

Biology and management of palm weevils

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University of Florida/IFAS
Fort Lauderdale Research and Education Center***



Dryophthoridae:

Palm Weevils: (Rhynchophorini)

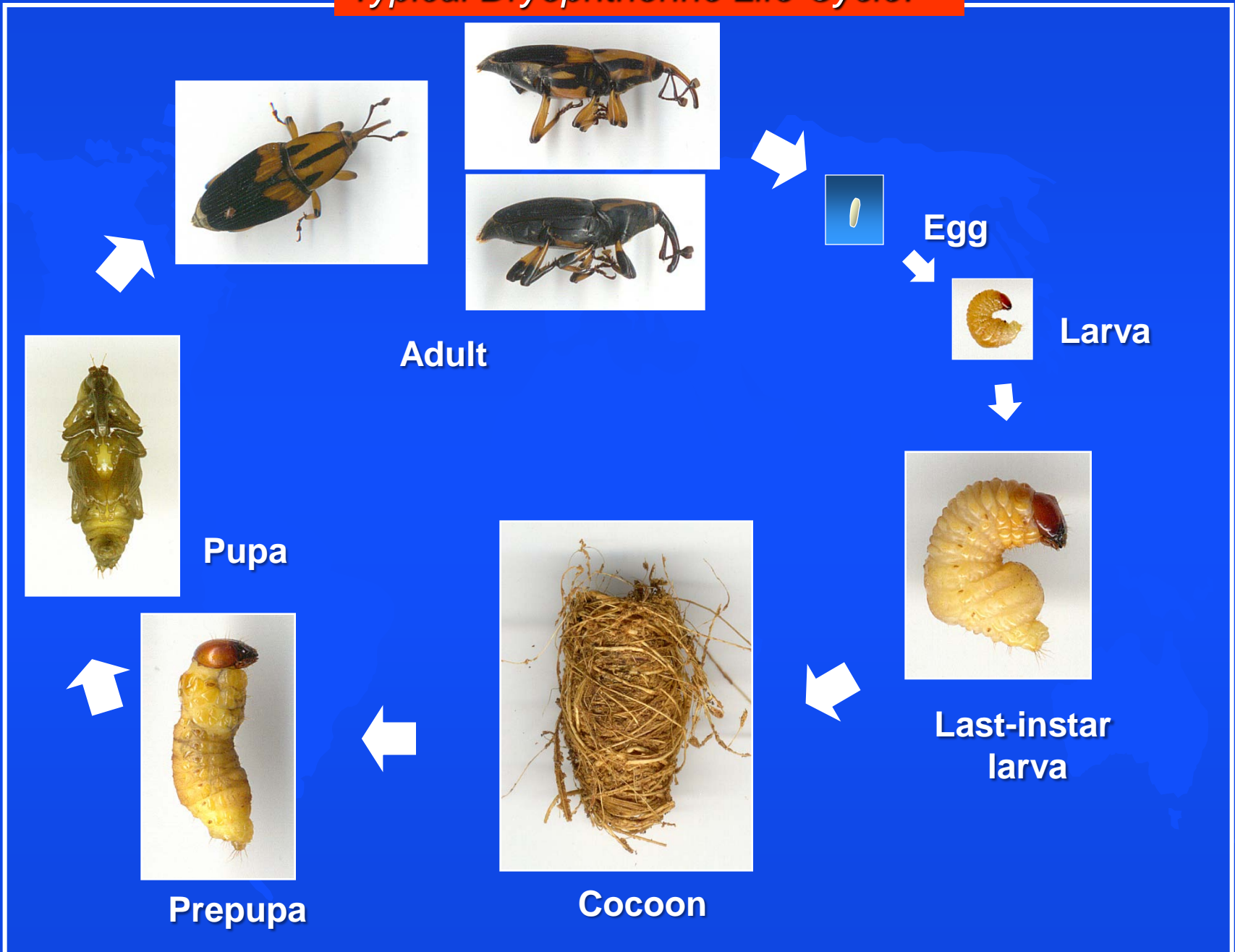


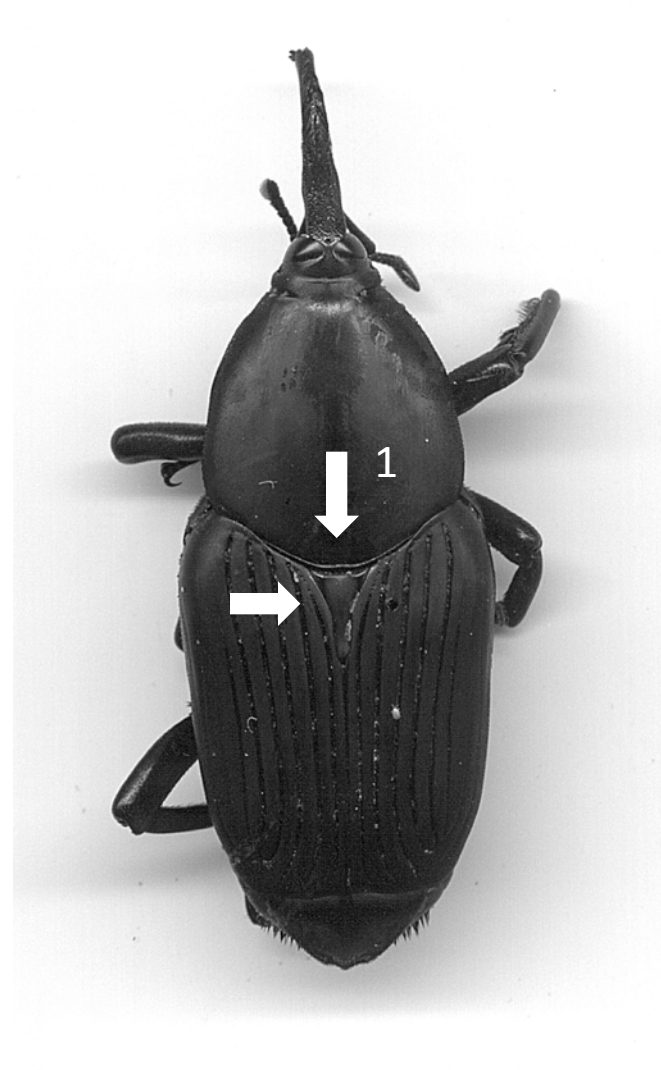
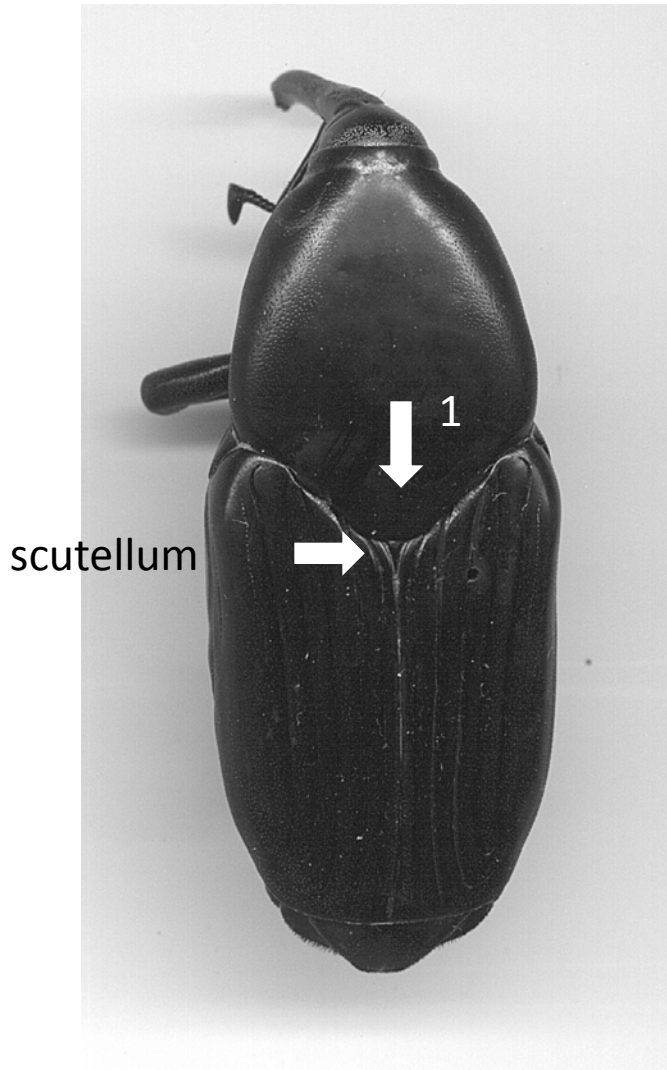
- ✓ *Rhynchophorus* species
- ✓ *Dynamis borassi*

