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MOTH PESTS OF AVOCADOS

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INTRODUCTION

Damage to avocado fruits by insect pests in South Africa has been well documented (Du Toit, De Villiers & Tuffin, 1979; De Villiers & Van den Berg, 1987; Du Toit & De Villiers, 1990; Du Toit, Steyn & De Beer, 1993; Erichsen, 1993; Erichsen, McGeoch & Schoeman, 1993). The economic loss experienced by the South African avocado industry as a result of these pests has also been determined (Dennill & Erasmus, 1991; Erichsen & Schoeman, 1992). The pest complex on avocados is ever increasing, with a fourfold increase in the number of pests over the last decade. Pest recruitment has been facilitated by the fact that avocado pests are highly mobile and polyphagous insects. Within the last five years the Nelspruit/ Hazyview region has seen sporadic outbreaks of both thrips and avocado beetle (Dennill & Erasmus, 1991; Erichsen, McGeoch & Schoeman, 1993). However, a group which has received little attention are the moth pests (Lepidoptera). Moth pests of avocado include False codling moth (*Cryptophlebia leucotret*a (Meyrick) *Tortricidae*), the Citrus leafroller (*Cacoecia occidentalis* Wlsm *Tortricidae*), the Apple leafroller (*Tortrix capensana* (Walker) *Tortricidae*), and Looper (*Ascotis reciprocaría reciprocaria* (Walker) Geometridae). Sporadic outbreaks and resultant economic losses outline the history of these moth pests on a variety of host crops (e.g. citrus and deciduous fruits). On avocados, damage by the moth pests reduces the marketability of fruit. However, data on the biology of the moth species, natural enemies, and their potential to inflict heavy crop losses are sorely lacking. The moth pests are discussed with particular reference to the importance of the group on avocados.

FALSE CODLING MOTH

Distribution and host plants

False codling moth (FCM) is indigenous to Africa south of the Sahara, but is also found on Madagascar and on Atlantic and Indian Ocean islands in close proximity to the African continent (Anon., 1984). The moth has been recorded as a pest of a variety of cultivated crops, deciduous, tropical and subtropical fruit crops, as well as many wild fruit trees and shrubs (Taylor, 1957; Catling & Aschenborn, 1974; 1978; Hill, 1979). In South Africa, FCM is a pest of a number of horticultural crops, including citrus, peaches, mangoes, guavas and avocados (Catling & Aschenborn, 1974; 1978; Daiber, 1976; Annecke & Moran, 1982; De Villiers & Van den Berg, 1987; Hill & Waller, 1988).

Economic importance

Of the moth pests that damage avocado fruits, FCM was found to be the most

significant (Erichsen & Schoeman, 1992). A survey conducted in the Nelspruit/ Hazyview region during 1991 found 1.32% of avocado fruit damaged by FCM (Table 1). The percentage fruit loss (both local and export) was calculated as totalling ca. R302 470 (Table 1). The cultivars Edranol, Hass and Pinkerton were most susceptible to attack by FCM (Erichsen & Schoeman, 1992). Reports of percentage cull as a result of FCM infestation over the past decade were not comparable to the results of Erichsen & Schoeman (1992) because, firstly, percentage damage was calculated from fruit that had already been washed and packed and, secondly, no distinction was made between similar damage symptoms (e.g. that of FCM and fruitfly). Hence, the importance of FCM could only be gauged in monetary terms.

TABLE 1
Percentage cull and equivalent loss in rands of avocado fruit in the Nelspruit/ Hazyview region by moth pests during 1991 (* all calculations include an estimate of 13% waste as determined by the South African Avocado Growers' Association).

