RAT DAMAGE TO COCONUT - A REVIEW

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Rats are a serious pest of food, fodder and plantation crops and a carrier of a number of diseases. They inflict incalculable losses not only to standing crops but also to stored food grains. Rat damage to coconut has been reported from most Pacific territories, Jamaica, India and Lakshadweep islands of Indian Ocean. Damages to coconut in different ways have been reported to be caused by different species of rats. The nature and extent of damage and the control measures adopted are given in this review.

Species Involved

Smith (1967, 1969) and Williams (1974) reported that damage on coconut is mostly caused by various sub-species of *Rattus rattus*. But *Rattus exulans* is reported in some of the Pacific islands (Wodzicki, 1969; Smith, 1969). In Cook islands the rat species causing the greatest damage to coconut crops are reported to be *Rattus ratttus frugivorous* and *R. rattus alexandrinus* (Thomson, 1969). Mariano (1970) recorded only one species, *R. rattus mindenensis*, in his experimental area in Laguna. Sanchez *et al.* (1973) reported that *R. exulans* is apparently restricted to the coconut and shrub habitats. In Nicobar islands, Sadanandan (1975) reported damage of coconuts due to *Rattus rattus*. Rajasekharan *et. al.* (1975) reported that coconuts are attacked by *R. r. rufescens*. Koya *et al.* (1975), Natarajan *et al.* (1976) and Kurian *et al.* (1977) reported that coconut palms are attacked by *Rattus rattus*, *Bandicoto indica*, *Bandicota bengalensis* and *Tutera indica*. Urs (1979) reported that *B.bengalensis* cause severe damage to coconut seedlings raised in nurseries.

Nature and Extent of Damage

Marshall (1965) observed rats chewing male flowers of coconut palms but he concluded that it did not appear to affect the production. Yelf (1966) suggested that the feeding activity of rats on male coconut flowers caused significant premature nut fall. Minor damage to the male flowers was observed, but as there is a considerable excess of pollen, this is unlikely to have any effect on production. Smith (1967) found that the Polynesian rats do not climb the trees. However Wodzicki (1968) found that the Polynesian rats climb the coconut palms in the Tokelans. He also confirmed the observations recorded in 1967 and 1968 that all rats do their damage to coconuts while they are on the tree and not while on the ground. It was reported in Jamaica that the dwarf variety is more susceptible to rat damage than the Jamaica Tall probably because the palms are shorter and thus more accessible to the rats and because the fruit has a much thinner and softer husk. The water is also sweeter and may be more attractive to the rats. (Anonymous, 1969-70). A comparison of damage incurred by short and tall palms showed that short palms incurred significantly higher damage (Williams, 1971). The higher level of damage is

almost certainly due to the greater number of *Rattus exulans* foraging in such palm crowns. Wodzicki (1972) reported that *R. exulans* show a marked preference for certain developmental stages and varieties and the damage occurs only in the crowns. 86.5% of damage to nuts occurred at the stage when they begin to contain enough juice for drinking and the meat is starting to form.

In Fiji Williams (1974) reported that rats clearly favoured particular palms in all plantations resulting in over 75% of the damage being confined to 30% of the palms, particularly those under 10 m tall He also reported that in Fiji damage was mainly concentrated on coconuts aged 3 to 6 months and 90% of the damage occurs before the eighth month with most of the damage being inflicted by *R. rattus*. It is also noted that little damage occurred before the developing nuts are 3 months old, in spite of claims by earlier authors (Marshall, 1965; Yelf, 1966) that damage to very young or button nuts was important.

Damage of coconut varied considerably from month to month with seasonal trends in damage being apparent at only one site (Williams, 1974). Rajasekharan *et al.* (1975) reported that in coconut gardens in Andhra Pradesh more rats were found during July to September (40/rats/ha). The author has noted 98 rats/ha in a paddy-cum-coconut plantation at Kuttanad in central Kerala. Typical rat damage to coconut consists of one or sometimes two holes usually found burrowed near the nut's point of attachment (Rajasekharan *et al.*, 1975; Natarajan *et al.*, 1976). The rat burrows into the bony endocarp, drinks the water and very rarely eats the edible portion inside. The holes made by ratsare serrated and uneven (Rajasekharan *et al*, 1975). The damage nuts detach from the inflorescence two to six days after attack (Williams, 1974; Rajasekharan, 1975).

