# Movement of Litchi (*Litchi chinensis*) Fruits From Hawaii into other regions of the United States

## Qualitative, Pathway-Initiated Pest Risk Assessment

**November 1995**

**Agency Contact:**

**John Lightfield, Agriculturist**

**Biological Assessment and Taxonomic Support**
**Plant Protection and Quarantine**
**Animal and Plant Health Inspection Service**
**U.S. Department of Agriculture**
**4700 River Road, Unit 133**
**Riverdale, MD 20737-1236**

# A. Introduction

This pest risk assessment was prepared by the Animal and Plant Health Inspection Service (APHIS) of the U.S. Department of Agriculture (USDA) to examine plant pest risks associated with the movement into the continental United States of *Litchi chinensis* fruits grown in Hawaii. This is a qualitative pest risk assessment, that is, estimates of risk are expressed in qualitative terms such as high or low as opposed to numerical terms such as probabilities or frequencies.

International plant protection organizations (*e.g.*, North American Plant Protection Organization (NAPPO), International Plant Protection Convention (IPPC) of the United Nations Food and Agriculture Organization (FAO)) provide guidance for conducting pest risk analyses. The methods we used to initiate, conduct, and report this plant pest risk assessment are consistent with guidelines provided by NAPPO, IPPC and FAO. Our use of biological and phytosanitary terms (*e.g.*, introduction, quarantine pest) conforms with the *NAPPO Compendium of Phytosanitary Terms* (NAPPO 1995) and the *Definitions and Abbreviations* (Introduction Section) in *International Standards for Phytosanitary Measures, Section 1—Import Regulations: Guidelines for Pest Risk Analysis* (FAO 1995).

Pest risk assessment is one component of an overall pest risk analysis. The *Guidelines for Pest Risk Analysis* provided by FAO (1995) describe three stages in pest risk analysis. This document satisfies the requirements of FAO Stages 1 (initiation) and 2 (risk assessment).

The Food and Agriculture Organization (FAO, 1995) defines "pest risk assessment" as "Determination of whether a pest is a quarantine pest and evaluation of its introduction potential." "Quarantine pest" is defined as "A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled" (FAO, 1995; NAPPO, 1995). Thus, pest risk assessments should consider both the likelihood and consequences of introduction of quarantine pests. Both issues are addressed in this qualitative pest risk assessment.

This document presents the findings of our qualitative plant pest risk assessment. Our assessment methods or the criteria we used to rate the various risk elements are not described in detail. The details of our methodology and rating criteria can be found in our "template" document: ***Pathway-Initiated Pest Risk Assessment: Guidelines for Qualitative Assessments, version 4.0*** (USDA, 1995); to obtain a copy of our template, contact the individual named on the front of this risk assessment.

# B. Risk Assessment

## 1. Initiating Event: Proposed Action

This pest risk assessment is commodity-based, and therefore "pathway-initiated"; the assessment is in response to the request for USDA authorization to allow movement of a particular commodity presenting a potential plant pest risk. In this case, the movement of litchi fruit, *Litchi chinensis*, grown in Hawaii into the U.S. is a potential pathway for introduction of plant pests. 7 CFR §319.13 provides general regulatory authority for the movement of Hawaiian fruits and vegetables.

*Litchi chinensis* belongs to the Sapindaceae family, which consists of about 125 genera and more than 1000 species of trees and shrubs. There are 2 species of *Litchi*, one widely cultivated in warm parts of

the Orient for its fruit which is either eaten fresh or dried. *Litchi chinensis* is grown in Hawaii (introduced in 1873) and Florida. In Hawaii, a good tree bears 200 or more pounds of fruit during May and June.

## 2. Assessment of Weediness Potential of Litchi

The initial step after receiving a request for the movement of a commodity is to analyze the weediness potential of the species. Table 1 shows how the weediness potential was assessed and presents the findings for *Litchi chinensis*.

**Table 1: Process for Assessing Weediness Potential of Plant Species**

**Commodity:** Fruits of *Litchi chinensis* Sonn. - Litchi

**Phase 1:** Litchi is grown commercially in Florida and Hawaii.

**Phase 2:** Is the species listed in:

NO *Geographical Atlas of World Weeds (Holm, 1979)*

NO *World's Worst Weeds (Holm, 1977)*

NO *Report of the Technical committee to Evaluate Noxious Weeds: Exotic Weeds for Federal Noxious Weed Act (Gunn & Ritchie, 1982)*

NO *Economically Important Foreign Weeds (Reed, 1977)*

NO Weed Science Society of America List (WSSA, 1989)

NO Is there any literature reference indicating weediness (*e.g.*, *AGRICOLA*, *CAB*, *Biological Abstracts*, *AGRIS*; search on "species name" combined with "weed").

**Phase 3: Conclusion:**

Because *Litchi chinensis* already occurs in the United States, and because there was no indication in the scientific literature that it has weediness potential, we proceeded with the pest risk assessment according to our guidelines (USDA, 1995).

## 3. Previous Risk Assessments, Current Status and Pest Interceptions

There is no previous risk assessment (decision sheet) on *Litchi chinensis* from Hawaii. However, PPQ has intercepted litchi fruits carried in passengers baggage and arriving in the mail. The pest interceptions for FY 1985 to FY 1995 are as follows:

| PEST | Where[1] | Total | HOST |
|---|---|---|---|
| *BACTROCERA DORSALIS* | 01 | 1 | *LITCHI CHINENSIS* (FRUIT) |
| *BACTROCERA DORSALIS* | 02 | 1 | *LITCHI CHINENSIS* (FRUIT) |
| *CRYPTOPHLEBIA OMBRODELTA* | 01 | 15 | *LITCHI CHINENSIS* (FRUIT) |
| *CRYPTOPHLEBIA OMBRODELTA* | 02 | 5 | *LITCHI CHINENSIS* (FRUIT) |
| *CRYPTOPHLEBIA OMBRODELTA* | 03 | 1 | *LITCHI CHINENSIS* (FRUIT) |
| *CRYPTOPHLEBIA OMBRODELTA* | 02 | 2 | *LITCHI* SP. (FRUIT) |
| *DACUS DORSALIS* | 01 | 3 | *LITCHI CHINENSIS* (FRUIT) |
| PSEUDOCOCCIDAE, Species of | 02 | 3 | *LITCHI CHINENSIS* (FRUIT) |
| TEPHRITIDAE, Species of | 02 | 1 | *LITCHI CHINENSIS* (FRUIT) |

## 4. Pest List: Pests Associated with *Litchi* in Hawaii

Table 2 shows our pest list for Hawaiian *Litchi*. We generated the list after review of the information sources listed in USDA (1995). The pest list includes limited information on the distribution of each pest, pest-commodity association, and regulatory history.

