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# YIELD LOSSES IN COCONUT DUE TO THE ERIOPHYID MITE (*ERIOPHYES GUERRERONIS*)

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## ABSTRACT

Tests were carried out on Maypan and Malayan Dwarf coconut varieties in two ecological zones, to assess the yield loss of copra due to the mite, *Eriophyes guerreronis* Keifer (Acarina: Eriophyidae). The results show a significant decline in copra output with increased mite damage ($p<0.001$). Total copra losses ranged from 4-5% but may be higher than 80% in the most severely damaged fruit.

## INTRODUCTION

The coconut mite, *Eriophyes (Aceria) guerreronis* Keifer (Acarina: Eriophidae) is a microscopic organism that breeds under the perianth of the fruit of coconut (*Cocos nucifera*) where it feeds on the epidermal cells of the meristematic region. Occasionally it feeds on the apical meristem of the seedling.

The earliest symptom of damage is the appearance of white streaks originating from beneath the perianth. These regions enlarge and eventually become brown and corky. As the fruit grows in size the rapid cell division of the surrounding cells causes much stress in the damaged areas. This results in the development of deep fissures in the pericarp known to be characteristic of mite damage. In extreme cases, up to 80% surface area may be damaged. The result is great distortion and reduction in fruit size and a consequent decline in copra output (Julia and Mariau 1979; Hall, 1981; Anonymous 1985).

Although the mite was known to be in Jamaica since 1941 (Hall, 1981), it did not arouse serious concern until 1972 (Coconut Industry Board, 1973; Hall, 1981). Since then, the mite damage on coconut has been observed islandwide (Hussey, 1975). However, there has not been any previous attempt to quantify damage in terms of copra loss. Pesticides have been used without adequate information and there is no available record of the actual economic status of the pest in Jamaica.

Crop loss may be categorized according to the stage at which it occurs: pre-harvest, at harvest or post-harvest. Losses in coconut yields occur at all three stages. Losses during pre-harvest and harvest may be due to the death of plants, or loss of immature fruit resulting from pests, diseases, natural catastrophes, or praedial larceny. Normally small nuts are not bought by farm gate purchasers and heavily scarred nuts are too difficult to husk. If reaped, these nuts may be sold to copra factories at much reduced prices and in some cases, labor cost will exceed sale costs. Post harvest losses will occur during storage and may result from theft or infestation by pests and diseases.

Chiarappa (1971) observed that many estimates of crop losses have been made, but very few were realistic assessments in terms of actual quantity or quality. The objectives of this study are to quantify the effect of mite damage on copra yield and to determine whether the effect of mite damage on copra output varies with variety and site.

## MATERIALS AND METHODS

This assessment was made during the harvesting period and was carried out on both Maypan and Red Malayan Dwarf coconut varieties on two farms in each of the parishes of Portland and St.

Mary. These farms were well managed with recommended levels of fertilizer being applied to the coconut trees which were grown in pure stands. The sections within these parishes from which data were obtained represent distinct ecological zones. The Portland site has a higher average annual rainfall (3,000-3,500 mm/annum) than the St. Mary site (<2,000 mm/annum).

The harvested fruit were grouped according to the extent of external mite damage using a modified scale for visual assessment (Julia and Mariau, 1979; Moore *et al*, 1989 ):

Grade 1 - fruit with no mite damage,
Grade 2 - fruit with up to 30% mite damage,
Grade 3 - fruit with 30-60% mite damage and less than 20% reduction,
Grade 4 - fruit with 60-80% mite damage, 20-30% reduction and with some distortion,
Grade 5 - fruit with over 80% mite damage, over 30% reduction and often greatly distorted.

The total number of fruit observed in each damage category was counted. A sample of five fruit was taken from various sections of the farm in each damage category for further processing. Each nut was labelled and taken to the laboratory where it was husked and the nuts broken to remove the endosperm. The endosperm was then weighed and placed in a kiln at 70°C for approximately 18 hours when the moisture content was at an average of 6%. The dry (copra) weight was taken.