Sugarcane/Palm Weevils: (Sphenophorini)

- ✓ *Metamasius hemipterus* and other species
- ✓ *Rhabdoscelus obscurus*

Typical Dryophthorine Life Cycle:





Dynamis borassi 1. *Rhynchophorus palmarum*

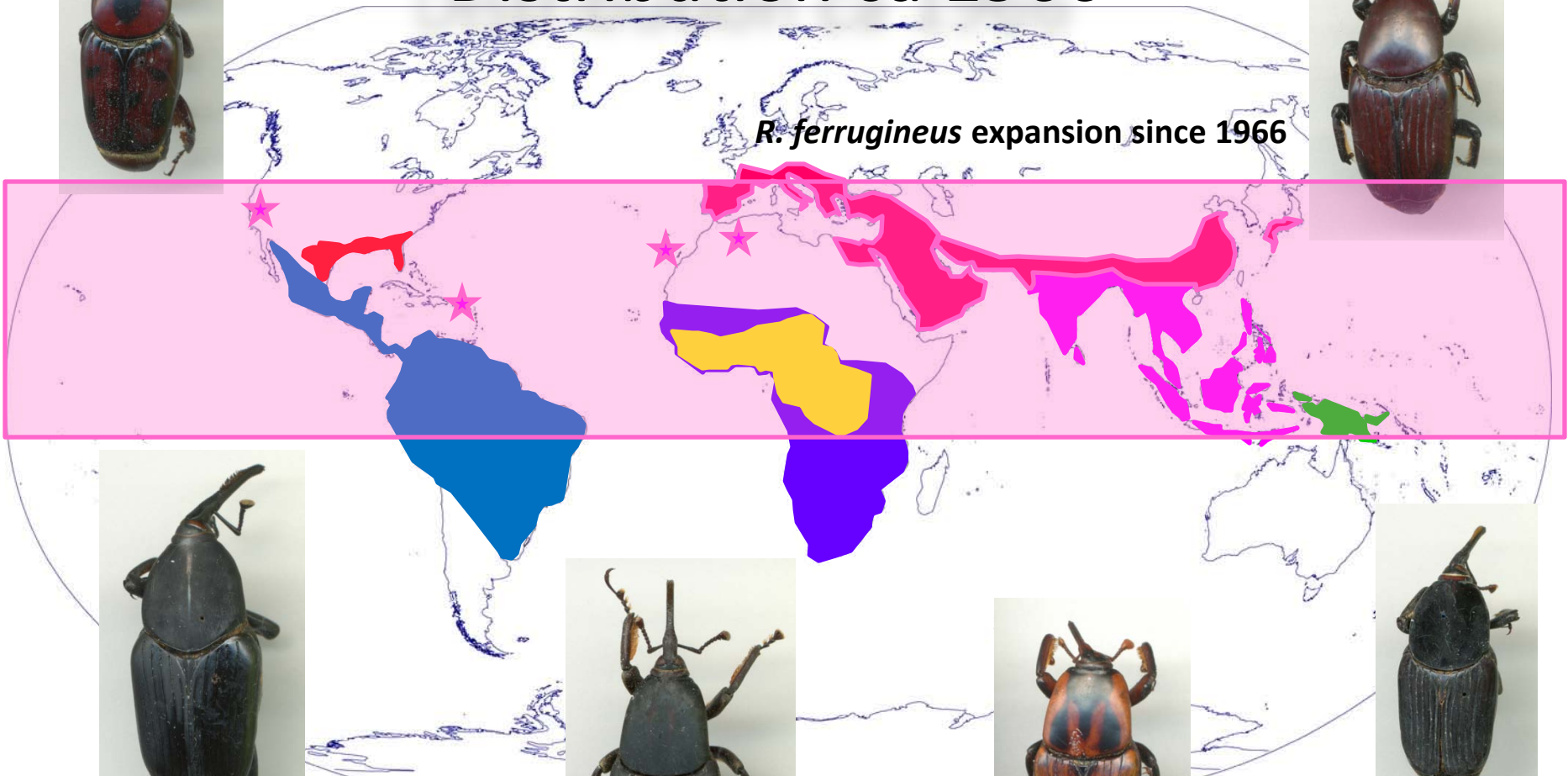
R. cruentatus



Rhynchophorus

Distribution ca 1966

R. ferrugineus



R. palmarum



R. phoenicis



R. quadrangulus



R. bilineatus

R. bilineatus