**Table 2: Pest List - Hawaiian *Litchi chinensis***

| Scientific Name, Classification | Distribution[1] | Comments[2] | References |
|---|---|---|---|
| **Arthropods** | | | |
| *Anacamptodes fragilaria* (Grossbeck) (Lepidoptera: Geometridae) | HI,CA | c,f | Anon., 1994 |
| *Bactrocera dorsalis* (Hendel)(Tephritidae) | HI,US$_3$ | g,w,x,z$_1$ | Kumar, 1988; White, 1992; IIE Map 109, 1994 |
| *Bactrocera latifrons* (Hendel)(Tephritidae) | HI,US$_3$ | g,i | Liquido *et al.*, 1994; Wong, 1995 |

[1] Code 01 = baggage, 02 = mail, 03 = general cargo

| | | | |
|---|---|---|---|
| *Ceratitis capitata* (Wiedemann) (Tephritidae) | HI,$US_3$ | g,w,$z_1$ | White, 1992; IIE Map 1, 1984 |
| *Chaetanaphothrips orchidii* (Moulton) (Thysanoptera: Thripidae) | HI,US | a,c | Anon., 1994 |
| *Coccus acutissimus* (Green)(Coccidae) | HI,FL | a,c,f | Grove *et al*, 1974 |
| *Coccus viridis* (Green)(Coccidae) | HI,FL | a,g | IIE Map 305, 1972; Wong, 1995 |
| *Cryptophlebia illepida* (Butler)(Tortricidae) | HI | g,$z_1$ | Jones, 1994; Wong, 1995 |
| *Cryptophlebia ombrodelta* (Lower)(Tortricidae) | HI | g,x,$z_1$ | Jones, 1994; CIE 353, 1976; Wong, 1995 |
| *Eotetranychus sexmoculatus* (Riley)(Tetranychidae) | OT | a,c | Grove *et al*, 1974 |
| *Ephiphyas postvittana* (Walker)(Tortricidae) | HI | g,$z_1$ | IIE Map 82, 1992 |
| *Eriophyes litchi* (Kiefer) (Eriophyidae) | HI | g,$z_e$ | Balerdi *et al*, 1993 |
| *Ferisia virgata* (Cockerell) (Homoptera: Pseudococcidae) | HI,US | c,y,$z_e$ | Anon., 1994; McKenzie, 1967; Pena & Bennett, 1995 |
| *Ischnaspis longirostis* (Signoret) (Homoptera: Diaspididae) | HI,US | a,c | Anon., 1994 |
| *Liriomyza huidobrensis* (Blanchard)(Agromyzidae) | HI,CA | a,h | Spencer, 1973 |
| *Plautia stali* Scott (Heteroptera: Pentatomidae) | HI | e | Anon., 1994 |
| *Pseudaulacaspis major* (Ckll.)(Diaspididae) | FL | a,c | Grove *et al.*, 1974 |
| *Pseudococcus affinis* (Maskell) (Homoptera: Pseudoccoccidae) | HI,US | c | Anon., 1994; McKenzie, 1967 |
| *Pulvinaria mammeae* Maskell (Homoptera: Coccidae) | HI | a | Anon., 1994 |
| *Pulvinaria psidii* (Mask)(Coccidae) | HI,FL,OT | a,c | Grove *et al.*, 1974; IIE Map 59, 1994 |
| *Thysanofiorinia leei* Williams (Homoptera: Diaspididae) | HI | a,h | Anon., 1994; Beardsley, 1983 |

| **Nematodes** | | | |
|---|---|---|---|
| *Xiphinema americanum* Cobb | HI,FL,OT | a,c | Raabe *et al.*, 1981 |

[1] Distribution legend: HI = Hawaii; CA = California; FL = Florida; OT = Other States in U.S.

[2] Comments:
- a = Pest mainly associated with a plant part other than the commodity.
- c = Organism does not meet the geographical and regulatory definition for a quarantine pest
- e = Although pest attacks commodity, it would not be expected to remain with the commodity during processing
- f = Pest occurs in the U. S. and is not subject to official restrictions and regulations
- g = Listed in the USDA catalog of intercepted pests as actionable
- h = Pest is present in the U.S. and is listed in the USDA catalogue of intercepted pests as actionable at ports of entry, but the pest is not currently subject to further official restrictions and regulations
- i = A single unconfirmed report lists this species
- x = Multiple interception records exist
- w = Program pest
- y = Pest is a vector of plant pathogens.
- $z_i$ = Internal: Pest is known to attack or infect commodity and it would be reasonable to expect the pest may remain with the commodity during processing and shipping
- $z_e$ = External: Pest is known to attack or infest *Litchi* and it would be reasonable to expect the pest may remain with the commodity during processing and shipping

3 *Bactrocera dorsalis and Ceratitis capitata* have been detected on occasion in the United States. Whenever they are detected, a quarantine is established and an eradication program implemented. One adult *B. latifrons* has been caught in the U.S. These fruit flies are considered to be quarantine pests in the United States.

## 5. List of Quarantine Pests

Our list of quarantine pests for commercial shipments of *Litchi chinensis* fruits from Hawaii is provided in Table 3. Should any of these pests be intercepted on commercial (or any other) shipments of *L. chinensis*, quarantine action may be taken. Other pests are not expected to be associated with the fruit after harvest and packing. However, PPQ has a history of intercepting an occasional hitchhiking pest with other Hawaiian commodities. The hitchhikers are routinely detected by normal inspections. All quarantine pests are subject to action based upon inspection findings and pest identification.

**Table 3: Quarantine Pests: Hawaiian *Litchi chinensis* fruits for consumption**

| | |
|---|---|
| **Arthropods** | *Bactrocera dorsalis* (Hendel) |
| | *Ceratitis capitata* (Wiedemann) |
| | *Coccus viridis* (Green) |
| | *Cryptophlebia illepida* (Butler) |
| | *Cryptophlebia ombrodelta* (Lower) |
| | *Ephiphyas postvittana* (Walker) |
| | *Eriophyes litchi* (Kiefer) |
| | *Liriomyza huidobrensis* (Blanchard) |

## 6. Quarantine Pests Likely to Follow Pathway (*i.e.*, Quarantine Pests Selected for Further Analysis)

A description of the criteria that pests must satisfy to be considered for further analysis can be found in USDA (1995). Following is a brief discussion for each of the quarantine pests/pest groups.