The effects of mite damage (grade), variety, site and their interactions on copra yield were analyzed with the use of regression analyses. For the tabulated summaries, the copra yield within each category was estimated by multiplying the average copra yield per nut in the sample for each category by the total number of nuts within that group. The total copra yield of the harvested nuts was calculated by summing these copra yields. The percentage copra loss was estimated in the following way:

$$\text{percentage loss} = \frac{\text{potential yield - actual yield}}{\text{potential yield}} \times 100,$$

where the copra yield of the least damaged nuts[1] was used as potential yield.

RESULTS

There was a significant decline in copra output with increased mite damage ($p<0.001$). Generally, copra yield for Maypan was significantly higher than that of Red Malayan Dwarf ($p<0.001$), but the decline due to the mite was evident and similar for both varieties ($p=0.243$). See Fig. 1. There was no significant difference in the decline of copra yield with increased mite damage between the two sites, Portland and St. Mary ($p=0.070$). These results are summarized in Tables 1a,b.

| EFFECT OF MITE DAMAGE ON COPRA YIELD | | | | |
|---|---|---|---|---|
| | | | | |
| | | | | |
| DAMAGE GRADE | | MAYPAN | | RED MALAYAN DWARF |
| 1 | | 213.03 | | 160.48 |
| 2 | | 226.1 | | 149.81 |
| 3 | | 172.37 | | 119.79 |
| 4 | | 108.26 | | 60.21 |
| 5 | | 55.83 | | 27.94 |
| | | | | |

Fig. 1. Effect of Mite Damage on COPRA Yield.

Table 1A. Copra Loss Assessment in Maypan Coconut at St. Mary and Portland, 1992-93.

| Parish | Damage Grade[1] | Number of Nuts | Copra Yield/nut (g) | Copra Yield (kg) | Copra Loss (%) |
|---|---|---|---|---|---|
| St Mary | 1 | 477 | 223 | 106 | 0[2] |
| | 2 | 1391 | 248 | 345 | 0[2] |
| | 3 | 339 | 190 | 64 | 22 |
| | 4 | 30 | 98 | 3 | 59 |
| | 5 | 2 | 68 | <1 | 72 |
| | Total | 2239 | 232 | 518 | 4 |
| Portland | 1 | 298 | 206 | 61 | 0[2] |
| | 2 | 472 | 210 | 99 | 0[2] |
| | 3 | 134 | 160 | 21 | 23 |
| | 4 | 19 | 116 | 2 | 44 |
| | 5 | 0 | - | 0 | - |
| | Total | 923 | 199 | 183 | 4 |

Notes:
[1]Grade 1 Fruit with no mite damage.
Grade 2 Fruit with up to 30% mite damage.
Grade 3 Fruit with 30 to 60% mite damage and less than 20% reduction.
Grade 4 Fruit with 60 to 80% mite damage, 20 to 30% reduction and with some distortion.
Grade 5 Fruit with over 80% mite damage, over 30% reduction and often greatly distorted.

[2]The copra loss for these two categories was not estimated as both these were used as a baseline from which to determine copra loss.
- No nuts were found in this category.
Standard deviation for copra yield/nut (g) is 31.0.

Table 1B. Copra Loss Assessment in Red Malayan Dwarf Coconut at St. Mary and Portland, 1992-93.

| Parish | Damage Grade[1] | Number of Nuts | Copra Yield/nut (g) | Copra Yield (kg) | Copra Loss (%) |
|---|---|---|---|---|---|
| St Mary | 1 | 347 | 144 | 50 | 0[2] |
| | 2 | 911 | 151 | 137 | 0[2] |
| | 3 | 296 | 132 | 39 | 8 |
| | 4 | 41 | 53 | 2 | 66 |
| | 5 | 5 | 22 | <1 | 84 |
| | Total | 1600 | 143 | 228 | 4 |
| Portland | 1 | 425 | 173 | 73 | 0[2] |
| | 2 | 848 | 149 | 126 | 0[2] |
| | 3 | 205 | 111 | 23 | 29 |
| | 4 | 20 | 65 | 1 | 68 |
| | 5 | 4 | 32 | <1 | 80 |
| | Total | 1502 | 149 | 223 | 5 |