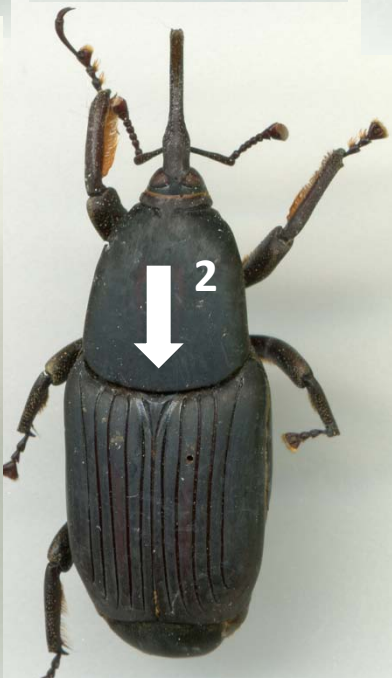
R. cruentatus



R. ferrugineus



R. palmarum



R. phoenicis



R. quadrangulus



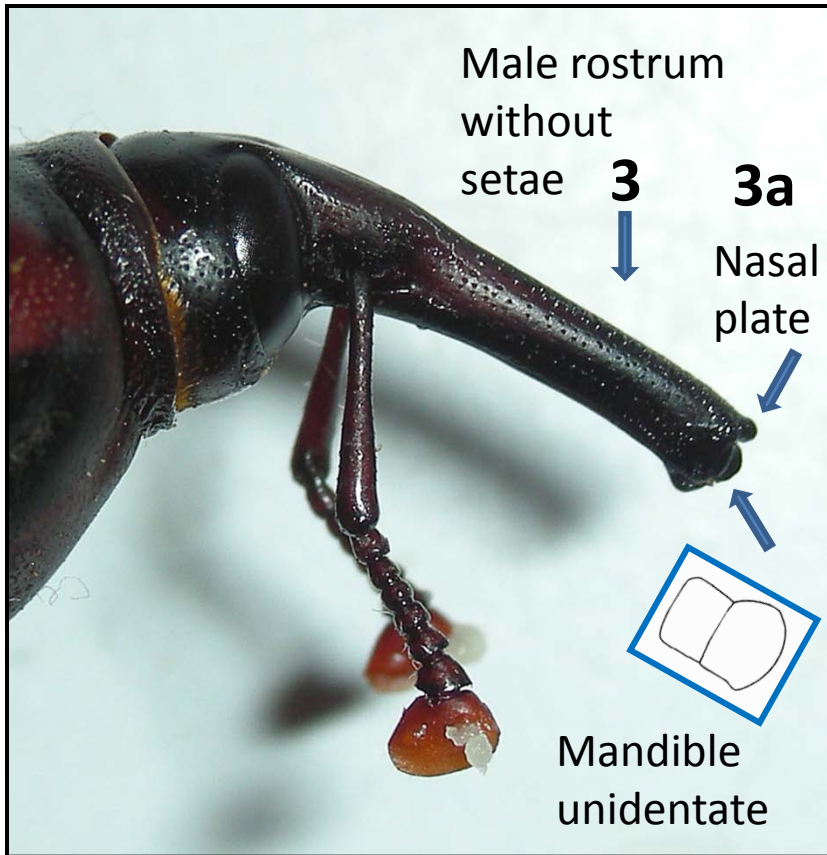
Rhynchophorus quadrangulus



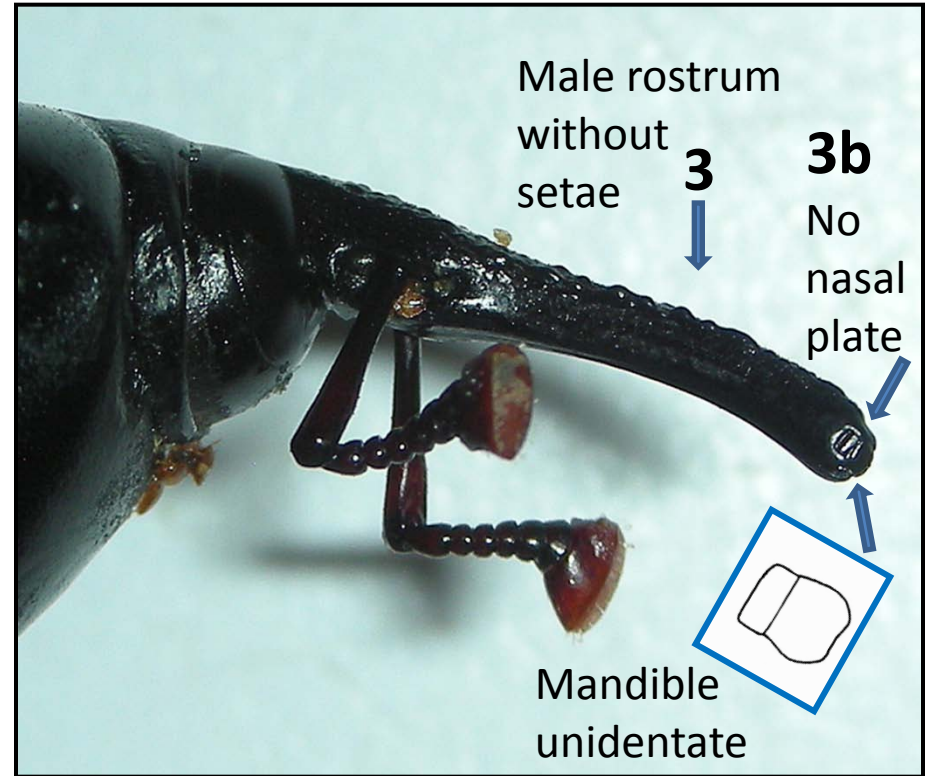
Rhynchophorus cruentatus



Rhynchophorus ferrugineus



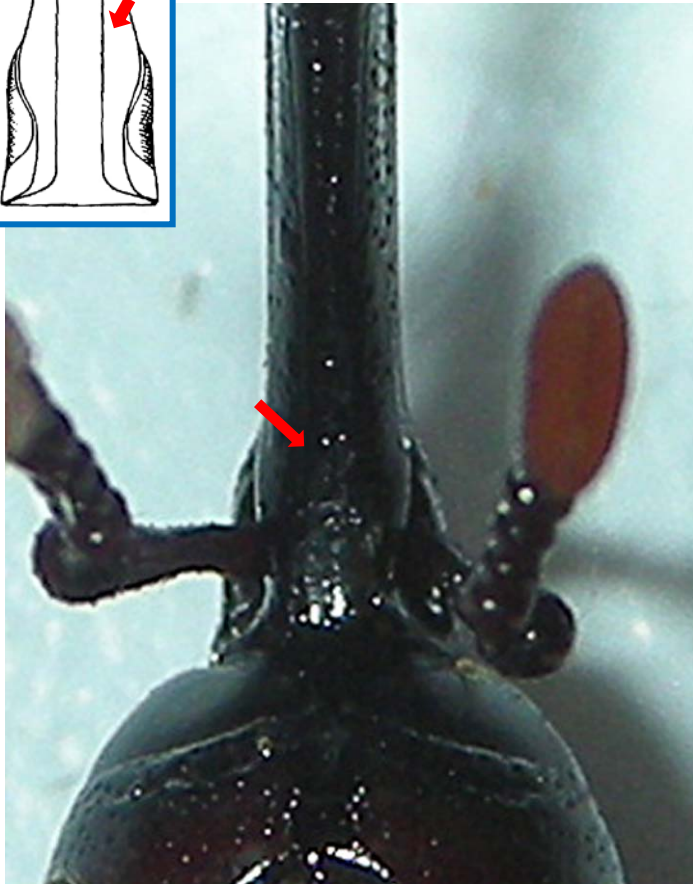
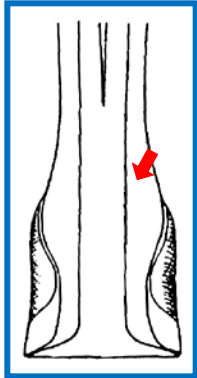
Rhynchophorus quadrangulus