**Tephritidae:** The larval forms of *Bactrocera dorsalis* and *Ceratitis capitata* are internal feeders and may move with fresh fruits.

**Coccidae:** *Coccus viridis* are associated with the leaves and not the fruits and therefore the commodity will not serve as a pathway. The processing and packing would also serve to eliminate any that were incidental with the fruits.

**Tortricidae:** The larval forms of *Cryptophlebia illepida*, *C. ombrodelta*, and *Ephiphyas postvittana* are internal feeders and may move with fresh fruits.

**Agromyzidae:** The larval forms mine the leaves. Fruit imports should be free of leaves and debris and not serve as a pathway.

**Eriophyidae:** *Eriophyes litchi* feeds on the leaves of litchi and may occasionally be found on the fruits. Because of their small size, they could move undetected with the fruits.

| Table 4: Quarantine Pest Selected for Further Analysis: Hawaiian *Litchi chinensis* fruits for consumption | |
|---|---|
| **Arthropods** | *Bactrocera dorsalis* (Handel)<br>*Ceratitis capitata* (Wiedemann)<br>*Cryptophlebia illepida* (Butler)<br>*Cryptophlebia ombrodelta* (Lower)<br>*Ephiphyas postvittana* (Walker)<br>*Eriophyes litchi* (Kiefer) |

## 7. Economic Importance: Consequences of Introduction

For each quarantine pest selected for further analysis, we consider the consequences of introduction. For qualitative, pathway-initiated pest risk assessments, these risks are estimated by rating each pest with respect to five risk elements. A full description of these elements and rating criteria can be found in USDA (1995). Table 5 shows our risk ratings for these risk elements.

**Table 5: Risk Rating: Consequences of Introduction**

| Pest | Climate/ Host | Host Range | Dispersal | Economic | Environ-mental | Risk Rating |
|---|---|---|---|---|---|---|
| *Bactrocera dorsalis* | high | high | high | high | medium | high |
| *Ceratitis capitata* | high | high | high | high | medium | high |
| *Cryptophlebia illepida* | medium | medium | medium | medium | medium | medium |
| *Cryptophlebia ombrodelta* | medium | high | medium | medium | medium | medium |
| *Ephiphyas postvittana* | high | high | low | high | medium | high |
| *Eriophyes litchi* | medium | medium | low | medium | medium | medium |

With these risk ratings, on this commodity, we rate *Bactrocera dorsalis*, *Ceratitis capitata*, and *Ephiphyas postvittana* as pests of *high* risk with respect to consequences of introduction.
*Cryptophlebia illepida*, *Cryptophlebia ombrodelta*, and *Eriophyes litchi* were ranked as pests of medium risk with respect to consequences of introduction.

## 8. Likelihood of Introduction

For each quarantine pest selected for further analysis, we consider the likelihood of introduction. For qualitative, pathway-initiated pest risk assessments, these risks are estimated by rating each pest with respect to six risk elements. A full description of these elements and rating criteria can be found in USDA (1995). Table 6 shows our ratings for these risk elements.

**Table 6: Risk Rating: Likelihood of Introduction**

| Pest | Quantity of commodity imported annually | Likelihood survive postharvest treatment | Likelihood survive shipment | Likelihood not detect at port of entry | Likelihood moved to suitable habitat | Likelihood find suitable host |
|---|---|---|---|---|---|---|
| *Bactrocera dorsalis* | medium | high | high | high | high | high |
| *Ceratitis capitata* | medium | high | high | high | high | high |
| *Cryptophlebia illepida* | medium | medium | medium | medium | medium | low |
| *Cryptophlebia ombrodelta* | medium | medium | medium | medium | medium | low |
| *Ephiphyas postvittana* | medium | medium | medium | medium | medium | low |
| *Eriophyes litchi* | medium | medium | medium | high | low | low |

With these risk ratings, we rate the cumulative likelihood of introduction of these arthropods with shipments of litchi fruits as:

*Bactrocera dorsalis* - high risk
*Ceratitis capitata* - high risk
*Cryptophlebia illepida* - medium risk
*Cryptophlebia ombrodelta* - medium risk
*Ephiphyas postvittana* - high risk
*Eriophyes litchi* - medium risk

## 9. Conclusion: Pest Risk Potential and Phytosanitary Measures

Our measure of pest risk potential combines the risk ratings for consequences and likelihood of introduction as described in USDA (1995). Table 7 shows our estimated pest risk potential for the six quarantine pests selected for further analysis for the movement of Hawaiian *Litchi chinensis* fruits.

**Table 7: Pest Risk Potential, Quarantine Pests, Hawaiian *Litchi chinensis* fruits**

| Pest | Pest risk potential |
|---|---|
| *Bactrocera dorsalis* | high |
| *Ceratitis capitata* | high |
| *Cryptophlebia illepida* | medium |
| *Cryptophlebia ombrodelta* | medium |
| *Ephiphyas postvittana* | high |
| *Eriophyes litchi* | medium |

The fruit flies, *Bactrocera dorsalis* and *Ceratitis capitata* were rated as high risk and we recommend a mitigation measure such as treatment be mandatory. *Cryptophlebia illepida*, *Cryptophlebia ombrodelta*, and *Eriophyes litchi* were rated as a medium risk with this commodity specific mitigation measures may not be needed. *Ephiphyas postvittana* was rated as a high risk, PPQ has increased the intensity of inspection for this insect in products from other countries.

There are only a few interceptions from *Litchi chinensis* fruits from Hawaii. However, virtually all the other external pests listed could be detected by inspection. Many polyphagous insects occur in Hawaii, several of them are quarantine pests and have been intercepted as hitchhikers with other commodities. Some of these may become hitchhikers with litchi fruit if the commodity is approved entry.

Detailed examination and choice of appropriate sanitary and phytosanitary measures to mitigate pest risk is undertaken as part of the pest risk management phase and is not discussed in this document.

# C. References


Anonomyous. 1994. Distribution & Host Records of Agricultural Pests and Other Organisms in Hawaii. 68 p.