Notes:
[1]Grade 1 Fruit with no mite damage.
Grade 2 Fruit with up to 30% mite damage.
Grade 3 Fruit with 30 to 60% mite damage and less than 20% reduction.
Grade 4 Fruit with 60 to 80% mite damage, 20 to 30% reduction and with some distortion.
Grade 5 Fruit with over 80% mite damage, over 30% reduction and often greatly distorted.

[2]The copra loss for these two categories was not estimated as both these were used as a baseline from which to determine copra loss.
Standard deviation for copra yield/nut (g) is 31.0.

## DISCUSSION

Most information found on yield reduction in coconut is not based on actual data. Julia and Mariau (1979), Mariau (1977, 1986) and Moore *et al* (1989) are among the few authors who have carried out research on actual quantitative losses in coconut yields due to premature fruit fall or reduction in copra production due to *E. guerreronis*.

Julia and Mariau (1979), studied the copra loss in two varieties (West African Tall and P-B 121 hybrid) using four damage categories. The average copra loss for the two varieties were 10, 30, and 45% in categories 2, 3, and 4, respectively. Mean copra yield loss was approximately 15% for the West African Tall and 7% for the P-B 121 hybrid varieties. Moore *et al* (1989) studied copra yield loss at five sites in St. Lucia over two years and found it to vary with space and time. Yield loss ranged from approximately 11-32%.

The results of this experiment have shown that the mite significantly reduces copra production. At both sites (St. Mary and Portland), copra loss may be as high as 80% in fruit found in the fifth damage category. However, these nuts comprise less than 1% of the total fruit produced. Fruit with least mite damage (i.e. those in grades 1 and 2) accounted for 79 to 85% of all fruit. Hence, the overall copra yield loss ranged from 4 to 5%.

Copra loss due to mite damage in Jamaica is subject to variability. Similar experiments have shown yield losses to range from 1 to 9% (McDonald *et al*, 1992). All these results are representative of the larger coconut farms which receive fairly good management. Relatively higher infestation levels have been observed on several small farms (McDonald and Alam, 1991).

Over the last two decades, the progress of distribution of *E. guerreronis* throughout the tropical and sub-tropical regions has been far reaching. This is largely due to wind currents which have aided its long distance migration. During this period several methods of control have been tested and/or proposed against the mite with varied success. These include chemical, physical, cultural and biological control methods.

Moore *et al* (1989) suggested that improved farming practices, combined with resistant varieties, could result in marked increases in crop yields. It was also found that yields were higher where coconut was intercropped with banana (Moore *et al*, 1989). This resulted from the positive response of the plant to the fertilization of the banana intercrop and the acaricidal property of the oil spray applied to banana. Mariau (1986) found copra loss to decline with irrigation and suggested that periods of moisture stress retard nut growth, when, meristematic tissue is subjected to extensive mite damage. Sarangamath *et al* (1976) further proposed that copra yield was dependent on various factors, including, variety, age of palm, soil, climate of the area, maturity of the nuts, seasons of harvest and period of storage.

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[1]Least damaged nuts are defined as those belonging to grades 1 and 2. As the copra yield per nut for grade 2 nuts was sometimes higher than that for grade 1 nuts, the weighted mean copra yield per nut for both grades was used as the potential copra yield per nut.

Therefore, there is need for further work to develop an integrated system of management of the coconut mite. This should include an evaluation of these methods to ensure that they are cost effective and sustainable. Any viable integrated pest management system for *E. guerreronis* should involve the use of cultural practices and resistant varieties to delay the establishment of the mite as well as the use of effective biological control agents to suppress the mite population.

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