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COMMUNICATION II

A Life Table of the Asiatic Maize Stem Borer, *Ostrinia furnacalis* Guenee.

ABSTRAK

Kadar kemandirian dan fekunditi Ostrinia furnacalis *telah dihasilkan di makmal dengan menggunakan tanaman perumah utama perosak iaitu pokok jagung. Analisis jadual hidup ke atas data asal berdasarkan kepada cara satu-seks telah dilakukan. Kadar pertambahan bilangan intrinsik juga berdasarkan kepada cara satu-seks. Kadar intrinsik pertambahan semula jadi (r_m), kadar pembiakan net (R_o), jangkamasa generasi (T) dan jangka masa ganda dua kali (DT) ialah 0.157, 139.6, 31.5 hari dan 4.62 hari. Graf fekunditi menunjukkan oviposisi mencapai kemuncak pada hari ke-8 selepas penjelmaan dewasa dan berlangsung selama 11 hari. Kadar kemadirian bagi peringkat telur, larva dan pupa ialah 96, 85 dan 90%. Jangka masa hayat hidup (telur-kematian dewasa) ialah 38 hari. Rama-rama jantan menjelma 2 hari terdahulu dari rama-rama betina. Secara purata serangga dewasa dapat hidup selama 7 hari. Fekunditi serangga betina yang maksima ialah 115 biji telur sehari dengan purata fekunditi sebanyak 60 biji telur setiap serangga sehari.*

ABSTRACT

The survivorship and fecundity rates of Ostrinia furnacalis *Guenee were measured in the laboratory using the major host plant, the maize plant. Raw data analysis of the age-specific single-sex female life table is described. The intrinsic rates of increase were calculated with respect to single sex. Using the single-sex method, the intrinsic rate of natural increase (r_m), the net reproductive rate (R_o), the generation time (T) and the doubling time (DT) were 0.157, 139.6, 31.5 days and 4.62 days, respectively. The age-specific survival and fecundity curves showed that oviposition peaked on the 8th day after female emergence and lasted for 11 days. The survival rates for the egg, larval and pupal stages were 96, 85 and 90%, respectively. The maximum life span (from egg to death of adult) was 38 days. The male moth emerged 2 days earlier than the females. Adult longevity averaged 7 days. Female fecundity reached a maximum of 115 eggs with an average fecundity of 60 eggs per female.*

INTRODUCTION

The Asiatic maize stem borer, *Ostrinia furnacalis* Guenee (Lepidoptera : Pyralidae), is still the most important insect pest of maize throughout South Asia (Teng *et al.* 1990) including Malaysia (Yunus & Ho 1969; Hussein and Kameldeer 1988). The female moth lays the eggs in batches ranging from 10-30 per batch (Hussein and Kameldeer 1988). Crop loss resulting from borer attack is currently being minimized by controlling the pest using synthetic organic insecticides or by conserving the naturally occurring biological control agents (Hussein 1991). The current approach in solving the pest problem is adopting integrated pest management (IPM) concepts and practices. The concept of pest management from a population life table point of view was critically examined by Knipling (1979). However, the lack of critical research data has slowed down the process of implementing IPM programmes in Malaysia. Research data pertaining to the pest's life tables and capacity for natural increase are urgently needed. We have constructed a life table of *O. furnacalis* and estimated the survival and fecundity rates under laboratory conditions. The data thus generated will be compared to the field data and used for understanding the pest population demography, modelling and developing IPM strategies.

MATERIALS AND METHODS

Pupae of *O. furnacalis* were collected in the field and brought to the laboratory to allow the adult moth to emerge. Newly emerged adult moths were sexed and a pair of male and female moths was then placed in the oviposition cage. The oviposition cage consisted of a cylindrical-shaped wire mesh (1cm x 1cm), 10 cm diameter and 15

cm height. The wired mesh frame was covered with green plastic mesh screen (6 mesh/cm). A layer of wax paper was secured to line the top of the cage and acted as the oviposition site. Water and sucrose solution were provided in the cage. The cage with the moths inside was placed in the dark throughout the oviposition period. Relative humidity and room temperature were maintained at 80 ± 10% and 25 ± 5°C, respectively.

