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BIOLOGY OF THE COTTON SEED BUG (OXYCARENUS LUCTUOSUS (MONTR. AND SIGN.))

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SUMMARY

The incubation period of the eggs averages between 6 and 7 days and development through the five nymphal stages requires approximately 23 days. Such development will not occur in the absence of seed material of cotton or other host plant. Under laboratory conditions adults lived for periods up to 121 days on dehusked sunflower seed and water.

Under field conditions adults may be present on cotton crops from seedling emergence to disposal of crop residues. Breeding does not occur until the bolls begin to open.

Eighteen alternative host plants are known; 17, mostly common weeds, belong to the Malvaceae and one to Sterculiaceae. The major weed hosts are *Malva parviflora, Hibiscus trionum, Pavona hastata, Anoda cristata, Abutilon oxycarpum, A. tubulosum* and *Sida rhombifolia.* These hosts, together with a long adult life, enable the pest to be present in numbers throughout the year.

I. INTRODUCTION

The cotton seed bug (*Oxycarenus luctuosus* (Montr. and Sign.)) has been associated with cotton in Queensland for many years. Ballard (1925, 1927) reported that the bugs fed on the seed of mature bolls, causing lint staining and a reduction in germination of seed. More recent authors, in discussing cotton pests in Queensland, have either omitted reference to the insect or indicated that its feeding causes no economic loss in cotton (Passlow 1967). In New South Wales, Wright (1965) suggested that it was not a major pest. A result of these different views is that little information on the biology and ecology of *O. luctuosus* is available. The present work covers an investigation conducted during 1963-66 on the biology of this insect, with particular reference to its seasonal history.

II. SPECIES DISTRIBUTION

According to Gross (1959) three species of *Oxycarenus* are present in Australia—*O. bicolor* Fieber, occurring in the far north of the continent; *O. arctatus* (Walk.) recorded in the southern part but not from Queensland; and *O. luctuosus,* which has been recorded from many areas in this State. Many of the early records of the genus in Queensland were referred to *O. arctatus;* for example, Officers of the Department of Agriculture and Stock (1951) stated that *O. arctatus* is a widely distributed minor pest of cotton in the State.

During the present investigations cotton seed bugs were taken from such widely scattered areas as Gatton, Warwick, Brookstead, Biloela, Theodore, Rockhampton, Emerald and Millaroo in Queensland; Narrabri in New South Wales; and Daly Waters in Northern Territory. All specimens were identified as *O. luctuosus*. In addition, examination of material held in the Department of Primary Industries insect collection showed that earlier records referred to *O. arctatus* belong to *O. luctuosus*.

III. HOSTS

A number of host records from the distribution study are given in Table 1. These records represent breeding populations of adults together with nymphs. In all instances seed material was present on the plants. The significance of this is discussed later. The insect has been recorded from cotton in all the Queensland districts in which the crop is grown and therefore the host is not included in the table. All of the localities mentioned are in Queensland, except Daly Waters, which is in Northern Territory.

TABLE 1

HOSTS OF *Oxycarenus luctuosus*

Plant	Locality	Collection Date
Fam. Malvaceae		
Abutilon micropetalum	Theodore	August 1965
Abutilon octocarpum	Daly Waters	May 1965
Abutilon oxycarpum forma *acutatum*	Mt. Russell	May 1964
	Bell	January 1965
	Bell	July 1965
Abutilon oxycarpum var. *subsagittatum*	Mt. Russell	May 1964
Abutilon tubulosum	Mt. Russell	May 1964
Anoda cristata	Kingaroy	February 1964
Hibiscus heterophyllus	Cooyar	March 1964
Hibiscus tiliaceus	Coochie Mudlo Is.	July 1964
Hibiscus trionum	Warwick	February 1964
	Laidley	March 1965
Malva parviflora	Toowoomba	September 1964
Malvastrum coromandelianum	Mt. Russell	May 1964
Malvastrum spicatum	Stoneleigh	April 1964
	Mt. Russell	May 1965
	Bell	January 1965
	Bell	March 1965
	Biloela	August 1965
Pavonia hastata	Toowoomba	February 1965; November 1965; December 1965
Sida cordifolia	Kilkivan	June 1965
	Gayndah	August 1965
Sida rhombifolia	Mt. Russell	May 1964
	Biloela	August 1965
Sida subspicata	Murgon	June 1965
Gossypium sturtii	Rockhampton	May 1964
Fam. Sterculiaceae		
Brachychiton sp.	Bell	July 1964

IV. SEASONAL HISTORY

The seasonal occurrence of *O. luctuosus* on cotton was studied from 1963 to 1966 on cotton crops at Brookstead and Warwick on the Darling Downs and at Gatton in the Lockyer Valley.

During seedling growth in October and early November, small numbers of adult *O. luctuosus* were present in most crops, shortly after the seedlings emerged from the soil. The bugs appeared to be sheltering on the under-surfaces of the leaves and on the upper surfaces in leaf folds and crinkles. These insects were not observed to feed and nymphal stages were not noted during this period.