Rhynchophorus cruentatus

3a

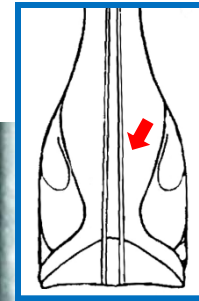
Submentum
wide



Rhynchophorus quadrangulus

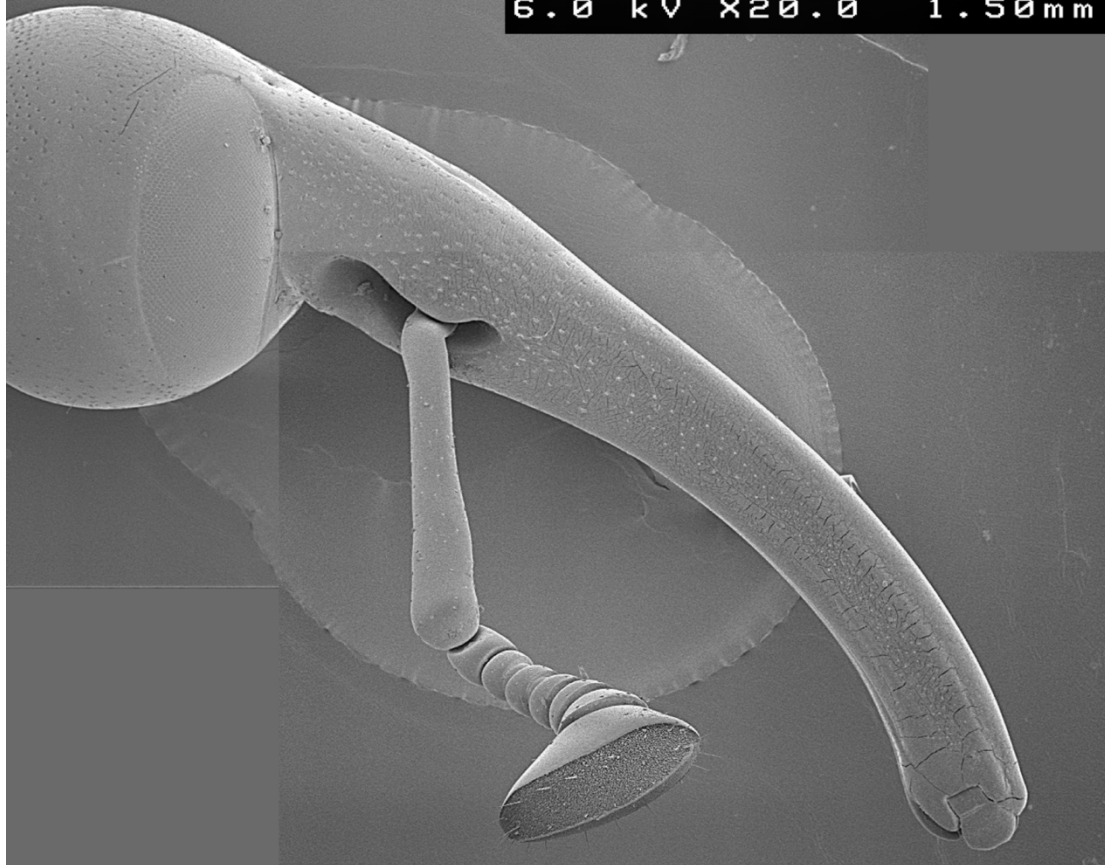
3b

Submentum
narrow



Rhynchophorus cruentatus

6.0 kV X20.0 1.50mm

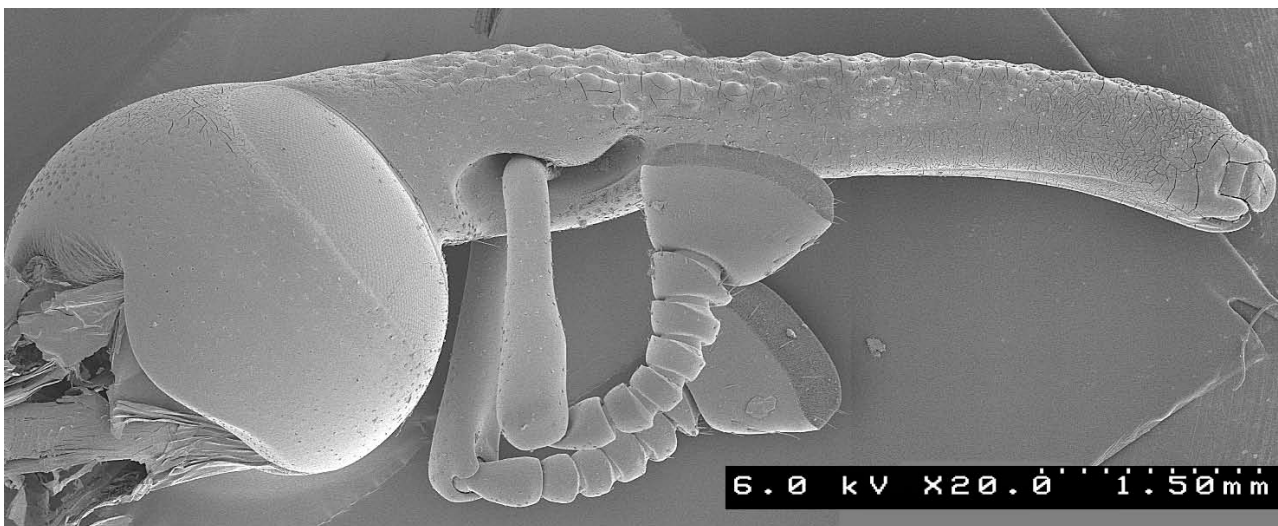


Rhynchophorus cruentatus

female



male

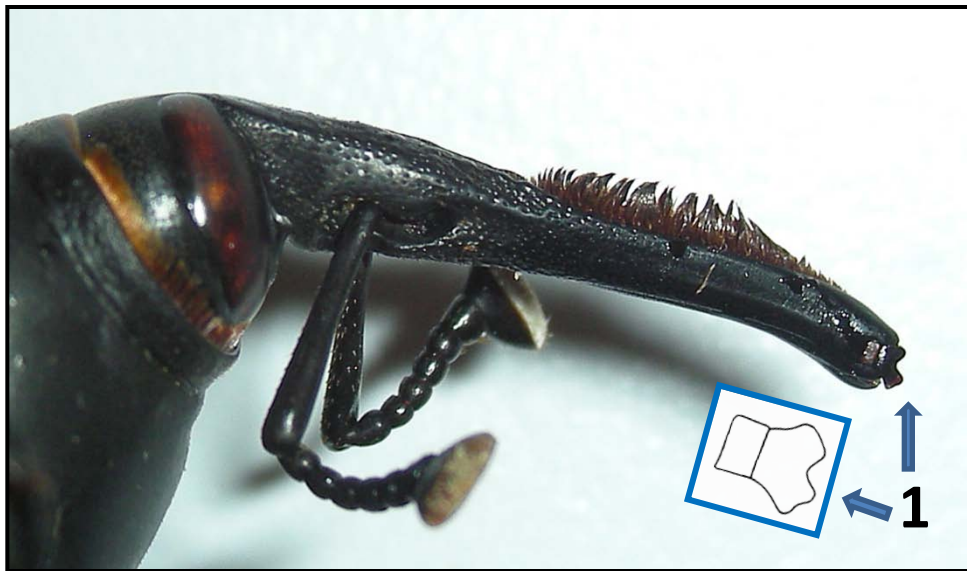


6.0 kV X20.0 1.50mm

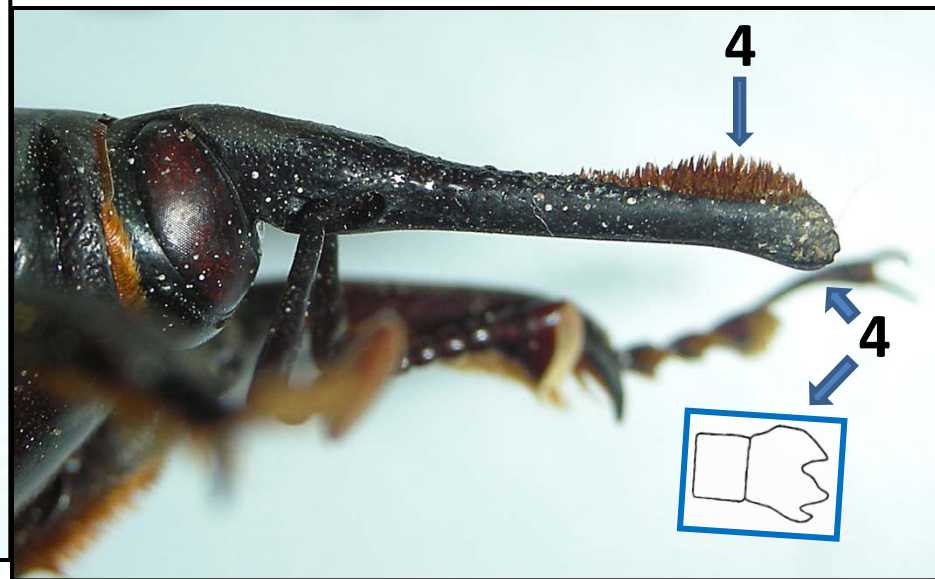
Rhynchophorus bilineatus



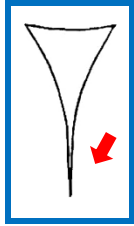
Rhynchophorus ferrugineus



Rhynchophorus palmarum



Rhynchophorus phoenicis

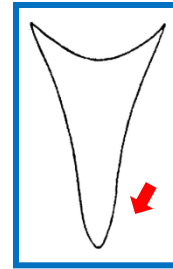


4a

Scutellum
tapers acutely



Rhynchophorus phoenicis



5

Scutellum