It is reported that in Lakshadweep *Rattus rattus* builds nests on the top of the palms and breeds there and at night comes down and damages household articles and provisions [Sethumadhavamenon, 1972] Natarajan *et al* [1973] reported that house rats inhabit the interspaces of nuts of coconut bunches in Kuttanad and destroy tender coconuts. They also reported that in severe cases even the crown of the palm is damaged. Serious damage to the leaf stalks results in the arrest of the vegetative growth of the palm. The other species of rats found causing damage to coconut are the *Bandicota bengalensis*, *B. indica* and *Tatera indica*. The former two are burrowing forms found living in burrows. They eat away the bole portion of the coconut seedlings and cause mortality [Natarajan *et al.*, 1976]. The maximum population was reported in October and November and minimum during April, May and June They reported that mature nuts are also damaged by *Ratius rattus* to a much smaller extent The same was reported by another earlier worker, Wodzicki [1972] and the damage was estimated to be only 0.8%. Urs [1979] reported that *B. bengalensis* attacks seedlings raised in nurseries at a particular growth stage consuming the collar region at the junction of the seed nut and shoot system. He found that damage starts when the seedlings are nine months old and continues thereafter. Maximum damage occurrs at 13th, 14th and 15th months after sowing.

Rats have been considered an agriculture problem in Fiji for many years particularly in relation to coconut. Turbet [1925] estimated that 10% of coconut crop was being lost by rats while Taylor [1930] who made the earliest detailed assessment of rat damage to coconuts calculated losses as 6.8% [3.6 nuts/palm/year] of the total crop. This figure was based on the difference between the number of nuts on the fourth bunch and the oldest bunch. This estimate prompted a further study by Paine [1934] and the loss was estimated to be 28% [23 nuts/palm/year] of the total crop. In Tavenni island, Simmonds [1951] reported that 51% of the fall of nuts two months before maturity was due to rats. In Laccadives, Kidavukoya [1955] reported that about 50% of the yield of coconut palms are damaged by rats. Lasella Sere [1955] found that 28% [9.6 nuts/palm/year] of the nuts produced were damaged by rats in Tahiti. Five years of observations in a plantation of 45-year-old coconuts in Philippines revealed that 14% of the nuts were lost by rat damage [Montenegro, 1962]. In Jamaica nut loss due to *R rattus* was reported to be 10 to 25 nuts/tree/year, ie 25 to 50% loss of the actual yield [Anonymous, 1962-63].

A survey over several years in Jamaica [Smith, 1967] recorded rat damage ranging from 5 to 71% [1.8-30 nuts/tree/year]. while a survey in the Gilbert and Ellice islands indicated that rat damage ranged from 16 to 77% ie. 2.8 to 23.2 nuts/tree/year [Smith, 1968].

Srivastava [1970] reported that the crop loss for coconut is estimated to be 5.7 to 16% by *Rattus rattus refescens*. A preliminary survey of rat damage to coconut in the province of Laguna showed an incidence ranging from 2.11 to 8.44% [Guerrero, 1971]. More recent estimate of damage in Pacific have come from Tongo where Pierce [1971] reported loss of 5% [2 nuts/palm/year]. Sethumadhavamenon [1972] reported that rats and rhinoceros beetles are the only two major pests of coconut in Laccadives. Of these rats are the most destructive pest which causes heavy damage to the extent of 20 to 25% of the total production. Polynesian rats (*R. exulans*), the only rodent present in the Tokelan islands, has destroyed up to 40% of the coconut crop in some areas [Wodzicki, 1972] In Comoro islands, 37% of nuts are reported to be damaged by rats [Delorme, 1973]. In Fiji, Williams [1974] conducted a 3-year survey of the incidence of damage by rats and revealed that the annual losses were relatively low, amounting to between 1.3 and 2.7 nuts / palm / year. Rajasekharan *et al.* [1975] reported that on an average 4.8% of trees are attacked by rats causing an actual loss to coconut to the extent of 8.7% of yield in infested garden.

Control

In control of rats no single method will bring down population below the level of economic injury. General cleanliness and sanitation are essential pre-requisites for rat control. Cleaning of crown of the palms and prompt removal of weeds in the seedling pits and nurseries will reduce the rat harbourage. As a rodent proofing, banding or sheathing of trees is done to prevent access of rodents to the crown. Kidavukoya [1955] reported that in Laccadives people use to put bands made of coconut leaves around the trunk of the palms. Rat hunting is also reported to be a usual practice there. Naidu [1960] suggested that rats can be successfully controlled by digging a trench around the seedlings and filling this and the whole nursery area with pure sand six inch deep as rats do not generally burrow through pure sand. Montenegro [1962] suggested poison baiting, trapping and wrapping the trunks with galvanized iron sheets for controlling the rats. He reported that poison baiting and trapping gave only temporary relief of rat damage in coconut plantations in Philippines. Complete protection of palms with trunks that did not deviate more than 15 degrees from the vertical was obtained by banding the trunks with 23 cm. wide strips of galvanized iron sheets at a height of 3 m. from the ground. Metallic strips of 15 and 18 cm. width were proved to be less effective [Montenegro, 1962]. Yelf [1965] suggested that hard aluminium alloy sheet is suitable for banding coconut palms in controlling rats. He reported that a width of 30 cm. is sufficient and can best be fixed at a height of 5 m., though a height of 3.6 m. from ground level is also effective. Bands of an aluminium alloy 0.15 mm thick have proved satisfactory and trials with plastic bands gave promising results [Yelf, 1966]. According to Mariano [1970] trunk banding was an efficient method of controlling rat damage to coconut fruits. He reported that he could collect 405 damaged nuts from 10 control palms while no nuts were lost in the trunk banded trees. In spite of claims by earlier authors [Kidavukoya, 1955; Montenegro, 1962; Yelf, 1965; Mariano, 1970] that banding coconut palms is effective to control the rats, Smith [1970] reported that banding coconut palms has not given adequate protection against rat attack on atolls of the Gilbert and Ellice islands. In crowded plantations where the tips of leaves of adjacent plants touch one another this may not prove effective since rats can freely move from one tree to another.

