SURVIVAL OF *Heliothis* EGGS AND LARVAE ON DARLING DOWNS CROPS.

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INTRODUCTION

Because of the ephemeral nature of habitats frequented by *Heliothis*, population densities can change radically and rapidly over time and space as egg-laying, deaths and movements occur.

By focusing on consequent fluctuations in population numbers we can begin to understand why *Heliothis* are a problem in particular areas. The major tool used to study the demographic causes of population fluctuations, while "ignoring" migration, is the life table, and such studies provide important information at three levels -

(i) by showing which crops, areas, times and conditions favour the survival of *Heliothis* immatures and hence contribute to the infestation of later crops,

(ii) by accounting for how *Heliothis* numbers within field infestations are controlled, and

(iii) by identifying natural enemies and assessing their effect on the immature stages of *Heliothis*, whereby directions for possible future biological control attempts are flagged.

My objective has been to construct life tables describing *Heliothis* egg and larval survival on the major crops of the Darling Downs over several seasons.

METHODS

Study Area : All work was carried out in blocks within growers' crop fields on farms in a 200 km^2 area just south-east of Cecil Plains. Usual agronomic practices were applied except that the use of insecticides was barred.

Sampling : Regular counts of *Heliothis* eggs on plants in particular crop fields showed when egg-laying was occurring.

Egg sampling and marking was then carried out 3 times per week, generally with the eggs recorded over 3 to 5 consecutive sampling dates being included into the observed cohort for that block. A cohort is simply a group of individuals of the same age.

Eggs were marked by tatooing the nearby leaf surface with a fine-tipped felt pen. Eggs deposited after cohort numbers closed were wiped from the plants. Larvae hatching from marked eggs were tracked over plants by marking the site of each live larva at each sampling date. Cadavers were actively searched for during the whole plant examinations.

All individuals were observed over consecutive sampling dates until they died, disappeared or were collected as mature larvae prior to pupation. Where possible the reason for any deaths was recorded. Collected larvae were returned to the laboratory for incubation and identification of resultant pupae and moths. This also provided information on pupal parasitism.

RESULTS AND DISCUSSION

A total of 18625 Heliothis individuals in 52 cohorts have been observed.

Although the life tables constructed for these cohorts are not presented here, the k-values developed from those tables appear in Table 1. (A k-value is the difference between the log10 of numbers entering successive developmental stages, i.e. a k-value for egg mortality in a particular cohort is log10[total eggs] - log10[total 1st instar larvae]). A k-value effectively measures the intensity of mortality occurring within a developmental stage and is independent of the size of the cohort.

Table 1 shows that under natural conditions, regardless of crop, highest mortality and hence least survival (as indicated by highest k-values) occurred consistently during the 1st instar larval (LI) stage. Mortality within the egg stage was also intense.

This indicates that the survival curves for Heliothis immatures were similar in all studied crops (Slobodkin's Type IV) in which deaths most severely affect the early developmental stages.

However k-values varied widely between crops and, as demonstrated in sunflowers, between different fields of the same crop grown at different times during the season. The survival of Heliothis in cotton is CLEARLY different to that in sunflower, as is that in early sunflower crops compared with late season ones.

Three seasons' work have established a data base from which some interesting points are emerging. Firstly, the life tables imply that the role of natural enemies in reducing numbers is limited and this is supported by information from other aspects of the project work. Secondly, the causes of deaths occurring under natural conditions within the youngest developmental stages were generally not known by direct observation.

This places importance on the roles of weather and predation in limiting survival - which is further supported by results from caged-cohort studies (not reported here) in which weather and predation were shown to have measurable effects. The actual effect of weather can only be calculated by correlating residual survival rates with particular weather factors once the effects of other measurable mortality categories have been accounted for.

A continuing objective for the coming, final season for this project is to partition the observed mortality within the life tables into the broad categories of predation, parasitism, disease, weather and host plant quality.

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TABLE 1: k-VALUES IN DEVELOPMENTAL STAGES OF OBSERVED *Heliothis* COHORTS UNDER NATURAL CONDITIONS.