Tapers broadly

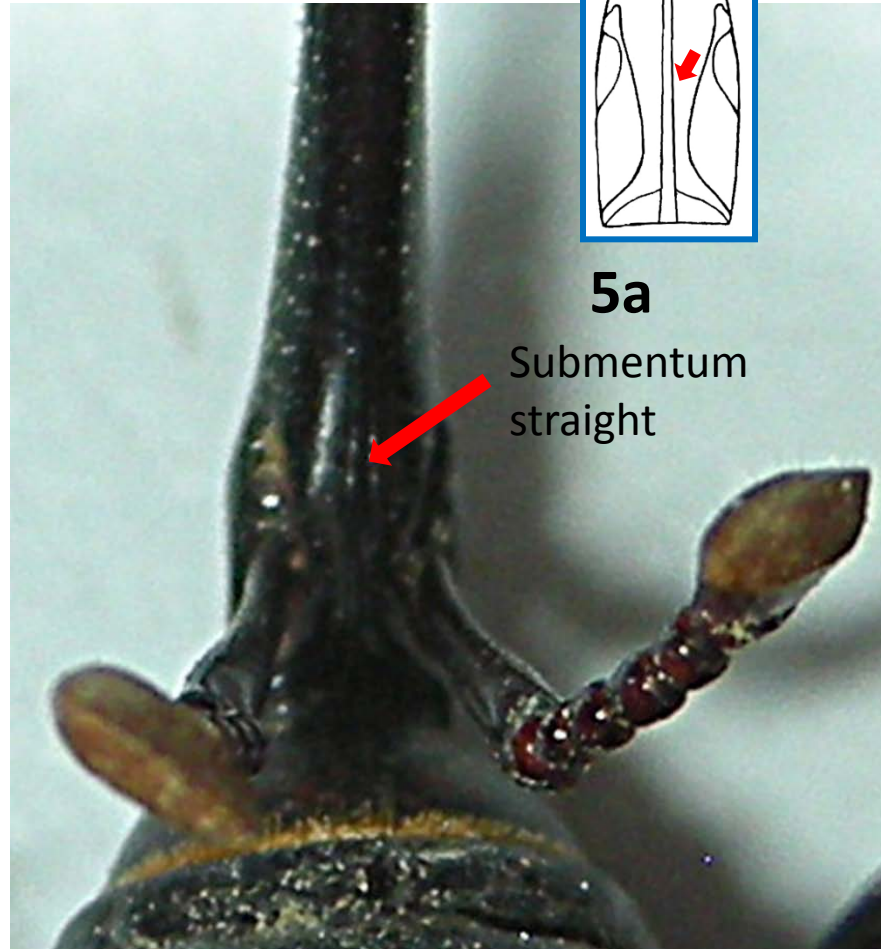


Rhynchophorus bilineatus



Rhynchophorus ferrugineus

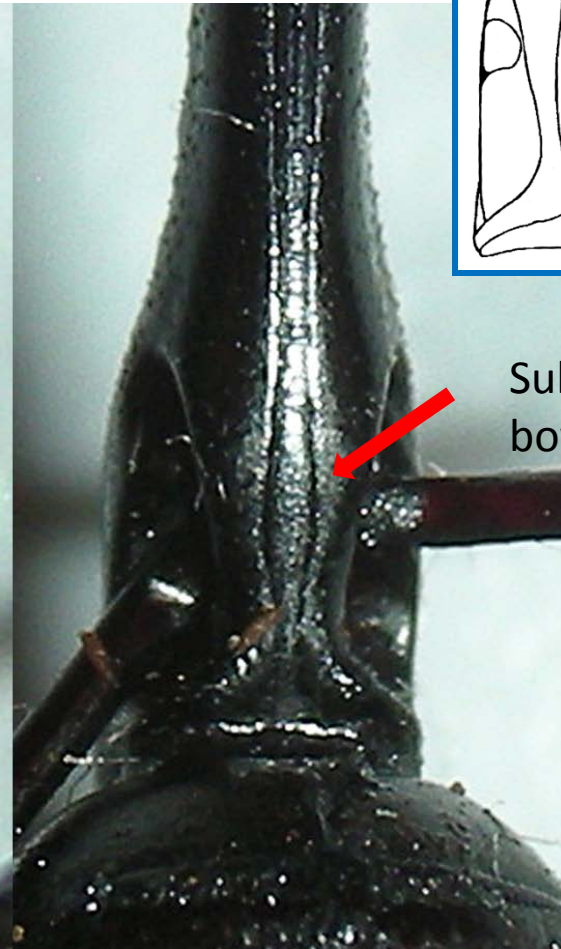
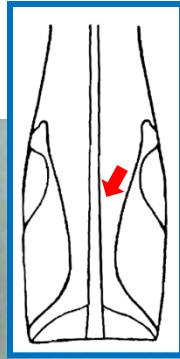




5a

Submentum
straight

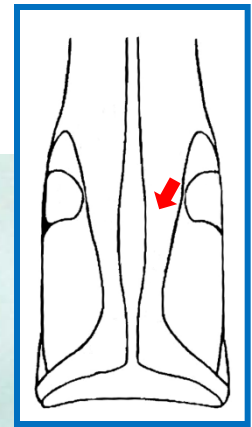
Rhynchophorus bilineatus



5b

Submentum
bowed

Rhynchophorus ferrugineus





R. bilineatus

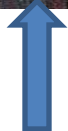
R. cruentatus

R. ferrugineus

R. palmarum

R. phoenicis

R. quadrangulus





R. bilineatus

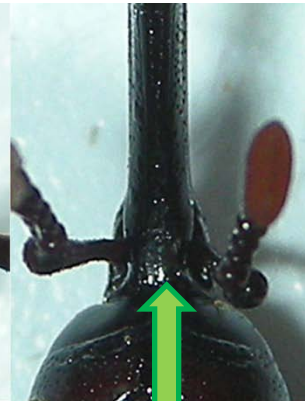
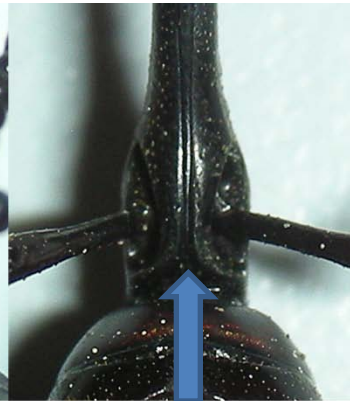
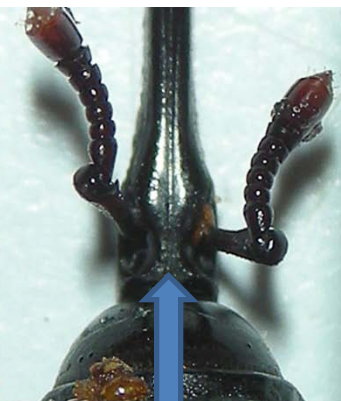
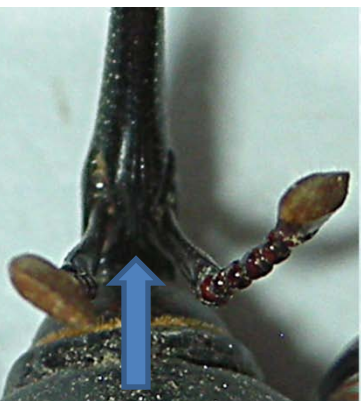
R. cruentatus

