

How Pest Infestations Occur with Special Reference to Coconut

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SUMMARY

An account is given of the major factors which contribute to the occurrence, spread and fluctuations of pest infestations with special reference to coconut in Sri Lanka. Some preventive and control measures and studies that would be useful in eliminating, reducing or controlling pest infestations are suggested.

INTRODUCTION

The purpose of this article is to outline the major factors responsible for the occurrence of pest infestations on coconut estates and to suggest possible methods of controlling and preventing them.

Before the advent of crop husbandry the "balance" in nature was such that a large variety of plants and animals existed in a state of apparent equilibrium. Under these conditions, a diversity of plants of different species would have been growing side by side and plants of the same species may not have been found in large numbers in close proximity to each other.

Let us consider the position of a specific insect pest under such a situation. If the insect completed feeding on one plant, or was obliged to go in search of another host plant, then it had to move over a large number of plants of other species (on which it may not have fed) before reaching another host plant, so that the problem of any pest insect developing as an infestation was reduced.

History reveals that in early times men were essentially hunters who gradually gave up their wandering habits and became herdsmen and cultivators. The type of agriculture practised by these "farmers" does not appear to have caused serious out-breaks of pests and diseases. The introduction of what may be called monoculture, that is, the cultivation of a single species of plant on the same land area over a long period of time, was more conducive to the spread of pests and diseases. Under such conditions an insect pest had little difficulty in moving from one host plant to another and in many instances had only to 'slip and fall' to find that it has landed on yet another plant of the same species. In other words, food, one of the most important requirements for a voracious, quick-growing pest insect, became available in relative abundance, consequent on man upsetting the 'natural balance' in favour of the pest by providing it with a plentiful supply of food and more favourable breeding grounds. These relatively recent cultivation practices saw the beginning of man's constant problems with pest and disease infestations.

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The problem that confronts us now is to determine, and subsequently control where possible, the conditions which contribute to the occurrence and spread of pest infestations under present agricultural patterns.

The mere occurrence of a pest should not be considered as an infestation. The term infestation signifies the occurrence of a pest at population levels which cause significant economic damage. To cause serious damage a pest must be present in sufficient numbers; this will vary from pest to pest and with the nature of damage to the host plant. Thus, relatively large numbers of a pest such as the coconut scale, *Aspidiotus destructor* Sign., would be necessary to cause significant damage and reduce yield; whereas, a few red weevils *Rhynchophorus ferrugineus* F., may be sufficient to cause serious damage to young palms.

CONDITIONS REQUIRED FOR PEST INFESTATIONS

There are four main conditions which are essential pre-requisites for the occurrence and spread of pest infestations. These are :—

1. the presence of the pest insect (or organism) in sufficient numbers ;
2. the availability of the food plant in a suitable condition ;
3. favourable environmental conditions such as climate, weather, vegetation etc. ; and
4. the locality must be comparatively free from natural predators; parasites and diseases of the pest.

1. Presence of the pest insect

Obviously, the presence of the pest insect or organism is an essential condition to the occurrence and spread of pest infestations. This is a factor that can be controlled to some extent. Firstly, it is possible to prevent the introduction of pest material into new areas. For instance, there is a strict procedure of quarantine, fumigation and careful observation to prevent the introduction of pest material from one country to another.

An extension of the general principle behind quarantine procedures, adopted between countries, to estates may help in reducing the frequency of pest infestations. Estate owners and planters should be careful of the planting material etc. they bring into their land, because this could be a potential source of pests. For example, leaf-eating caterpillars, scale insects, weeds etc. can be easily transported along with coconut seedlings if they are not properly selected. Coconut leaves collected from estates infested with the coconut caterpillar, *Nephantia serinopa* Meyr., could carry the pest to new areas.



A potential breeding ground for the black beetle—coir dust, with palms in the vicinity that have been attacked by the pest.

Regular and careful inspection of young palms for attack by the red weevil and the use of the red weevil trap (CRI Leaflet No. 37) can help considerably in preventing and reducing the occurrence and spread of this pest. Estate sanitation helps in eliminating common pests such as the black (rhinoceros) beetle, *Oryctes rhinoceros* L., rats, bandicoots and porcupines (C.R.I. Leaflet No. 50).

Once a pest has been introduced to an estate and is noticed in the very early stages, it is advisable to aim at complete eradication; and the age old practice of "cut or remove and burn" could very well be used to advantage. The vigilance of the estate superintendent would, undoubtedly, be very helpful in achieving this.

When a pest organism has established itself and spread into infestation proportions, it is extremely difficult, and sometimes almost impossible, to completely eradicate it. What is often aimed at in such a situation is not so much the complete eradication of the pest, but the check or control of the pest to low population levels, at which the economic loss is not significant. This is done through the spraying of insecticides, biological control, cultural methods including estate sanitation etc. The use of predators and parasites in the (biological) control of insect pests is now receiving more and more attention.

2. Availability of the food plant in a suitable condition

The attractiveness of the food plant to a pest is being investigated for its possible use in pest control. The host plant may be attractive to the pest if it is in a "favourable" stage of development and condition of growth; or it may be in a particularly susceptible state for pest and disease infestations. An example of the former is seen in coconut where young palms with thick sappy trunks are more prone to attack by the red weevil than are young palms with hard fibrous trunks; this pest rarely attacks mature palms. Thus, where conditions appear favourable precautionary measures should be taken to a greater extent.



A section of a caterpillar-infested frond showing larval galleries.

