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Developments in the Control of Coconut Scale, *Aspidiotus destructor* Sign. in Sri Lanka

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ABSTRACT

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Studies were commenced on an intensive biological control programme of the coconut scale, *Aspidiotus destructor* Sign. in Sri Lanka. Out of the natural enemies of the coconut scale recorded, an aphelinid parasite *Aphytis chrysomphali* Mercet and two coccinellid predators, *Chilocorus nigritus* F. and *Pullus xerampelinus* Mulsant were found to be important, the latter being recorded for the first time from Sri Lanka. Other indigenous predators recorded for the first time are two coccinellids, *Chilocorus circumdatus* Sch., *Pullus* sp.? *coccidivora* Ayyar and a nitidulid *Cebocephalus* sp. *Ch. nigritus* and *P. xerampelinus* were attacked by parasites, *Homalotylus flaminius* Dalman, *Syntomosphyrum* sp. nr. *obscuriceps* Ferriere and *Aminellus indicus* Kerrich. A hyperparasite *Lygocerus* sp. on *H. flaminius* was also recorded. The coccinellids *Cryptognatha nodiceps* Mshl., *Lindorus lophanthae* Blaisd. and *Chilocorus cacti* L. were imported, mass multiplied on coconut scale on pumpkin and released in the field. They were unable to establish. The risks of using kerosene oil/soap emulsion by causing mortality of predators have been evaluated. Control measures for coconut scale in Sri Lanka are suggested.

INTRODUCTION

Aspidiotus destructor Sign. (Hem: Diaspididae) is a pest of several tropical crops. It has been recorded in Fiji on 22 varieties of plants including coconut and banana (Taylor, 1935), and on coconut in Hawaii (Hawaii Insect Report, 1968), Principe (Simmonds, 1960) and in several other countries (Lever, 1969). In Sri Lanka *A. destructor* was first reported on coconut by Hutson (1920). It is a serious pest on coconut in North Western, Western, Southern and sometimes in the North Central Provinces of Sri Lanka.

In Sri Lanka measures adopted for the control of scale pest are:

a. Spraying of kerosene oil/soap emulsion and b. Use of the indigenous predator *Chilocorus nigritus* F. The predator known for a long time in Sri Lanka is *Ch. nigritus* (Anon, 1965). In some countries successful biological control of *A. destructor* has been achieved by the use of predatory coccinellid beetles. In Fiji, a scale infestation was eradicated by introducing *Cryptognatha nodiceps* Mshl. (Taylor, 1935). *Cr. nodiceps* also gave successful control of coconut scale within two years of its release in Principe (Simmonds, 1960). Using another predatory beetle, *Lindorus lophanthae* Blaisd. outbreaks of scale pest were controlled in five months in Efate Island in the New Hebrides (Cochereau, 1965). The predators had been bred on coconut scale reared either on banana leaves (Taylor, 1935) or on potato tubers (in Pakistan) (Ahamad and Ghani, 1970).

In 1974, an intensive biological control programme was initiated by the importation, mass rearing and field releases of three coccinellid species from Trinidad *viz. Cryptognatha*

nodiceps Mshl., *Lindorus lophanthae* Blaisd. and *Chilocorus cacti* L. The studies reported in this paper are on indigenous natural enemy complex, breeding and colonization of imported coccinellids and the effects of kerosene oil/soap emulsion on the coccinellid predators.

MATERIALS AND METHODS

1. Indigenous natural enemies

Predators of the coconut scale in the field were collected and identified. The insect specimens that were observed to be parasitised were kept in the laboratory for observation and the insects which emerged were identified.

2. Introduced predators

Imported predators were mass multiplied on a laboratory culture of *A. destructor*.

(i) Preparation of host material

A. destructor was established on the surface of the fruits of *Cucurbita maxima* (pumpkin squash). Fruits selected for this purpose had their stalks intact and were fully mature, fresh, free from insect attack or injury and of convenient size to permit accommodation in insect breeding cages (45 x 3 x 30 cm) (Fig. 1), which had glass sides, a glass door, muslin-cloth tops and a hardboard bottom. The fruits were thoroughly washed in tap water to remove any surface dirt and surface sterilized by swabbing with 0.1% formalin solution. The fruits were then washed with sterile distilled water and air-dried in the laboratory.