MOTH PEST	% CULL	DAMAGE (RANDS)*
False codling moth	1.32	302 470
Leafrollers	0.34	78 010
Looper	0.15	38 928
TOTAL	1.81	414 700

Biology

FCM adults are nocturnal and live for only two to three weeks during which time the female mates several times (Annecke & Moran, 1982; Newton, 1990b). The eggs are oviposited on the fruit, or nearby, and the delicate nature of the eggs in addition to cannibalism by larvae ensures that most often only one larva matures on each fruit (Annecke & Moran, 1982). The larva burrows into the fruit and tunnels just beneath the skin of the fruit, forming a dark, sunburned scab-like lesion. Entrance holes on the fruit can be spotted by the white exudate and frass which is often apparent (De Villiers & Van den Berg, 1987; Du Toit & De Villiers, 1990; C.E., personal observation). However, such symptoms are easily confused with those of oviposition holes made by fruitfly.

The larva does not complete it's development within the fruit (Schwartz, 1978). Larvae reared in the laboratory by the authors were found to always exit the fruit upon pupation. Under natural conditions, the larva drops to the ground and pupates in a cocoon of fine soil particles on the soil surface or beneath leaf litter (Newton, 1990b; C.E., personal observation). FCM do not diapause, but over winter as adults, a result of which fruit can be attacked throughout the year. Damage to fruit by FCM facilitates entry of secondary organisms such as bacteria and fungi which lead to decay.

Natural enemies

Nine species of hymenopteran parasitoids and two predator species are known to attack FCM (Searle, 1964; Prinsloo, 1984). Ants are known to attack moth larvae and pupae when found on the ground. How many of these parasitoids are present or effective against FCM in avocado orchards has not been determined. Monitoring of FCM is possible with the use of pheromone traps. Growers may be well advised to

determine to what extent FCM is prevalent in avocado orchards and hence the contribution by this pest to fruit cull.

CITRUS AND APPLE LEAFROLLERS

Systematists have often considered leafrollers to be a "complex" group in which much needed clarity amongst the different species is required. Species identification, therefore, is often difficult and leafrollers recorded on different host plants may well be the same species. The habits of the Citrus and Apple leafroller are similar and will be discussed with general reference to the group.

Distribution and host plants

A number of leafroller species have been recorded as pests on a variety of crops, primarily throughout the temperate regions of the world (Ebeling, 1959). In South Africa, the Citrus and Apple leafroller have been recorded as pests mainly on citrus, apples, apricots, peaches, peas, coffee, ornamentals and avocados (Matthew, 1975; Bedford, 1978; De Villiers & Van Den Berg, 1987; Annecke & Moran, 1982; Newton, 1988; 1990a; Du Toit & De Villiers, 1990).

Economic importance

The importance of leafrollers as a pest of avocados is determined by their sporadic occurrence. Sporadic outbreaks on citrus have highlighted the potential of leafrollers as economically important pests.

The Citrus and Apple leafroller were together responsible for 0.34% of the damage recorded to avocado fruit (Table 1). The damage was calculated as representing a cull worth ca. R78 010. Damage by the two leafroller species was reasonably consistent across all of the avocado cultivars (Table 2).

Biology

Eggs are oviposited on leaves in a compact egg parcel (Catling, 1970; Newton, 1990a). The larvae feed on leaves and tender, young growth, including young fruitlets. Later in the season when fruits have enlarged and begin touching, the larvae characteristically web leaves and/ or fruit together and feed within the spun shelter (Annecke & Moran, 1982; De Villiers, 1990; Newton, 1990a). The skin of the avocado fruit is removed and small indentations from eating into the flesh are occasionally evident. Portions of the leaf epidermis may also be fed upon. The larvae do not habitually fall to the ground, but pupate within the spun shelter.

Natural enemies

The role of parasitoids in controlling leafrollers in general is uncertain (Annecke & Moran, 1982) and on avocados not known. On citrus, the parasitoid complex associated with leafrollers includes two larval and two pupal parasitoids on the Citrus leafroller and two egg and six larval parasitoids on the Apple leafroller (Annecke & Moran, 1982; De Villiers, 1990).