Plant susceptibility to pest and disease attacks could either be inherent (genetic) or due to some other factor such as nutrient deficiency. In inherent susceptibility attempts are made to breed less susceptible (or more resistant) varieties. An example of breeding for pest resistance is seen in the development of high-yielding varieties of rice, such as TKM-6, which are highly resistant to rice stem-borers and also to many other common pests and diseases. [This quality of TKM-6 was used in hybridisation programmes for the production of varieties with insect and disease resistance together with a potential for high yield and good quality grain. The new variety IR 20, a hybrid incorporating TKM-6, possesses these qualities.

(IRRI-Annual Report 1969). Breeding for resistance is more common with diseases than with pests. Work on disease resistance in coconut is being done in Jamaica where the Malayan Dwarf variety shows every indication of high resistance to lethal yellowing (Harries 1969).

A nutrient imbalance or deficiency in a crop plant could predispose the plant to attack by pests and diseases. This is seen in the case of Leaf Blight of coconut, where phosphate deficiency is a predisposing factor.

3. Favourable environmental conditions

The requirement of favourable environmental conditions, such as climate, weather and vegetation for pest outbreaks in infestation proportions, is also an important factor. Climate and weather however, have obvious limitations in their use as controlling factors.

Heavy rain could often affect populations of the coconut caterpillar and the coconut scale. The coconut caterpillar lives inside galleries constructed out of its faecal pellets and silk. During very heavy and prolonged rain these galleries get thoroughly soaked and this causes a high mortality of caterpillars in the very early stages (1st and 2nd instars). The bigger caterpillars and adult moths also do not seem to find conditions of heavy continued rain favourable. Thus, the coconut caterpillar thrives during dry weather.

Climate and weather factors are beyond human control, but vegetation and the general surroundings could be manipulated to some extent and used to advantage in controlling or reducing pest attacks. This is clearly demonstrated by the prevalence of that ubiquitous pest of coconut, the black (rhinoceros) beetle. Observations indicate that the damage caused by the black beetle is relatively high in estates where dead and rotting logs abound and around fibre mills with fibre-dust heaps. Likewise, undergrowth of weeds in a coconut plantation is generally recognised as a favourable breeding ground for rats which attack seedlings and tender nuts.

The important influences of vegetation are twofold: it could either serve as an alternate source of food supply or provide shelter or both. Thus in the Eastern Province the coconut caterpillar is also found on palmyra palms (*Borassus flabelliformis*) which grows alongside with coconut palms. During the unfavourable periods of heavy, continual rain, the coconut caterpillar larvae on the palmyra appear to be better sheltered (by the thick broad leaves) than those on coconut. It is possible that the larvae on palmyra are affected to a lesser extent by rain under these conditions. It is also observed that very often the coconut caterpillar on the palmyra palm is less accessible to parasitic insects, predatory birds and spiders. Thus on coconut estates where there are palmyra palms it has been observed that the coconut caterpillar infestations sometimes originate, or are heavier, in the areas around the palmyra palms.



A young palm that has been attacked by the black beetle.

4. Absence of Natural Parasites and Predators

For a pest to spread rapidly the habitat should be comparatively free from parasites, predators and other biological control agents. A large number of pest species have a variety of parasites, predators, diseases etc. which cause mortality in various stages of their life cycles. In a number of cases the respective biological control agents are capable of keeping pests under control, thereby preventing pest infestations. Under favourable conditions the population of a pest species tends to increase and if these conditions continue over relatively long periods, the pest populations may grow into "outbreak" or infestation proportions. Under such conditions "temporary biological control methods" of breeding and releasing large numbers of naturally occurring parasites and predators could be used to bring the infestations under control.

For the control of the coconut caterpillar in Sri Lanka the Coconut Research Institute operates a biological control project with Parasite Breeding Stations at Lunuwila in the North-Western Province and at Mylambavely in the Eastern Province. Parasites of the coconut caterpillar are bred on a large scale at these two stations and the parasites are supplied free of charge to planters on request.

When a pest species which is controlled in its original habitat by parasites, predators or other biological control agents, is introduced into a new locality free from its original controlling agents, then the spread of the species may go on unabated, provided other conditions are favourable. There are many cases on record, where such situations have been brought under control by the timely introduction of biological control agents, very often collected from the original 'home' of the pest species. An example is the control of coconut scale in the Portuguese island of Principe in 1955 by the introduction of the lady bird beetle *Cryptognatha nodiceps* from Trinidad. (Simmonds 1963).

If the populations of parasites and predators are reduced for instance by the spraying of insecticides, it may result in pest outbreaks. An example of such a situation was seen when dieldrin was sprayed against the shot-hole-borer, *Xyleborus fornicatus* of tea, continuously over a period of three years. This gave rise to the appearance, in considerable numbers, of two other pests of tea, the twig caterpillar, *Eotropis bhurmitra* Wkr., and the looper caterpillar, *Biston suppressaria* Gn. These



A *Corcyra cephalonica* larva paralysed by the parasite *Perisierola nephantidis* prior to egg laying.

two pests were probably kept under control by their respective parasites before the spraying of dieldrin and they came into prominence when their parasites were destroyed by the insecticides. The twig and looper caterpillars are considered potentially more dangerous than either the shot-hole-borer or the tea tortrix. These findings resulted in the withdrawal (in 1966) of all previous recommendations for shot-hole-borer control using dieldrin and aldrin. (Danthanarayana 1966).

DISCUSSION

In pest control work a study of the life history and habits of the pest alone is not sufficient. A parallel study of the environment under which the pest lives, possible modes of introduction to new localities, alternate sources of food, the other animals and plants which co-inhabit the environment, behaviour and mortality of parasites and predators etc. are factors that would prove to be very useful in attempts at eliminating, reducing or controlling pest infestations.

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