Balerdi, C. & J. Crane, 1993. LEM threatens lychees. Dade County Grower, July. p. 16

Beardsley, J. W. 1983. *Thysanofiorinia leei* Williams. Proceedings Hawaii Ent. Soc. 24(2-3): p. 188.

CIE. 1972. Distribution Maps of Pests. Number 305, Coccus viridis. Commonwealth Institute of Entomology, CAB, UK.

CIE. 1976. Distribution Maps of Pests. Number 353, Cryptophlebia ombrodelta. Commonwealth Institute of Entomology, CAB, UK.

FAO. 1995. International Standards for Phytosanitary Measures. Section 1 - Import Regulations: Guidelines for Pest Risk Analysis (Draft Standard). Secretariate of the International Plant Protection Convention of the Food and Agriculture Organization of the United Nations. Rome, Italy.

Grove, W. R. & D. R. Van Sickler 1974. The lychee in Florida today. Proceedings of the Florida State Horticultural Society 87: 338- 339.
Gunn, C.R. and C. Ritchie. 1982. 1982 Report of the Technical Committee to Evaluate Noxious Weeds; Exotic Weeds for Federal Noxious Weed Act. (unpublished).
Holm, L.G., D.L. Plucknett, J.V. Pancho and J.P. Herberger. 1977. The World's Worst Weeds. University of Hawaii Press, Honolulu.
Holm, L.G., J.V. Pancho and J.P. Herberger and D.L. Plucknett. 1979. A Geographical Atlas of World Weeds. John Wiley and Sons, New York.
IIE. 1984. Distribution Maps of Pests. Number 1, Ceratitis capitata. Commonwealth Institute of Entomology, CAB, UK.
IIE. 1992. Distribution Maps of Pests. Number 82, Ephiphyas postvittana. Commonwealth Institute of Entomology, CAB, UK.
IIE. 1994. Distribution Maps of Pests. Number 109, Bactrocera dorsalis. Commonwealth Institute of Entomology, CAB, UK.
IIE. 1994. Distribution Maps of Pests. Number 59, Pulvinaria psidii. Commonwealth Institute of Entomology, CAB, UK.
Jones, V. P. 1994. Oviposition Patterns Of KOA Seedworm and Litchi Fruit Moth On Macadamia and Litchi in Hawaii; Journal of Economic Entomology 87 (5):1278-1284.
Kumar, M. and B. S. Lall. 1988. Incidents of Insects Pests of Litchi Fruits in Different Localities of Bihar. Bull. Entomol. 29(2):217-219.
Liquido, N. J.; E. J. Harris & L. A. Dekker, 1994. Ecology of Bactrocera latifrons (Diptera:Tephritidae) Populations: Host Plants, Natural Enemies, Distribution, and Abundance. Annals of the Entomological Society of America 87:71-84.
McKenzie, H. L. 1967. Mealybugs of California. University of California Press, Berkeley, CA. 525 p.
NAPPO. 1995. NAPPO Compendium of Phytosanitary Terms, B.E. Hopper, NAPPO Sectretariat, ed. North American Plant Protection Organization (NAPPO), Nepean, Ontario, Canada.
Quarantine plant pests database. 1992. Search completed on July 1995.
Raabe, R. D.; I. L. Conners and A. P. Martinez. 1981. Checklist of plant diseases in Hawaii. Hawaii Institute of Tropical Agriculture and Human Resources, College of Tropical Agriculture and Human Resources, Information Text Series 022. University of Hawaii, Honolulu. 313 p.
Reed, C.F. 1977. Economically Important Foreign Weeds. Agriculture Handbook No. 498
Spencer, K. A., 1973. Agromyzidae (Diptera) of Economic Importance. Dr. W. Junk, The Hague.
USDA. 1995. Pathway-Initiated Pest Risk Assessment: Guidelines for Qualitative Assessments, ver. 4.0 PPQ, APHIS. 15 pp.
White, I. and M. M. Elson-Harris. 1992. Fruit Flies of Economic Significance: Their Identification and Bionomics. CAB International, Redwood Press, Ltd., Melksham. 601 pp.
Wong, L. 1995. Pest Risk associated with Shipments of Hawaii-Grown Commodities to Illinois for Scientific Research. 13 pp.
WSSA, 1989. Composite List of Weeds. Weed Science Society of America.

## C. Pest Data Sheets

PEST DATA SHEET

**Ceratitis capitata**
**Mediterranean Fruit Fly**

### IDENTITY

**Name:** Ceratitis capitata Wiedmann
**Synonymy:** Ceratitis citriperda MacLeay, Ceratitis hispanica De Breme, Pardalaspis asparagi Bezzi, Tephritis capitata Wiedemann, Trypeta capitata Wiedemann
**Classification:** Diptera:Tephritidae
**Common names:** Mediterranean Fruit Fly, Mouche Mediterraneene des Fruits, Mouche de l'oranger, Mouche des Fruits, Mittelmeerfruchtfliege, Mosca Mediterranea Moscamed, Mosca de las Frutas, Gusano de las Frutas

### HOSTS

This insect infests more than 250 types of fruits, flowers, vegetables and nuts. Weems (1981) lists 42 host species as "heavily or generally infested", 15 species as "occasionally infested", 25 species as "rarely infested", 21 species as "laboratory infestations", and 153 species as "unknown importance". Liquido et. al. (1991) report 180 genera, worldwide, as hosts for this insect.

### GEOGRAPHIC DISTRIBUTION

Indigenous to tropical Africa, this insect has now spread to the Mediterranean Region and portions of Central and South America.

**Africa**: Algeria, Angola, Benin, Burkina Faso, Burundi, Cameroon, Cape Verde Islands, Congo, Cote d'Ivoire, Egypt, Ethiopia, Gabon, Ghana, Guinea, Kenya, Liberia, Libya, Madagascar, Malawi, Mali, Mauritius, Morocco, Mozambique, Niger, Nigeria, Reunion, Sao Tome, Principe, Senegal, Seychelles, South Africa, St. Helena, Sudan, Tanzania, Togo, Tunisia, Uganda, Zaire, Zimbabwe.
**Asia:** Cyprus, India, Israel, Jordan, Lebanon, Saudi Arabia, Syria, Turkey.
**Europe:** Albania, France (locally distributed in the south), Greece (including Crete), Italy, Malta, Portugal (including Azores and Madeira), Spain (including Canary Islands), Switzerland, Ukraine, Yugoslavia.
**North America:** Hawaii (USA).
**Central America:** Costa Rica, El Salvador, Guatemala, Nicaragua, Panama.
**South America:** Argentina (locally), Bolivia, Brazil, Chile (extreme north), Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela.
**Oceania:** Australia (Western Australia), Northern Mariana Islands.