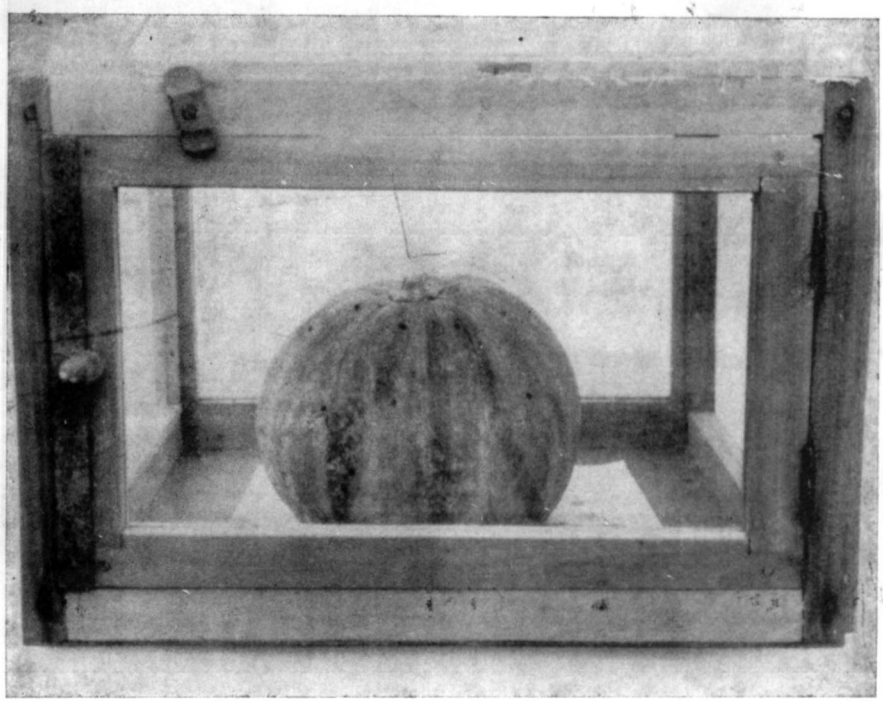

Fig. 1. Coccinellids breeding on *A. destructor* infested *C. maxima* fruit in cage.

(ii) Inoculation

Coconut leaflets infested with *A. destructor* were collected from the field. Leaf pieces (15-20 cm) containing crawlers or hatching eggs were wrapped round the fruits and held by rubber bands with the infested surface in contact with the fruits (Fig. 2). Inoculated fruits were incubated at 22°C in dark as the crawlers prefer dark. The fruits got infested within 4-5 days. Afterwards, coconut leaflets were removed and the fruits were left for 20 days under the same conditions for further development of scales.

Fig. 2. Infesting *C. maxima* fruits with *A. destructor* found on coconut leaflets.

(iii) Collection of predators for field releases

Mating pairs of each species of the predators were separately released on caged scale-infested fruits of *C. maxima* (Fig. 1). Ten pairs each of *Cr. nodiceps* and *L. lophanthae* and five pairs of *Ch. cacti* were released separately. Newly hatched out larvae were transferred with a camel hair brush on to pieces of scale infested coconut leaflets (15 cm) which were kept in glass tubes (12 x 2 cm), the open end of which was covered with muslin cloth. Fresh feeding material was provided every 48 h until pupation. The adults were then collected into glass tubes and fed on *A. destructor* on coconut leaflets for seven days before release in the field.

(iv) Colonization in the field

In short palms (*ca* 2 m in height) the predators were released on infested fronds from ground level while in tall palms, they were released at the crown level. Table 1 gives the number of predators released in North Western, Western and Southern Provinces in 1974, 1975 and up to August, 1976. Regular monthly observations were made in the field of the liberated predators.

Table 1

Release of exotic predators from 1974 to August, 1976

Number released

Predator	*North Western Province*	*Western Province*	*Southern Province*	*Total*
Cr. nodiceps	18,869	2,824	4,666	26,359
L. lophanthae	7,047	300	850	8,197
Ch. cacti	768	—	—	768

(v) **Field experiment**

In the field 10 males and 10 females of *Cr. nodiceps* adults were released on a scale infested coconut frond and caged in a cloth bag to observe the longevity and fecundity. This experiment was repeated three times.

3. The effect of kerosene oil/soap emulsion on coccinellids

The effect of kerosene oil/soap emulsion was tested on *Ch. nigritus* and *P. xerampelinus*, the indigenous predators and *Cr. nodiceps* and *L. lophanthae*, the exotic predators. The mortality test comprised three replications for each species of the predator with 20 larvae and 30 adults per replicate. The kerosene oil/soap emulsion was prepared using the following ingredients as described elsewhere (Anon, 1965). The emulsion was diluted 10 folds with water.