Biological insecticides (e.g. *Bacillus thuringiensis)* have been used with success although *Bacillus* species are generally effective only against young larvae. Different strains of the bacterium have been shown to possess varied degrees of efficacy. In

Israel, success in controlling leafrollers has been achieved by introducing the bacterium into the plant, which provides it with so-called "plant resistance".

LOOPER

Looper on avocados has recently been identified as *Ascotis reciprocaria reciprocaria* and is the same species found on citrus (Erichsen & Schoeman, 1994).

Distribution and host plants

A.r. reciprocaria and related species have been recorded on a number of host plants in countries within the temperate belt of the world. Host plants include legumes, citrus, apples, avocados, tea and coffee, cotton and mulberry (Wysoki *et al.,* 1975; Wysoki, 1982). In South Africa, the main hosts are citrus and avocados (Annecke & Moran, 1982).

Economic importance

Of the three lepidopteran pest groups recorded as damaging avocados, loopers were responsible for the least damage (Erichsen & Schoeman, 1992). Loopers accounted for only 0.15% of the damage to avocado fruits by insect pests (Table 1). Damage was calculated as totalling ca. R38 928 (Table 1). Edranol, Pinkerton and Hass were damaged to the greatest extent by looper compared to other cultivars (Table 2). The potential of looper in causing economically serious losses as a direct result of indiscriminate use of pesticides has been discussed by Erichsen & Schoeman (1994).

Biology

The adult moth oviposits eggs in clusters on branches or stems in concealed areas. The young larvae feed on tender new growth, but as the larvae mature they later also feed on avocado fruits. Larvae feed on and through the skin of the fruit and eat characteristic potholes into the flesh. Unlike leafrollers, loopers do not spin leaves or fruit together. Larvae spin down to the ground on a thin thread and pupate amongst the leaf litter.

Natural enemies

Parasitoid wasps have been reported to keep looper under satisfactory control on citrus at Zebediela Estates with an approximate rate of suppresion at 90%. Which parasitoids are most effective against loopers on avocados has not been determined (De Villiers, 1990).

OTHER MOTH PESTS

Upon investigating the damage to fruit by FCM, the authors found two additional moth species which were reared for identification. They were *Eublemma brachygonia* Hampson *(Noctuidae)* and *Lobesia stericta* (Meyr.) *(Tortricidae).* Damage to fruit was indistinguishable from that of FCM. The extent to which these two moth species may damage avocado fruit has not been determined. Larvae of *E. brachygonia are* effective predators of a number of scale and mealybug pests and play an important role in regulating pest populations on certain crops. These species are most likely of incidental occurrence, having pupated within, fruit that had already been damaged by FCM.

TABLE 2
Median (%) and range (%) of the extent of leafroller and looper damage to avocado fruits per cultivar.

CULTIVAR	LEAFROLLERS		LOOPER	
	Median %	Range %	Median %	Range %
Pinkerton	5.3	0-20	10	0-20
Ryan	5.0	0-10	5	0-10
Edranol	5.5	0-20	12.2	0-50
Hass	5.9	0-30	7.7	0-50
Fuerte	5.5	0-20	5.7	0-20

CONCLUSION

1. Damage by moth pests reduces the marketability of the fruit, both as export and local production. Secondary infection by fungi and bacteria into wounded areas results in internal fruit decay which may only become apparent after the fruit has been inspected.
2. Fruit cull due to insect pests in the Nelspruit/ Hazyview region for the 1991/1992 season has been calculated to total ca. R2.93 million (Erichsen & Schoeman, 1992), and moths contributed an effective R414 700 to this loss (Table 1).
3. Data on the biology of moth pests and associated predator/ parasitoid complex on avocados are very limited.
4. With increasing pest recruitment on avocados, investigation into which insects are the most likely potential pests is warranted.
5. With particular reference to (3.) and (4.), the use of pesticides on avocados should be kept to a minimum as such practices can only boost pest recruitment and increase the present status of moth pests.

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