## LIFE HISTORY

Female Ceratitis capitata oviposit up to 14 eggs below the skin of the host fruit (McDonald and McInnis, 1985), with the potential of producing up to 1000 eggs throughout its lifetime. Hatching occurs in 2-18 days, depending upon the temperature. The three larval instars require 6-50 days. Pupation occurs in soil, with adult eclosion in 6-60 days (EPPO, 1979; Weems, 1981). The preoviposition period lasts from 2-163 days. Developmental zero is $10^0$C. Approximately 50% of the adults die during the first two months, post eclosion. However, some adults survive for up to one year or more under favorable conditions (PNKTO; Weems, 1981). Adults fly short distances, but may be carried by wind for 2.4 km, or more (PNKTO; Weems, 1981). Steiner et. al. (1962) have reported migratory movements of 40-72 km, and sustained overwater flights of 19-64 km. This insect is multivoltine, with 10-15 generations possible in warm climates (EPPO, 1979).

## DETECTION AND IDENTIFICATION

**Symptoms:** Larva occur in the fruit; infested fruit exhibit oviposition punctures.

**Morphology**

**Adult:** EPPO, 1992; Foote, et. al., 1993; PNKTO; White and Elson-Harris, 1992.

**Larval:** Berg, 1979; Hardy, 1949; PNKTO; Sabatino, 1974; Weems, 1981.

## MOVEMENT AND DISPERSAL

**Natural spread:** Adult flight - long distance dispersal has been reported in this species.

**Man-assisted spread:** Larva in fruit; puparia at the bottoms of containers.

## PEST SIGNIFICANCE

**Economic impact:** One of the most destructive fruit pests in the world, this insect not only has a broad host range, but has been able to survive and expand its range wherever establishment has occurred.

**Control:** Cultural practices, such as destruction of fallen and infested fruit; insecticide applications, including cover sprays and bait sprays; limited success with biological control agents.

## PHYTOSANITARY MEASURES

**Treatment:** Fumigation, fumigation plus refrigeration, cold treatment, high temperature forced air treatment, systems approach.

**Other safeguards:** Inspection at port of entry; destruction of containers.

## LITERATURE CITED


Berg, G. H. 1979. Pictorial Key to Fruit Fly Larvae of the Family Tephritidae. Organismo Internacional Regional de Sanidad Agropecuaria, San Salvador, El Salvador. 36 pp.

EPPO. 1979. Ceratitis capitata (Wiedemann) Diptera:Tephritidae. Data Sheet on Quarantine Organisms. 6 pp.

EPPO. 1992. Quarantine Pests for Europe. Data Sheets on Quarantine Pests for the European Communities and for the European and Mediterranean Plant Protection Organization. CABI International, University Press, Cambridge. 1032 pp.

Foote, R. H., Blanc, F. L. and A. L. Norrbom. 1993. Handbook of the Fruit Flies (Diptera:Tephritidae) of America North of Mexico. Comstock Publishing Associates, Ithaca and London. 571 pp.

Hardy, D. E. 1949. Studies in Hawaiian fruit flies. Proc. Entomol. Soc. Wash. 51:181-205.

Liquido, N. J., Shinoda, L. A. and R. T. Cunningham. 1991. Host plants of the Mediterranean fruit fly, Ceratitis capitata (Wiedemann) (Diptera:Tephritidae): an annotated world review. Misc. Pub. 77, Entomol. Soc. Am.

McDonald, P. T. and P. O. McInnis. 1985. Ceratitis capitata: effect of host fruit size on the numbers of eggs per clutch. Entomol. Exp. Appl. 37:207-13.

PNKTO. Pests Not Known to Occur in the United States. USDA.

Sabatino, A. 1974. Distinctive morphological characters of the larvae of Dacus oleae, Ceratitis capitata, Rhagoletis cerasi. Entomologica 10:109-16.

Steiner, L. F., Mitchell, W. C. and A. H. Baumhover. 1962. Progress of fruit fly control by irradiation sterilization in Hawaii and Mariana Islands. Internat. J. Appl. Rad. Isotopes 13:427-34.

Weems, H. V. 1981. Mediterranean fruit fly, Ceratitis capitata (Wiedemann) (Diptera:Tephritidae). Entomol. Circ. 230, Fla. Dept. Agric. Consum. Serv., Div. Plant Indus. 8 pp.

White, I. and M. M. Elson-Harris. 1992. Fruit Flies of Economic Significance: Their Identification and Bionomics. CAB International, Redwood Press, Ltd., Melksham. 601 pp.

Gary L. Cave
November, 1994

PEST DATA SHEET

Cryptophlebia illepida (Butler)
Koa seedworm

## IDENTITY

**Name:** Cryptophlebia illepida (Butler)
**Synonyms:** Teras illepida Butler, Cryptophlebia illepida illepida (Butler) Walsingham, Cryptophlebia illepida variety fulva Walsingham, Cryptophlebia illepida variety suffusa Walsingham, Cryptophlebia tetrao Walsingham, Cryptophlebia vulpes Walsingham, Argyroploce illepida (Walsingham) Meyrick, Cryptophlebia illepida (Butler)

**Taxonomic position:** Lepidoptera: Tortricidae
**Common names:** Koa seedworm. Klu tortricid, Koa seed moth, Litchi borer, Litchi moth, Macadamia nut borer, Macadamia nut moth

## HOST RANGE

Acacia confusa, Acacia farnesiana, Acacia koa, Acacia koaia, Alectryon macrococcum, Cassia glauca, Dodonaea viscosa, Inga edulis, Litchi chinensis, Macadamia ternifolia, Mangifera indica, Mezoneuron kauaiense, Phaseolus sp.(garden beans), Pithecolobium dulce, Sapindus oahuensis, and Sapindus saponaria (Zimmerman, 1978).