Kerosene oil	—	2	l
Water	—	1	l
Laundry soap	—	5	g

For this experiment, exotic predators were obtained from laboratory cultures and the indigenous predators were collected from the field. Adult predators were caged in the insect breeding cage (Fig. 1) with feeding material. The larvae were caged in glass tubes of 15 x 2 cm with scale infested leaflets. The insects were sprayed with diluted kerosene oil/soap emulsion using a hand sprayer capable of giving continuous even spray. For control, insects were sprayed with water. The adults were sprayed inside the cage and were supplied with fresh *A. destructor* on coconut leaflets. The larvae were sprayed while on scale infested coconut leaflets and transferred on to fresh scale-infested leaflets and caged at the rate of five individuals per tube. Observations were recorded on the mortality of the predators at 24 h intervals after spraying.

RESULTS

1. Indigenous natural enemies

(i) **Parasite**

An aphelinid ectoparasite identified as *Aphytis chrysomphali* Mercet (Hymenoptera) was found in all coconut growing areas, sampled. It provided good control of coconut scale in certain localities. More than 500 adult parasites emerged from four scale infested coconut leaflets in the laboratory.

(ii) **Predators**

The following predators were recorded:

(a) *Chilocorus nigritus* F. (Col: Coccinellidae)

(b) *Pullus xerampelinus* Mulsant (Col: Coccinellidae)

(c) *Chilocorus circumdatus* Sch. (Col: Coccinellidae)

(d) *Pullus* sp.? *coccidivora* Ayyar (Col: Coccinellidae)

(e) *Cebocephalus* sp. (Col: Nitidulidae)

Except for *Ch. nigritus*, the other predators are recorded in Sri Lanka for the first time.

From the field collected parasitised specimens of *Ch. nigritus* and *P. xerampelinus*, the following hymenopteran parasites were recorded for the first time:

(a) From *Ch. nigritus*—*Homalotylus flaminius* Dalman (Encyrtidae)—from larvae and pupae and *Syntomosphyrum* sp. nr. *obscuriceps* Ferriere (Eulophidae)—from larvae. The parasitism in the field by these two parasites was observed to range from 4-28% with an average of 18%.

A hymenopteran hyperparasite *Lygocerus* sp. (Ceraphronoidea) was also observed on *H. flaminius*.

(b) From *P. xerampelinus*, *Aminellus indicus* Kerrich (Encyrtidae)—from prepupae and pupae. The parasitisation in two estates ranged from 10-24%

2. Introduced predators

When introduced predators were released they readily settled on scale-infested coconut leaflets and started feeding. All coccinellids found at points of release were collected and identified. However, introduced predators were not recovered in spite of several attempts. *Cr. nodiceps* adults, which were released three times on the caged scale infested coconut frond, died within 12 days of release. They did not reproduce.

3. The effects of kerosene oil/soap emulsion on coccinellids

Larvae of all coccinellids died within 24 hours after spray. The adult predator mortality was the highest in *L. lophanthae*. Mortality was initially evident within 48 h of spraying but further mortality was negligible (Fig. 3).

