mean	3.63	11.65	4.93	20.28
LSD		0.9	0.0164	0.017	0.913

Means of 18.4-21.8, 18.4-20.5, 17.4-24.7 and 18.9-23.6 days were recorded for the total developmental time of immature stages on potatoes, hibiscus, pumpkin and grape, respectively.

Statistical analysis showed that the longest time for the development of *Scymnus coccivora* immature stages was recorded on pumpkin ,which were 24.7, 17.4 and 22.7 days during the first,second and third generations, respectively. While, the shortest period was noticed on hibiscus (20.5, 18.4 and 20.5,respectively). which clear that, the duration of the larvae and pupal stages were nearly similarly affected by host plant.

Influence of host plant on stage-specific survival of *S. coccivora*:

Survival among larval stage was much higher on potatoes than on other tested host plants (Table,2). It was 78.9±6.97, 73.8±12.0, 64.4±5.1 and 61.1±3.8.% on potatoes, pumpkin, hibiscus and grape, respectively. As shown in Table 2, it could be noticed that the pupal survival did not affected by host plant. However, all the formed pupae complete their development and emerged to adult stage.

Table (2): Survival percentages of immature stages of *S. coccivora* reared on pink mealybug on four host plants at laboratory conditions.

	Total larvae				Pupal stage			
	G1	G2	G3	mean	G1	G2	G3	mean
Hibiscus	70.0	63.3	60.0	64.4±5.1	100	100	100	100±0
Pumpkin	60.0	80.0	81.5	73.8±12.0	100	100	100	100±0
Grape	56.7	63.3	63.3	61.1±3.8	100	100	100	100±0
Potatos	76.7	86.7	73.3	78.9±6.97	100	100	100	100±0

Influence of host plant on some biological parameters (Ro, r_m and T) of *S. coccivora*:

The age-specific fertility table is presented in Table (3) for each host plant. The net reproductive rate (Ro), the intrinsic rate of natural increase (r_m) and generation time (T) of *S. coccivora* were calculated.

The Ro and r_m values indicate the relative preferences of potatoes followed by hibiscus, Grape and pumpkin. These vales were 47.81 ± 17.09 , 35.84 ± 2.77 , 22.70 ± 4.64 and 22.55 ± 4.53 females/ female, respectively. In the same order, the r_m values were 0.097 ± 0.004 , 0.088 ± 0.005 , 0.083 ± 0.005 and 0.082 ± 0.006 females / female/ day, respectively.

Based on the data in Table 3, the duration of one generation of *S. coccivora* lasted about 39.39 ± 3.25 , 41.32 ± 6.35 , 38.07 ± 5.12 and 37.7 ± 2.47 days on potatoes, hibiscus, pumpkin and grape, respectively.

Table (3): Fertility Life table parameters (Ro , r_m and T) of *S. coccivora* when reared on different host plants, potatoes hibiscus, pumpkin and grape infested with the pink mealybug under laboratory conditions.

Host plant	parameters	Mean±SD
Hibiscus	Ro	35.84±2.77
	r_m	0.088±0.005
	T	41.32±6.35
Pumpkin	Ro	22.55±4.53
	r_m	0.082±0.006
	T	38.07±5.12
Grape	Ro	22.70±4.64
	r_m	0.083±0.005
	T	37.7±2.47
Potatos	Ro	47.81±17.09
	r_m	0.097±0.004
	T	39.39±3.25

DISCUSSION

From the obtained results, it is clear that, the durations (in days) of the immature stages of *Scymnus craccvora* was affected significantly by the different host plants. The shortest larval duration was recorded on hibiscus, while the longest duration was recorded on grape. The previous results supported the data of Ru & Mittsipa (1999 and 2002) and Abd EL-Kareim (2002), who found that the biology of coccinellid predators are strongly influenced by the host tissue contents. The more favorable host plant had comparatively faster maturation and higher percentage of juvenile survivorship.

Literature data revealed that the survival in the younger stages of predatory coccinellids, *N. includens* (Canhilal *et al.*, (2001), Kontodimas *et al.* (2004) and Abd El-Salam, *et.al.*,2010). Based on the influence of host plant species on the survival rate of the tested coccinellid predator, *S. craccvora*, the lower survival rate was observed on grape followed by hibiscus, pumpkin

and potatoes, respectively. According to Mendel (1988) and Abdel-Mageed, (2005), the predator *R. cardinalis* was recorded with relatively high number on ficus trees, it was never occurred on coral trees.. These results may be explained by the emission of auditory stimuli (kairomone) from host plant species, or explained by the differences between host plant tissue contents.

Fecundity of *S. coccivora* female showed significant differences between the host plants all over three successive generations. The highest R_o and r_m –values were recorded on potatoes followed by Hibiscus. The lowest fecundity was on pumpkin. Similar results were obtained by , (Persad and Khan , 2002) who reported that *S. coccivora* populations doubled when reared on *M. hirsutus* fed on hibiscus plants. Also. Ru & Mittsipa (1999) reported that the net reproductive rate of the predator *Exochomus flaviventris* was higher on Zanaga than water weed.

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تأثير العائل النباتي على جداول الحياه والخصوبة للمفترس *Scymnus coccivora* Ayyar.

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بدراسة جداول الحياه والخصوبة للمفترس *Scymnus coccivora* Ayyar. عندما ربي على أربع عوائل نباتية مختلفة وهي (نبات الهيسكس ،درنات البطاطس و العنب وثمار القرع العسلي)المصابة ببق الهيسكس الدقيقي . *Maconellicoccus hirsutus* (Green) .
و قد أوضحت النتائج مايلي :

- 1- كان للعائل النباتي تأثير على فترات النمو لكل من اليرقات والعداري حيث كان أفضل العوائل للمفترس هو نبات الهيسكس.
- 2- كان لاختلاف العائل النباتي تأثير على لنسبة البقاء لليرقات حيث كان أعلى نسبة بقاء سجلت على البطاطس وأقل نسبة بقاء على العنب
- 3- تأثر كل من صافي معدل الخصوبة ومعدل التزايد الحقيقي لمفترس *S. coccivora* حيث سجلت أعلى المعدلات على ثمار القرع العسلي يليه نبات الهيسكس

قام بتحكيم البحث

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