## GEOGRAPHIC DISTRIBUTION

Hawaii

## BIOLOGY

The following biological information was taken from Namba (1957) studies of Koa seedworm and macadamia nut. The eggs are laid on the surface of the host fruit and several may be laid together. The incubation period is 3 - 5 days. There are five larval instars which occupy 8 - 34 days with an average of about 16 days. The larvae are whitish and often have a pink tinge. Pupation occurs in the tunnel near an exit hole in the husk. Sometimes if the husk splits before pupation, the cocoon may be built along one edge of the crack. The pupa is light brown at first, gradually becoming darker, and at time of adult emergence it is almost black. The pupal period ranges from 8 - 12 days. Thus the egg-to-adult cycle may occupy between 19 - 51 days. A single female may lay as many as 367 eggs. Adult activity is usually nocturnal. Jones (1994) studied oviposition preference and the results indicate that the females preferred macadamia nuts and litchi fruits of more than 20 mm in diameter for oviposition.

## DETECTION AND IDENTIFICATION

Symptoms: The larvae are fond of the developing seeds of Acacia, eating several seeds and may leave one seed pod and enter another. They also feed on the pulp of the pods. The larvae also feed in mango pulp, litchi fruits and on many other hosts. When feeding upon macadamia fruits, the larvae usually damage only the husk, but their attacks may prevent normal development of the nuts or may permit other organisms to entry through the husk and destroy the kernels.

Morphology: The circular or oval eggs are 0.8 mm long and have a finely reticulated shell. The are white or ivory when first laid, later red maculations appear and grow more extensive and then disappear before the eggs hatch. The pupae length is
8.5 mm. The adult wing span varies from 12 - 25 mm with great variability in color and pattern.

Detection and inspection methods:
The inspector should look for exit holes in legume pods, frass may be in evidence as well. Moldy or decaying pods, seeds, or fruits would be suspect as well. In macadamia normal development may be interrupted causing malformed or undersized nuts.

**MEANS OF MOVEMENT AND DISPERSAL**
**Natural spread:** Adult migrate from host to host. No long distance flights were noted in the literature.

**Man-assisted spread:** Infested pods or fruits could serve as a pathway for long distance spread.

**PEST SIGNIFICANCE**
**Economic impact:** Namba (1957) reported up to 80% of 200 macadamia nuts picked at random were infested. Swezey (1954) reported that this insect destroyed such a high percentage of Acacia koa seed that it was sometimes difficult to obtain seeds for planting in reforestation projects. Jones (1994) reported a twofold increase in macadamia nut drop 66 days after larval feeding.
**Control:** In Hawaii, parasites, cultural methods, and insecticides have been used with some success.

**Phytosanitary risk:**
**Treatment:** T203(c)(10) is approved for Cryptophlebia illepida in macadamia nuts (as seed).

**REFERENCES**

Jones, V. P. 1994. Oviposition patterns of koa seedworm and litchi fruit moth (Lepidoptera: Tortricidae) on macadamia and litchi in Hawaii. Journal of Economic Entomology 87(5):1278-1284.
Namba, R. 1957. Cryptophlebia illepida (Butler)(Lepidoptera: Eucosmidae) and other pests of macadamia nut in Hawaii. Proc. Hawaiian Ent. Soc. 16(2):284-297.
Swezey, O. H. 1908. Life history notes on two variable tortricids. Proc. Hawaiian Ent. Soc. 2(1): p. 14-16.
Zimmerman, E. C. 1978. Insects of Hawaii. Vol. 9, Microlepidoptera Part I. University Press of Hawaii, Honolulu. 881 pp.

John Lightfield
Agriculturist
Biological Assessment and Taxonomic Support
Plant Protection and Quarantine
September 1995
Reviewed: G. Cave

PEST DATA SHEET

Cryptophlebia ombrodelta (Lower)
Macadamia Nut Borer

## IDENTITY

**Name:** Cryptophlebia ombrodelta (Lower)
**Synonyms:** Argyroplace ombrodelta Lower

**Classification:** Lepidoptera:Tortricidae
**Common names:** Macadamia nut borer, litchi fruit moth, black spotted rolling-leaf moth, tamarind fruit-borer

## HOST RANGE

Acacia, Bauhinia, Cassia, Filicium, Indigofera, Litchi, Macadamia, Phaseolus, Poiciana, Sapindus, Tamarindus

## GEOGRAPHIC DISTRIBUTION

**Asia:** Bangladesh, Cambodia, China, Hong Kong, India, Indonesia, Japan, Laos, Philippines, Sri Lanka, Taiwan, Thailand, North Vietnam
**Australasia and Pacific Islands:** Australia, New Hebrides, Papua New Guinea, Fiji, Solomon Islands
**North America:** Marianas Islands (Guam), Hawaii

## BIOLOGY

The female deposits up to 7 small (in a cluster), silvery-white, scale-like eggs on the skin of the fruit or on the fruit stem. The eggs hatch in about 5 days and the larvae immediately burrows into the skin. Its primary target is the seed in which it can complete its development, if the seed is large enough. If infestation occurs when the seed is just forming, then a single larva may damage two or three fruit in the course of its development (Waite, 1986). Larval development takes between 21-27 days, pupal development 8 days in Australia (Ironside, 1974). In India the adults were reported to live for 7 days (Lingappa & Kanataka, 1981). In Australia laboratory studies indicated 2 weeks (Ironside, 1974).

## DETECTION AND IDENTIFICATION

**Symptoms:** Larvae feed in the fruit and the juices of the injured fruit oozes out of the entrance hole and frass may be present as well. Secondary fungi frequently decay the fruits.

**Morphology:** The length of the mature female 6.5-7.0 mm and the length of the spread wings is 6.5-7.0 mm.

**Detection and inspection methods:** Look for frass adhering to the entrance hole and decayed and rotting fruits.

**MEANS OF MOVEMENT AND DISPERSAL**

**Natural spread:** Adult flight

**Artificial spread:** Larvae in infested fruits

**PEST SIGNIFICANCE**

**Economic impact:** This insect can be a serious pest, infestations frequently cause the fruits to drop, secondary fungi can also decay the infested fruits remaining on the tree.

**Control:** Insecticides applied to the fruits prior to egg hatch.

**PHYTOSANITARY MEASURES**

**Treatment:** T203(c)(10) is approved for Cryptophlebia illepida in macadamia nuts (as seed), unknown if effective for C. ombrodelta in litchi.