The major square production of cotton in central and southern Queensland occurs during December and January. During this period small numbers, from 2 to 10, of adult bugs were recorded regularly from many of the growth terminals, and similar numbers were observed sheltering under the bracts below many of the larger squares. Mating pairs were not uncommon but feeding was not observed and nymphs were not recorded.

During January and February, when squares, flowers and green bolls constituted the fruit form production stages, adult *O. luctuosus* were present still in protected areas around the squares and green bolls, and sometimes within the flowers. Again there appeared to be no attempt at feeding and on only one occasion, during January, were nymphs observed. It is probable, however, that these nymphs moved from an adjacent malvaceous weed which carried a breeding population.

With the opening of bolls during March, breeding by *O. luctuosus* on the cotton commenced and from March to June populations of all stages were large in open bolls.

By July, when most crops had been harvested, breeding on remaining bolls declined sharply. Where the cotton bushes were allowed to stand over, adults remained in any bolls still present, but the numbers of nymphs decreased rapidly through July and August until, in September, no nymphs could be located.

In July 1964 a cotton crop at Warwick was slashed and ploughed in, but as usual some boll material remained on the surface. Examinations during July and August showed that no *O. luctuosus* were harboured amongst these boll remains. For further observations cotton bushes were allowed to stand over at Toowoomba until September in 1965, and despite frosts adults were present throughout the winter months until spring; on September 13, for example, eight *O. luctuosus* adults were taken from a random sample of 50 bolls on these plants.

These data show that *O. luctuosus* is unable to feed or breed in cotton in the absence of seed material. This was confirmed by the occurrences on other hosts, because on these egg-laying and breeding were observed only in the presence of seed material. The small numbers of adults encountered on cotton plants from the seedling stage until the opening of the bolls represent movement of adults from nearby alternative hosts.

The host data presented in Table 2 show that, depending on the distribution of alternative hosts, *O. luctuosus* is capable of breeding in some part of the State during every month of the year, and they provide an explanation for the regularity with which the insect is encountered on cotton during periods when breeding on this host is impossible.

To obtain more detailed information on seasonal history within a district, regular monthly random collections of 50 mature fruit forms were made from five common hosts within the Toowoomba-Mt. Russell region and the numbers of both adult and nymphal *O. luctuosus* present in each sample were recorded. The data obtained are presented in Table 2.

TABLE 2

GROWTH AND SEED PRODUCTION IN A NUMBER OF *Oxycarenus luctuosus* HOSTS IN THE TOOWOOMBA–MT. RUSSELL REGION DURING 1965 AND NUMBERS OF ADULT AND NYMPHAL *O. luctuosus* PER 50 "BOLLS" PER MONTH

Host and Insect Stage	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Abutilon oxycarpum forma *acutatum*	Green leaves, flowers, immature bolls	No record	Green leaves, flowers, mature bolls					Dry, dead stalks		Green leaves and flowers		
										Immature bolls	Mature bolls	
Adults	Nil	—	10	11	9	22	28	Nil	Nil	Nil	Nil	Nil
Nymphs ..			8	8	—	6	4					
Hibiscus trionum	Green leaves, flowers, immature and mature bolls						Dead bushes with mature seed bolls		No plant material			Green leaves, flowers, immature and mature bolls
Adults	> 50	> 50	> 50	> 50	> 50	> 50	> 50	Occasional adults only	—	—	—	15
Nymphs ..	> 50	> 50	> 50	> 50	> 50	> 50	> 50					16
Malva parviflora	No plants							Small bushes	Large bushes, flowers and mature bolls		Dead bushes, dry seed-heads	
Adults	—	—	—	—	—	—	—	Nil	46	49	> 50	> 50
Nymphs ..									37	34	> 50	> 50
Pavonia hastata	Green leaves, flowers, immature and mature bolls				Dead bushes, no bolls					Green leaves, squares	Green leaves, flowers, immature and mature bolls	
Adults	> 50	> 50	> 50	> 50	19	Nil	Nil	Nil	Nil	Nil	12	28
Nymphs ..	> 50	> 50	> 50	> 50	30						Nil	2
Sida rhombifolia	No records				Green leaves, flowers, immature and mature bolls		Green leaves with dry mature bolls			Green leaves but no boll material		
Adults	—	—	—	—	14	43	41	No record	43	Nil	Nil	Nil
Nymphs ..					5	25	23		30			

V. LIFE HISTORY

The details of the life history were investigated in the laboratory at Toowoomba. The period required for the egg stage was determined from observations of 100 newly deposited eggs placed in an incubator in which mean daily maximum and minimum temperatures were respectively 88·00 ± 2·14°F and 74·29 ± 3·71°F. The results are given in Table 3.