Fifty *O. furnacalis* eggs laid on the wax paper during the 24h period were used in the study. A group of 5 eggs was placed inside a plastic petri dish (5 cm diameter). Upon hatching, the first instar larva was provided with a freshly cut section of maize leaf (2cm x 1 cm). The larva was fed on maize leaf until it reached the third stage. The leaf sections were replaced every 3 days. The third instar larva was transferred into a large glass petri dish (14 cm diameter) and provided with a 10 cm section of the maize stem as food. The larva was allowed to burrow into the stem section and feed until pupation. The number of dead larvae were recorded daily. soon after emergence, the adult moths were sexed, paired and placed in the oviposition cage in the same manner described above. The daily survival rate and the female fecundity rate were computed. The life table data were analysed following the single-sex method (Birch 1948).

RESULTS AND DISCUSSION

The intrinsic rate of natural increase, r_m, the net reproductive rate, R_o, the mean generation time, T, and the doubling time, DT were 0.157, 139.6, 31.5 days and 4.62 days, respectively. The *O. furnacalis* population will multiply 139.6 times in 31.5 days under laboratory conditions when not confronted by the natural enemy or the effects of heavy rain and strong wind.

Table 1 presents the age-specific survival and fecundity rates of *O. furnacalis*. As can be seen from Table 1, oviposition peaked on the 8th day after female emergence and lasted for 11 days. The survival rate was very high (85-100%) as shown in Tables 1 & 2. The male moth emerged approximately 2 days earlier than the females. The maximum life span of *O. furnacalis* (from egg to death of adult) was 38 days. The adult moth only lives for 7 days. Oviposition began on the 3rd or 4th day after female emergence, peaked 4-5 days later and lasted for 10 days. The mean number of eggs produced per female per day was 59 (maximum of 115).

TABLE 1
Age-specific fecundity rate, survival rate and net reproductive rate of *Ostrinia furnacalis* at 27°C.

Pivotal Age in Days (x)	l_x	m_v^*	$l_x m_x$
1	1.00		
2	1.00		
3	1.00		
4	0.96		
5	0.94		
6	0.94		
7	0.90		
8	0.90		
9	0.90		
10	0.90		
11	0.90		
12	0.86		
13	0.80		
14	0.80		
15	0.80		
16	0.80		
17	0.80		
18	0.76		
19	0.70		
20	0.70		
21	0.68		
22	0.68		
23	0.68		
24	0.68		
25	0.68		
26	0.66		
27	0.66		
28	0.64	8.65	5.54
29	0.64	19.79	12.66
30	0.62	40.06	24.84
31	0.58	57.57	33.39
32	0.46	53.16	24.45
33	0.46	44.14	20.30
34	0.38	28.60	10.87
35	0.28	17.03	4.77
36	0.18	13.98	2.51
37	0.14	2.50	0.35
38	0	-	-
Sex Ratio of 1:1		R_o = 139.67	

*m_x values are a half of actual daily fecundity; assuming sex ratio of 1:1.

TABLE 2
Life table for *Ostrinia furnacalis*

x	l_x	L_x	d_x	100_{qx}	S_x	e_x
Egg	50	49.0	2	4.00	96.0	6.23
Larva I	48	46.5	3	6.25	93.8	5.46
Larva II	45	45.0	0	0	100.0	4.80
Larva III	45	44.5	1	2.22	97.8	3.80
Larva IV	44	42.0	4	9.09	90.9	2.87
Larva V	40	37.0	6	15.00	85.0	2.11
Pupa	34	32.0	3	8.82	91.2	1.39
Adult	31	15.5	-	-	-	-

x = Development stage
l_x = Number entering stage
L_x = Number alive in each age interval
d_x = Number dying during stage x
$100q_x$ = Percent apparent mortality
S_x = Survival rate within stage
e_x = Life expectancy

Using the age-stage life table based on both sexes (Chi 1988), the variable developmental rates among individuals have been accounted for but not so when using the single-sex age-specific female life table developed by Birch (1948). By including both sexes in the analysis, the variation in developmental rates was then integrated sequentially for all stages and expressed in the form of a stage distribution (Chi 1988). Since *O. furnacalis* is a lepidopteran and not parthenogenetic, both males and females are economically important. It is therefore more appropriate to construct the life table based on both sexes. Moreover, the development rates may differ between the sexes and susceptibility to either chemical or biological control agents may be quite variable among stages and sexes.

Although this study was carried out in the laboratory excluding effects of natural enemies and varying weather conditions, the life tables of *O. furnacalis* thus produced will be useful for evaluating effects of a range of environmental conditions upon the population growth. However, to utilize the data for computer modelling and simulation study of the field populations of this pest, we need to incorporate changing environmental variables and produce a "dynamic life table" (Hughes 1963; Southwood 1978; Gutierrez & Wang 1984).

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