CROP	*	START	#IN	EGG	LARVAE LI	LII	LIII	LIV	LV	LVI	PUPA	#OUT
Chickpea	R	10/86	262	0.2186	0.4292	0.1635	0.0389	0.0580	0.0158	0.0	0.0637	19
Chickpea	R	10/87	554	0.5704	>2.1732	...						0
Cotton	V	12/87	527	0.3955	1.6274	0.3979	0.0	0.3010	0.0	>0.0	...	0
Cotton	R	01/86	297	0.4313	>2.0414	...						0
Cotton	R	01/86	73	0.9602	>0.9031	...						0
Cotton	R	02/86	86	0.8931	>1.0414	...						0
Cotton	R	12/86	585	0.8061	>1.9590	...						0
Cotton	R	02/87	450	0.5888	0.6603	1.2041	***	...				0
Maize	V	01/86	1654	0.4726	>2.7459	...						0
Maize	V	11/86	256	0.4398	0.9685	1.00	***	...				0
Maize	V	11/86	306	0.5614	0.9700	0.2553	0.2218	0.1761	0.3010	0.0	0.0	1
Maize	V	10/87	529	0.3992	1.8472	>0.4771	...					0
(Data collected for reproductive maize not yet processed)												
Mungbean	V	03/88	160	0.3233	0.4658	0.2389	0.2730	0.1249	0.0	0.0	0.1249	3
Pigeonpea	V	01/87	243	0.2489	0.4456	0.1717	0.2398	0.3245	0.1091	0.0669	0.0	4
Pigeonpea	R	03/87	374	0.5816	1.0881	0.2041	0.0	0.0	0.0	0.3979	0.3010	1

V = Vegetative phase
R = Reproductive phase

#IN = Number of eggs included in the cohort
#OUT = Number of resultant Heliothis moths

> = more than
*** = UNDEFINED (cohort goes to zero from a single previous individual.

TABLE 1: (continued) .....

CROP	*	START	#IN	EGG	LI	LII	LIII	LIV	LV	LVI	PUPA	#OUT
					LARVAE							
Sorghum	V	11/86	97	0.4186	0.4543	0.0726	0.4393	0.0	0.1249	0.0	0.1761	2
Sorghum	V	12/87	150	0.3372	0.4239	0.1139	0.3010	0.2218	0.0792	0.0	0.0	4
Sorghum	V	03/88	456	0.3176	>2.0607	...						0
(Data collected for reproductive sorghum not yet processed)												
Soybean	V	01/88	48	0.1131	0.6140	0.1761	0.4771	0.3010	0.0	>0.0	...	0
Soybean	V	01/88	503	0.0416	0.5138	0.1594	0.7827	>1.2041	...			0
Soybean	R	01/86	392	0.2609	0.8553	0.1984	0.3245	0.6532	>0.3010	...		0
Soybean	R	02/86	154	0.4715	1.2389	0.1761	0.3010	***	...			0
Soybean	R	02/87	267	0.5127	1.2148	0.3979	0.0	0.3010	***	...		0
Soybean	R	03/88	570	0.3436	2.3054	>0.0	...					0
Sunflower	V	03/88	305	0.3974	0.8487	0.3274	0.1249	0.6201	0.0	0.0	0.0	1
Sunflower	R	01/86	540	0.4335	0.6268	0.1406	0.0130	0.2175	0.3979	0.4260	0.0000	3
Sunflower	R	02/86	619	0.4821	0.4011	0.0760	0.0263	0.0902	0.1975	0.3424	0.0300	14
Sunflower	R	11/86	211	0.4854	1.5378	>0.3010	...					0
Sunflower	R	11/86	344	0.3634	0.7418	0.5863	0.5441	0.3010	0.0	***	...	0
Sunflower	R	12/86	514	0.3218	0.6110	0.1654	0.0687	0.0389	0.2041	0.0669	0.0621	13
Sunflower	R	02/87	361	0.4272	0.4228	0.0355	0.0810	0.0997	0.0600	0.1303	0.1091	7
Sunflower	R	11/88	155	0.4196	0.9258	0.1461	0.0969	0.3010	0.0	0.0	0.0	2

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