TABLE 3

NUMBER OF DAYS REQUIRED FOR EGG HATCHING AND NYMPHAL INSTAR DEVELOPMENT OF *Oxycarenus luctuosus*

Incubation Period (days)		Instar Periods (days)							
		1st & 2nd Instars		1st, 2nd & 3rd Instars		1st, 2nd, 3rd & 4th Instars		1st, 2nd, 3rd, 4th & 5th Instars	
Period	No. of Eggs	Period	No. of Insects	Period	No. of Insects	Period	No. of Insects	Period	No. of Insects
4	18	7	6	10	6	14	5	15	1
5	6	8	17	11	31	15	1	18	4
6	7	9	20	12	15	17	2	19	3
7	69	10	22	13	9	18	3	20	1
8	17	11	11	14	5	19	5	21	9
9	Nil	12	7	15	3	20	3	22	11
10	1	13	6	17	4	21	2	23	9
		14	1	18	3	22	1	24	16
				23	1	26	1	25	8
						27	3	26	5
								27	4
								28	2
								29	1
								35	3
								36	1
Mean development time (days)									
6·55 ± 1·29		9·72 ± 1·66		12·44 ± 2·37		19·19 ± 4·06		23·71 ± 3·73	
No. of Insects									
118		90		77		26		78	

Eggs are not laid on vegetative plant parts. Under field conditions they are deposited in small groups of 4–7 on the lint of open or opening cotton bolls and on the mature seed-heads of malvaceous weeds. Eggs are not laid until the host plants provide these conditions.

Nymphal development was studied by rearing specimens in the laboratory and recording numbers of instars and instar periods according to wing bud development. Considerable difficulty, however, was experienced in distinguishing between the first and the second instars. For this reason instar periods are expressed as first and second together, first to third, first to fourth and first to fifth respectively. Specimens were reared in clear plastic petri dishes of approximately 3½ in. diam. and ½ in. in height. Husked sunflower seed was provided as food, moisture being given in the form of a water-soaked cotton-wool pad and a small piece of crinkled black filter paper being added to each dish to act as cover for the developing insects.

The work was carried out during the period from May to June 1964 in an incubator set within the temperature range mentioned above. The results are given in Table 3.

A further facet of the life history, namely adult longevity, was studied in the period from March to July 1965 in a warmed insectary at Toowoomba. Fifty insects were transferred to petri dishes as above immediately they became adult and observations on length of life were made daily. The data obtained are given in Table 4.

TABLE 4

Oxycarenus luctuosus—ADULT LONGEVITY

Number of days of adult life and maximum and minimum laboratory temperatures (°F) during the study

Length of Life (days)	No. of Insects	Maximum and Minimum Temperatures (°F) per Week		
		Period	Maximum	Minimum
1	1	March 8–14	76·2	73·0
2	2	15–21	73·0	69·5
7	4	22–28	72·5	71·1
8	1	March 29–April 4	72·4	71·1
11	1	5–11	72·1	69·0
14	2	12–18	70·9	69·0
17	1	19–25	72·7	70·0
18	1	April 26–May 2	64·0	62·5
25	2	3–9	64·0	62·6
26	5	10–16	66·0	64·0
28	3	17–23	62·0	60·6
29	2	24–30	62·0	60·0
38	1	May 31–June 6	61·0	59·9
40	2	7–13	61·0	60·0
41	3	14–20	59·0	57·5
43	2	June 21–July 4	59·0	57·5
44	1	5–11	58·3	56·0
52	2			
67	2			
69	1			
72	1			
76	1			
93	1			
107	1			
109	1			
114	2			
115	2			
117	1			
121	1			
Mean 45·36	Total 50		Mean 66·2	Mean 64·3

These life history data show that *O. luctuosus* eggs hatch in approximately 6–7 days. During nymphal development the insect passes through five instars. These required approximately 9, 3, 7 and 4 days for development through the first plus second, third, fourth and fifth instars respectively, complete nymphal development being completed in approximately 23 days. Adults lived up to 121 days, with a mean adult life of 45 days under the conditions of the study.

VI. NYMPHAL FOODS

Further support for the conclusion that *O. luctuosus* can feed only from mature or maturing seeds was obtained by placing groups of fourth and fifth instar nymphs upon cotton squares, near-mature green cotton bolls, cotton seed and dehusked cotton seed. The data obtained are given in Table 5.

TABLE 5

PRODUCTION OF ADULT *Oxycarenus luctuosus* AND SURVIVAL FROM 50 4th AND 5th INSTAR NYMPHS ON FOUR FOOD SOURCES

Food Source	No. of Adults Produced	Days to Production of Last Adult	Maximum Life Duration (days)
Cotton squares	3	1	4
Cotton bolls (green)	25	3	12
Cotton seed	34	15	30*
Sunflower seed	42	17	30*

* Experiment terminated at 30 days; 19 adult insects alive on cotton seed at termination; 24 adult insects alive on sunflower seed at termination.

These results showed that on squares and green bolls only those insects which were virtually ready to transform from fifth instar to adult at the time of commencement of the trial became adult. On cotton and sunflower seeds, on the other hand, most individuals became adult and lived satisfactorily for some time.

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