In an integrated pest management programme trapping plays an important role. Use of traps have been explored by different workers and various models were tested in several countries for trapping different species of rats. For obtaining an index of population density of rats in coconut groves a standard trapping technique was used (Wodzicki, 1968.) The traps were set 25 feet apart between coconut rows in a trap line which consists of 50 snap traps. Pieces of slightly toasted coconut meat was served as bait. The trap line was baited in the evening and observations were made for three successive days in each month for twelve months. Kurian *et al.* [1977] evaluated the preference of two types of indigenous traps in trapping different rat species associated with coconut plantations. They reported that snap-back-cum-noose trap [bamboo trap] is very effective in trapping the burrowing rats, *Bandicota bengalensis* and the plank trap or death fall trap is effective for trapping *R. rattus*, *Tatera indica* and particularly *R. indica*. The

percentage of catch by snap-back-cum noose trap and plank trap was reported to be 15.51% and 24.65% respectively.

Various predators were reported to be used in different countries for controlling rats. It is reported that the introduction of African barn owl to control rats in coconut groves, seems to be successful in Seychelles [Anonymous, 1959-60]. It is established that *Varanus indicus* makes some contributions to rat control in coconuts. The data from a study on Ifaluk atoll do favour further experimental introduction of these lizards in the South Pacific. The Japanese weasel, *Mustela siberica itatsi* is an alternative predator meriting serious considerations. Promising results in the Ryukyu islands warrant the experimental introduction of the Japanese weasel into South Pacific islands where severe damage to coconuts is caused by rats (Uchida, 1969). It is reported that trained dogs and cats are used for hunting dogs in Kuttanad and elsewhere [Natarajan *et al.* 1976]. In Kerala, the non-poisonous rat snake *Ptyas mucosus* is found to devour rats particularly *Rattus rattus* and hence wanton killing of non-poisonous snakes for their hides is to be prevented.

Both single dose and multiple dose poisons are used for rat control in coconut gradens. In Jamaica, use of warfarin in the control of rats was reported to be both effective and cheap. Experiments using coconut meal instead of corn meal have been carried out but the blocks are less attractive to rats. The low rate of application [1 block at every 5th or 6th palm] in use has been found to be adequate [Anonymous, 1964-65]. Placement of blocks on the ground is the easiest method of application and experiment showed no improvement in kill from placement of blocks in the crowns. Rat damage decreased from 14.5 to 0.5 nuts/palm/year in Jamaica as a result of large scale use of blocks [Anonymous, 1964-65]. Yelf [1966] reported that in small islands extermination of rats by means of poisoned baits may be preferable to banding. In Jamaica rat control using ½ lb poisoned blocks was successful [Smith, 1967]. The blocks were made from 11 parts oatmeal, 2 parts sugar and 11/4 parts warfarin mixed with 8 parts of molten wax.

In the coconut groves of the Ivory Coast the use of rat blocks containing rodenticides [anti-blood coagulant] sugar and corn-flour incorporated in paraffin wax has reduced losses by rat damage from 15-20% to negligible level [Mariano, 1967]. He reported that one block weighing about 170g is placed at the foot of every 6th palm, and one in the crown of the worst attacked palm. Thomson [1939] reported that in Cook islands poison baiting with a mixture of coconut and Na monofluoroacetate has proved preferable to traps and palm banding. Promising results have been obtained in baiting trials with warfarin and zinc phosphide although the latter material is limited because of its extreme toxicity [Smith, 1970]. Sethumadhavamenon [1972] reported that in Laccadives warfarin cakes has brought about a reduction of 91.3% in rat damage. In a heavily infested coconut garden in C. P. C. R. I. Campus at Kayangulam, the rat damage has been brought down to zero level during the course of two years by adopting an integrated method of control using various traps; single dose poison zinc phoshide, multiple dose poison warfarin and fumigant aluminium phosphide tablets [Kurian, 1978].

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