**Other safeguards:** Inspection at ports of entry, destruction of infested shipments.

**REFERENCES**

CIE, 1976. Distribution Maps of Pests. Cryptophlebia ombrodelta (Lower) #353, p. 2.

Hawaii Department of Agriculture, 1995. Pest risks associated with shipments of Hawaii-grown commodities to Illinois for scientific research (Draft). Honolulu, Hawaii. 13 pp.

Ironside, D. A. 1974. Biology of Macadamia nut borer (Cryptophlebia ombrodelta (Lower). Queensland Journal Agric. Anim Sci. 31 (3):201-212.

Lingappa, S. & C. Siddappa. 1981. Note on the biology of tamarind fruit-borer, Crytophlebia ombrodelta (Lower) (Lepidoptera: Olethreutidae). Indian Journal of Agricultural Sciences 51(6) p. 467-470;

Unknown, (year ?). Prevention and control of disease and insect pest in Chinese lychee. Chapter 6. 52 pp. (translated copy).

Waite, G. K. 1986. Pests of lychees in Australia. Proceedings of the First National Lychee Seminar, Eds. C.M. Menzel and G.N. Greer, Queensland, Australia. p. 42-48.

John Lightfield
Agriculturist
Biological Assessment and Taxonomic Support
Plant Protection and Quarantine
July 1995
Reviewed by G. Cave & A. Chawkat

PEST DATA SHEET

Epiphyas postvittana
Light-brown Apple Moth

IDENTITY

**Name:** Epiphyas postvittana (Walker)
**Synonyms:** Austrotortrix postvittana (Walker)
Tortrix postvittana Walker

**Taxonomic position:** Lepidoptera: Tortricidae
**Common names:** Light-brown apple moth

**HOSTS**

Acacia spp., Actinidia chinensis, Adiantum sp., Amaranthus hybridus, Amaranthus patulus, Aquilegia sp., Arbutus sp., Arctotheca calendula, Artemisia sp., Astartea sp., Aster subulatus, Baccharis sp., Boronia ledifolia, Brassica oleracea, Breynia sp., Buddleia sp., Bursaria sp., Calendula officinalis, Callistemon sp., Camellia sp., Campsis sp., Cassia sp., Ceanothus sp., Centranthus sp., Centranthus ruber, Chamaecyparis lawsoniana, Chenopodium album, Choisya sp., Chrysanthemum sp., Citrus sp., Clematis sp., Clerodendrum sp., Correa speciosa, Cotoneaster sp., Crataegus sp., Cucurbita pepo, Cydonia sp., Dahlia sp., Datura sp., Daucus sp., Dodonaea sp., Eriobotrya sp., Eriostemon sp., Escallonia sp., Eucalyptus sp., Euonymus sp., Euonymus japonica, Euphorbia sp., Feijoa sp., Forsythia sp., Fragaria sp., Fortunella sp., Gelsemium sp., Genista sp., Gerbera sp., Grevillea robusta, Hardenbergia sp. Hebe sp., Hedera sp., Helichrysum sp., Humulus lupulus, Hypericum sp., Jasminum sp., Juglans regia, Lathyrus sp., Lavandula sp., Leptospermum sp., Leucodendron sp., Ligustrum sp., Ligustrum ovalifolium, Linum sp., Litchi sp., Lonicera sp., Lupinus sp., Lycopersicon esculentum, Macadamia sp., Malus domestica, Mangifera sp., Medicago polymorpha, Medicago sativa, Melaleuca sp., Mentha sp., Mesembryanthemum sp., Michelia sp., Monotoca sp., Myoporum sp., Oxalis sp., Parthenocissus sp., Pelargonium sp., Persoonia lanceolata, Petroselinum sp., Philadelphus sp., Photinia sp., Phyllanthus sp., Pinus sp., Pinus patula, Pinus radiata, Pipturus sp., Pittosporum sp., Plantago lanceolata, Platysace sp., Polygala sp., Polygonum sp., Prunus armeniaca, Prunus avium, Prunus domestica, Prunus persica, Pteris sp., Pulcaria sp., Pulcaria dysenterica, Pyracantha sp., Pyrus communis, Quercus sp., Ranunculus sp., Raphanus raphanistrum, Reseda odorata, Ribes spp., Ribes fruticosus, Rubus hawaiiensis, Rumex acetosella, Rumex crispus, Salvia sp., Santalum sp., Senecio sp., Sida sp., Sisymbrium officinale, Smilax sp., Solanum tuberosum, Sollya sp., Tithonia sp., Trema sp., Trifolium glomeratum, Trifolium repens, Trifolium subterraneum, Triglochin sp., Ulex europaeus, Urtica dioica, Vaccinium sp., Viburnum sp., Vicia faba, Vicia hirsuta, Vicia sativa, Vinca sp., Vitis sp., Wikstroemia foetida, Wilkesia sp., and Wisteria sp. (Whittle, 1984). This species has been reported to feed on species from 27 families. Preferred hosts of economic importance are Malus domestica, Pyrus communis, and to a lesser extent Prunus persica. In England, preferred hosts have been reported as Hebe spp. and Euonymus spp. but not a pest of apples (Ford, 1988).

**GEOGRAPHIC DISTRIBUTION**

Europe: United Kingdom
Australasia and Pacific Islands: Australia, New Caledonia, and New Zealand.
North America: Hawaii (IIE, Map 82, 1992)

**POTENTIAL ECOLOGICAL RANGE**
Coastal areas of Washington, Oregon, California, Georgia, South Carolina, and North Carolina. Southern borders of Arizona, New Mexico, Texas, Louisiana, Mississippi, Alabama, and Florida (Anon, 1985).

**BIOLOGY**
In southern Australia and New Zealand this tortricid has three generations per year and overwinters as larvae. All stages have a lower threshold for development of 7.5° and, with no mention of a diapause in the literature. Female moths deposit egg masses on the upper leaf surface or on fruit. After dispersing, newly hatched larvae construct silken shelters on the underside of leaves, usually near a midrib or large vein. Older larvae roll together leaves and buds or fruit with webbing (Anon., 1985)

**DETECTION AND IDENTIFICATION**

Symptoms: Larval feeding on fruit results in large irregular blemishes. These blemishes may callous over and the fruit remain on the tree, or wet conditions may allow the entry of rot organisms. Larvae may excavate small round pits and produce scars similar to the "stings" of the larvae of Cydia pomonella (Linnaeus) (Whittle, 1984).