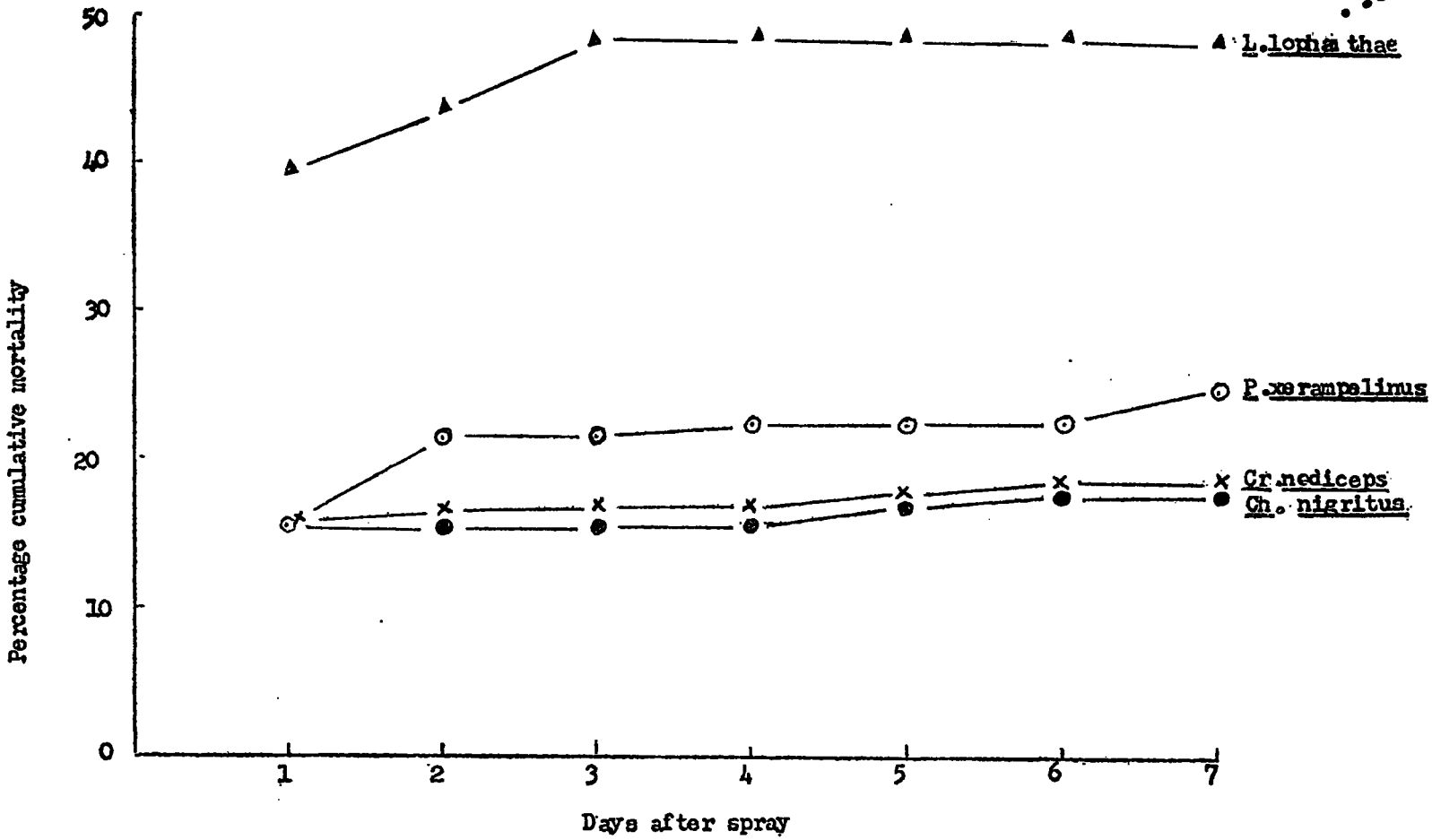

Fig. 3. The effect of kerosene oil / soap emulsion on adult coccinellid predators.

DISCUSSION

Of the indigenous natural enemies of *Aspidiotus destructor* in Sri Lanka, the parasite *A. chrysomphali* and the predatory coccinellids *Ch. nigritus* and *P. xerampelinus* were found important. Their population was observed in assessible densities from initial stages of scale outbreaks up to the complete disappearance of the pest whereas the role of other lesser important predators appear to be insignificant. However, one drawback is the presence of the parasites *Homalotylus flaminus*, *Syntomosphyrum*, sp. nr. *obscuriceps* and *Aminellus indicus* on the important predators mentioned above. However, the activity of the parasite *H. flaminius* could be checked by the hyperparasite *Lygocerus* sp.

As recoveries were not made of the exotic coccinellids from the field it is possible that they did not establish, perhaps due to climatic conditions of areas where they were released.

From the kerosene oil/soap emulsion experiments on coccinellids, 100% larval mortality and a considerable adult mortality were observed. This is noteworthy in view of the present practice of using kerosene oil/soap emulsion for the control of coconut scale outbreaks. It can only be recommended when the predators in the field are few and are in their adult stage. It is possible that use of kerosene oil/soap emulsion under certain conditions could lead to increase of the coconut scale, as seen with some of other pests. According to Huffaker and Messenger (1964), Bartlett (1964), Wood (1971) and De Bach (1974) pesticides increase the pest numbers by destroying its natural enemies.

During early stages of an outbreak, the scale pest could be controlled by cutting and burning the affected fronds. However, this cannot be used when the pest outbreak is in an advanced stage. Under such circumstances, it is necessary to assess the parasite/predator complex, and if they are found in sufficient numbers, further control activities may not be warranted. If they are insufficient, attempts may be made to mass - breed and release the predators or collect from areas where they are abundant and re-distribute in infested areas.

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