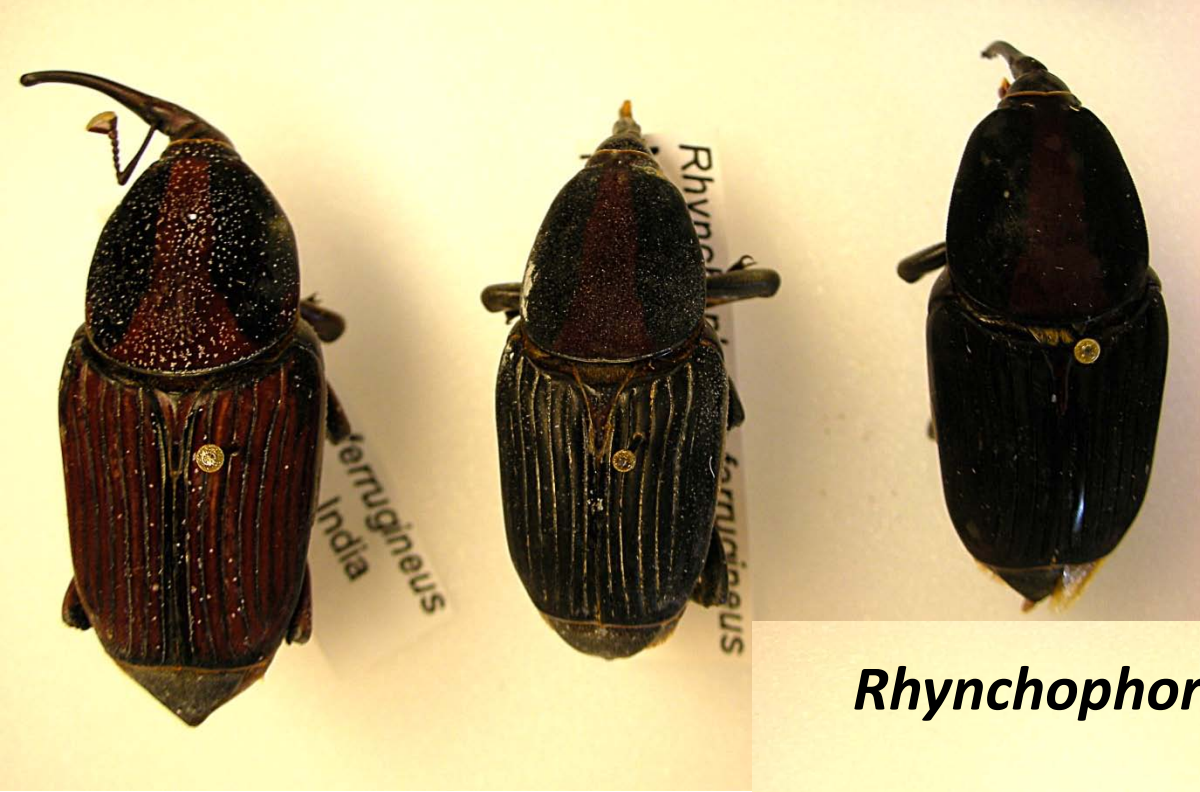
R. ferrugineus

R. palmarum

R. phoenicis

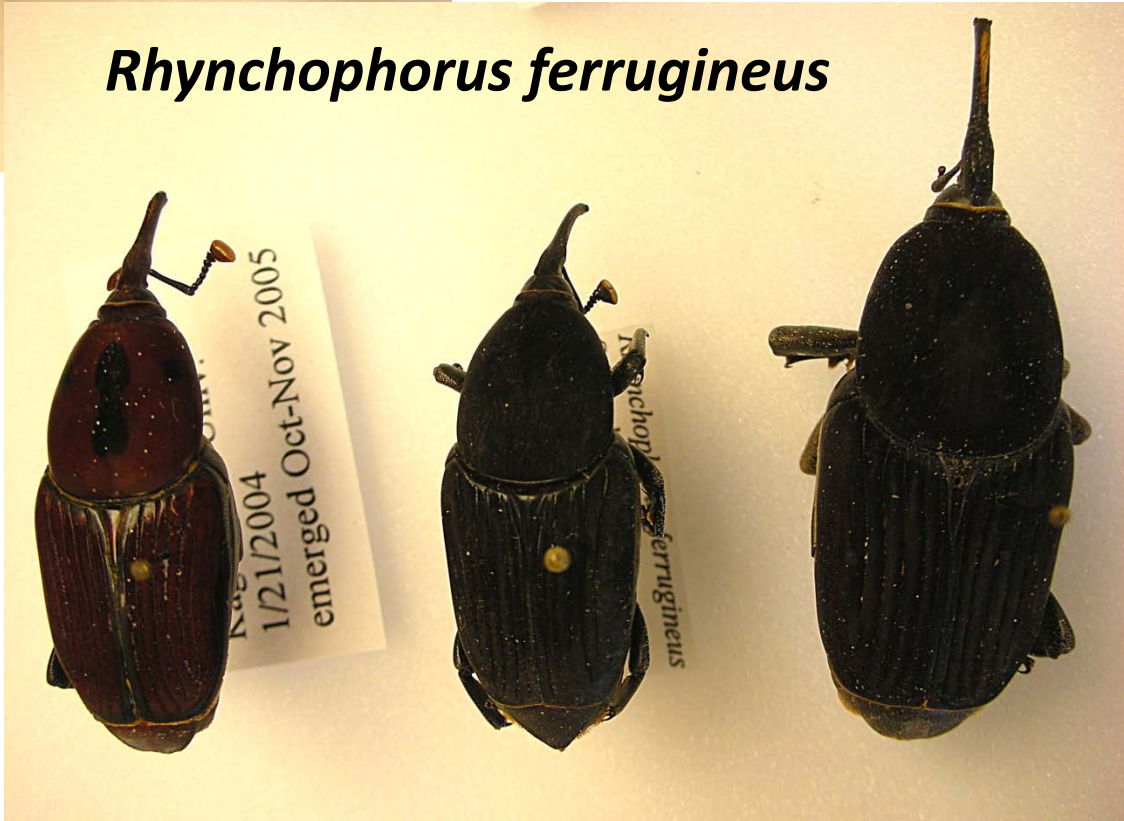
R. quadrangulus





Rhynchophorus ferrugineus
India

Rhynchophorus ferrugineus



Nes...
1/21/2004
emerged Oct-Nov 2005

Rhynchop...
ferrugineus

Rhynch



Rhynchophorus cruentatus



Rhynchophorus phoenicis



R. cruentatus



Stressed Sabal palmetto

Intraspecific

Semiochemical:

- ✓ **Releaser pheromone:** Chemical released by sender with immediate reversible effects on receiver (i.e. sex and aggregation pheromones)
- ✓ **Primer pheromone:** Chemical with long term effects on physiology and development of receiver (i.e. caste determination and reproductive synchrony)

Interspecific

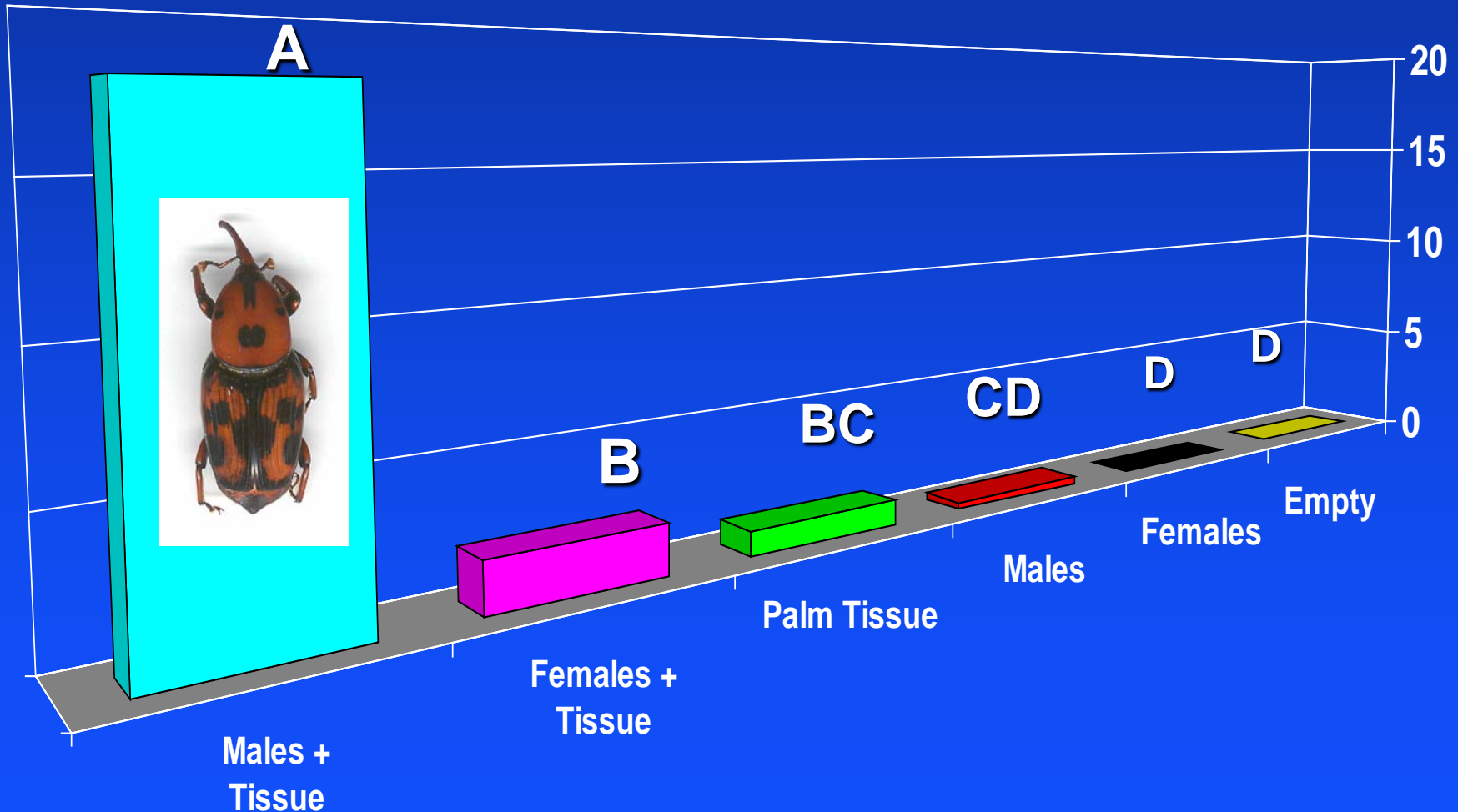
Semiochemical:

- ✓ **Kairomone:** Chemical released that benefits the receiver, but not the sender.
- ✓ **Allomone:** Chemical that benefits sender or sender and receiver.



10 live *R. cruentatus*

Weekly Weevil Counts from Traps Baited with 10 Live *Rhynchophorus cruentatus* and/or 1.5 kg of *Sabal palmetto* Tissue



Dryophthoridae:

Palm Weevils: (Rhynchophorini)