Morphology: Adult males are smaller than females, length 5-10 mm, wingspan 12-24 mm. Eggs are pale green to pale brown, almost flat, 0.84 by 0.95 mm. First instar larva is pale yellow head dark brown. Later instar head and prothoracic plate pale brown. Length of full-grown larvae 10-18 mm, body medium green, darker central strip, two side stripes (Whittle, 1984)

Detection and inspection methods:
Larval forms have been intercepted in shipments of fruits and propagative material. Larval and pupal forms may be associated with cut flowers and moved with international trade.

**MEANS OF MOVEMENT AND DISPERSAL**
**Natural Spread** - Adult moths do not fly great distances from plant hosts. The adults are nocturnal with flight periods peaking at dawn or dusk. Hitchhikers on airplanes would be leaving a south temperate zone and arriving in a north temperate zone during a season opposite from the one left behind.
**Man-assisted Spread** - Larval and pupal forms moving with importations of fruits, vegetables, and cut flowers.

**PEST SIGNIFICANCE**

Economic impact:
The larva of E. postvittana is a serious pest of fruit and ornamentals in Australia and New Zealand. During severe outbreaks, damage to the fruit may be as much as 75 percent.

Phytosanitary risk:
Host fruits from Australia are inspected using a statistical sampling method. Propagative material with egg masses appears to present the highest risk if destined to the southern states.

**REFERENCES**


Anonymous. 1985. Exotic Pest Detection Manual. Epiphyas postvittana. p. 28-30

Ford, E. J. 1988. Pathway Studies (Unplubished Document). Epiphyas postvittana. PPQ, APHIS, USDA. p. 231-237.

IIE. 1992. Distribution Maps of Pests, Number 82. Epiphyas postvittana. CAB International, London, UK.

Miller, C. E. 1982. Pathway Studies (Unplubished Document). Epiphyas postvittana. PPQ, APHIS, USDA. p. 154-156.

Whittle, K. 1984. Pest Not Known to Occur in the United States or of Limited Distribution. No. 50. PPQ, APHIS, USDA. 12 p.



John Lightfield
Agriculturist
Biological Assessment and Taxonomic Support
Plant Protection and Quarantine

September 1995
Reviewed: G. Cave

PEST DATA SHEET

Eriophyes litchii Keifer
Lychee Eriophyid Mite

**IDENTITY**

**Name:** Eriophyes litchii Keifer
**Synonyms:** Aceria litchii Keifer

**Classification:** Acarina: Eriophyidae
**Common names:** Lychee eriophyid mite, Erinose, leaf curl mite

**HOST RANGE**
Litchi chinensis, Dimocarpus (=Erphoria) longana

**GEOGRAPHIC DISTRIBUTION**
Australia, Bangladesh, China, India, Taiwan, Thailand, and USA (Hawaii)

**BIOLOGY**
Adults lay their eggs on the ventral side of leaves, incubation period is 2-3 days, nymphal 8-12 days. Sexual dimorphism is evident only in adult state. Over wintering is in adult stage (Butani, 1977).

**DETECTION AND IDENTIFICATION**

Symptoms: Severe infestations may damage developing flowers and fruit, and kill the growing points (Menzel et al., 1988)

Morphology: The white eggs are 0.04 mm in diameter and round in shape. They are laid singly on the ventral surface of the leaves at the base of the hair. The adults are 0.15 to 0.2 mm long with greatly enlarged abdomen having about 55 ring-like segments (Singh, G. 1993)

Detection and inspection methods: Affected leaves develop yellow or grayish-yellow velvety growth, which later turns brown. On matured leaves there are continuous or scattered patches of brown to deep-brown depressed regions resulting in gall formation, curling, twisting, thickening and pitting of the leaves. The flowers or buds show an enormous increase in size and are thickened with yellow or grayish-yellow velvety growth on the surface. An enlargement up to 4-5 times the normal size is not rare. Severe infestations may kill the growing points.

**MEANS OF MOVEMENT AND DISPERSAL**
**Natural spread:** Wind and rain serves as a vehicle for short distance spread.

**Artificial spread:** Movement of plants or plant parts for propagation contributes to long distance spread.

**PEST SIGNIFICANCE**

**Economic impact:** Wen & Lin (1991) reported an average of 24.59% of the plants were damaged in two localities over a two year period in Taiwan. High populations cause leaf drop and poor fruit set. Huang (1967) reported damages reaching a peak (83%) in May and a low (20%) in September in 3 districts of central-southern Taiwan.

**Control:** Insecticide applications, cultural methods such as collecting and burning or burying infected leaves and pruning infected parts.

**PHYTOSANITARY MEASURES**

Imported lychee plants and plant parts for propagation are regulated under 319.37-7(b) and are required to be grown in post entry quarantine for 2 years.

**REFERENCES**


Ammonrat, P. 1979. Seasonal fluctuation of Eriophyes litchii, Keifer population in lychee orchard. research report, Department of Agriculture, Bangkok. p. 86

Butani, D. K. 1977. Insect pests of fruit crops and their control: litchi. Pesticides, 11 (2):43-48.

Cull, B. W. & B. F. Paxton. 1983. Growing the lychee in Queensland. Queensland Agricultural Journal 109(2):53-59.

Huang, T. 1967. A study on morphological features of erinose mite of litchi (Eriophyes litchii Keifer) and an observation on the conditions of its damage. Plant Protection Bulletin, Taiwan 9 (3/4):35-46.

Menzel, C. M.; Watson, B. J.; Simpson, D. R. 1988. The lychee in Australia. Queensland Agricultural Journal 114 (1):19-26.

Pandey, R. M. & H. C. Sharma. 1989. The Litchi. Indian council of Agricultural Research Krishi Anusandhan Dhavan, Pusa, New Delhi. 80 pp.

Singh, G. Insect Pests of other subtropical fruits. Advances in Horticulture (3) - Fruit Crops: Part 3. Eds: K. L. Chadha and O. P. Pareek. p. 1514-1516.

Wen, H. C. & C. C. Lin. 1991. Field studies of litchi erineum mite (Eriophyes litchii Keifer) in southern Taiwan. Jour. Agric. Res. China 40(3):298-304.



John Lightfield
Agriculturist
Biological Assessment and Taxonomic Support
Plant Protection and Quarantine

July 1995
Reviewed by: G. Cave, A. Chawkat, and R. Stewart