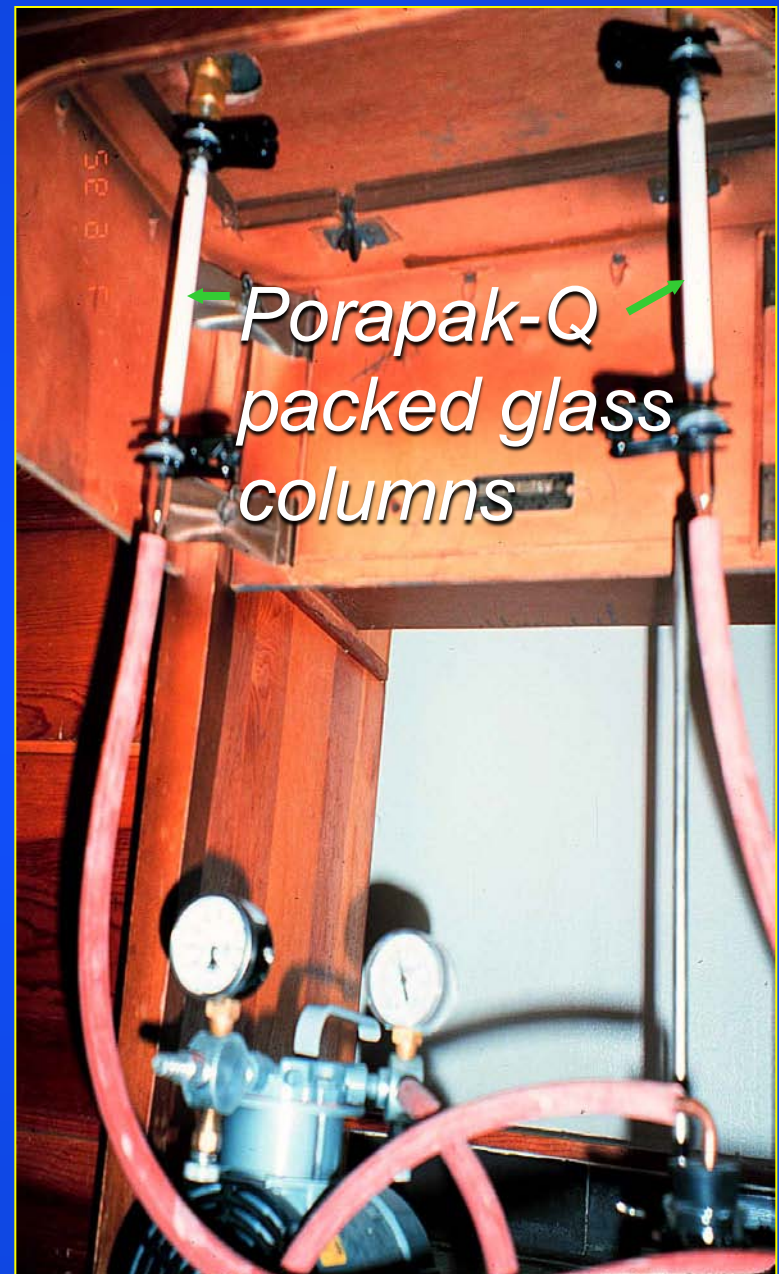
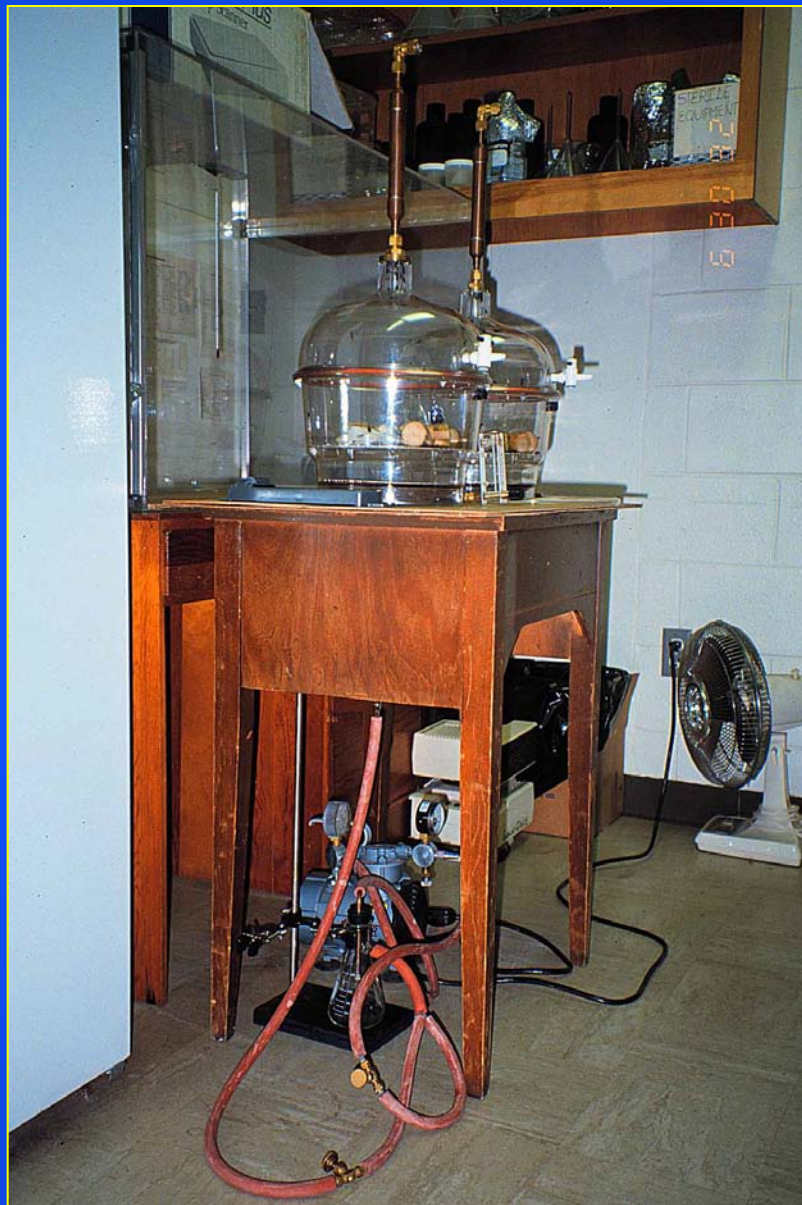
- ✓ *Rhynchophorus* species **YES**
- ✓ *Dynamis borassi* **YES**

Sugarcane/Palm Weevils:

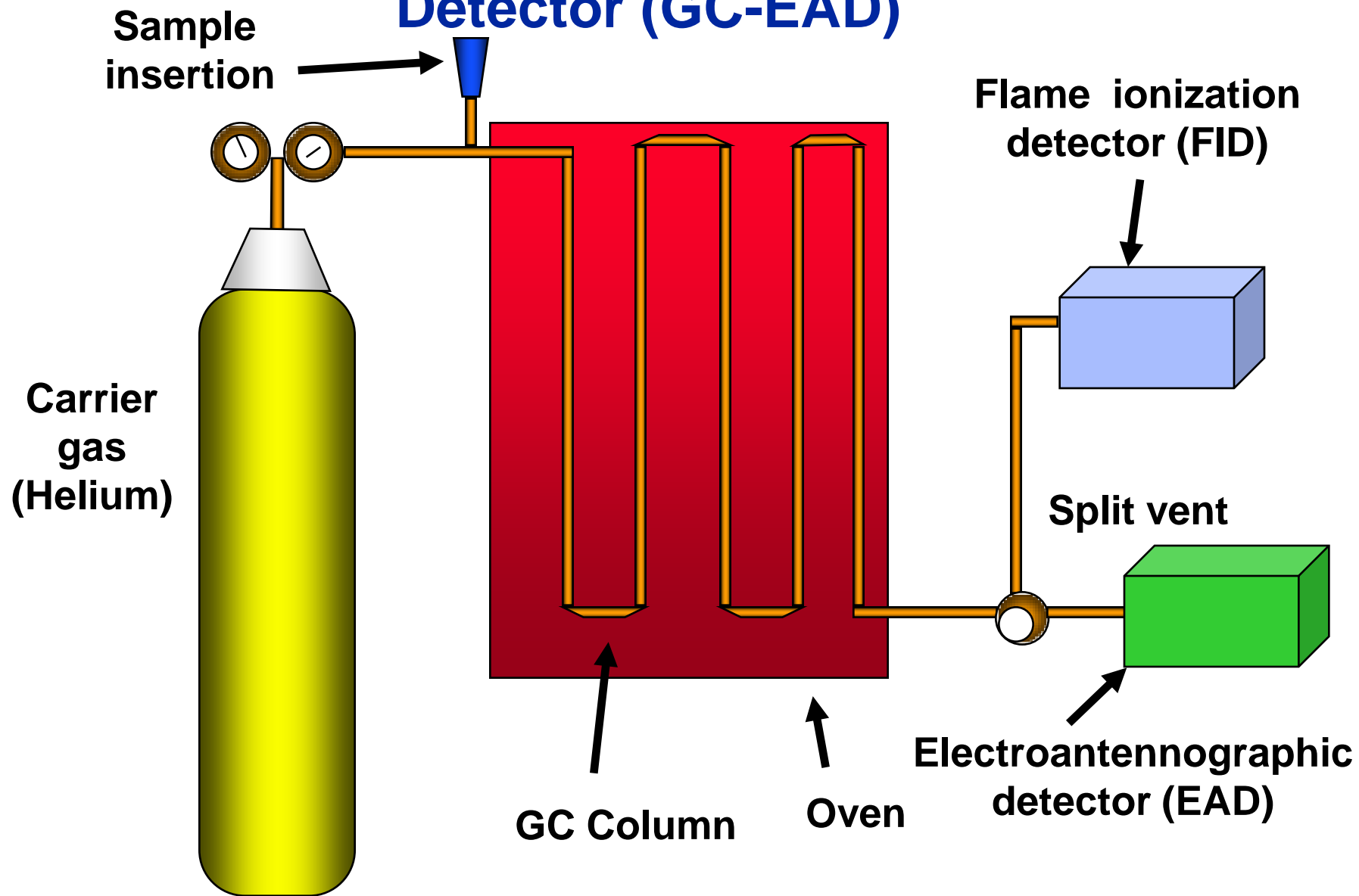
(Sphenophorini)

- ✓ *Metamasius hemipterus* and other species **YES**
- ✓ *Rhabdoscelus obscurus* **YES**

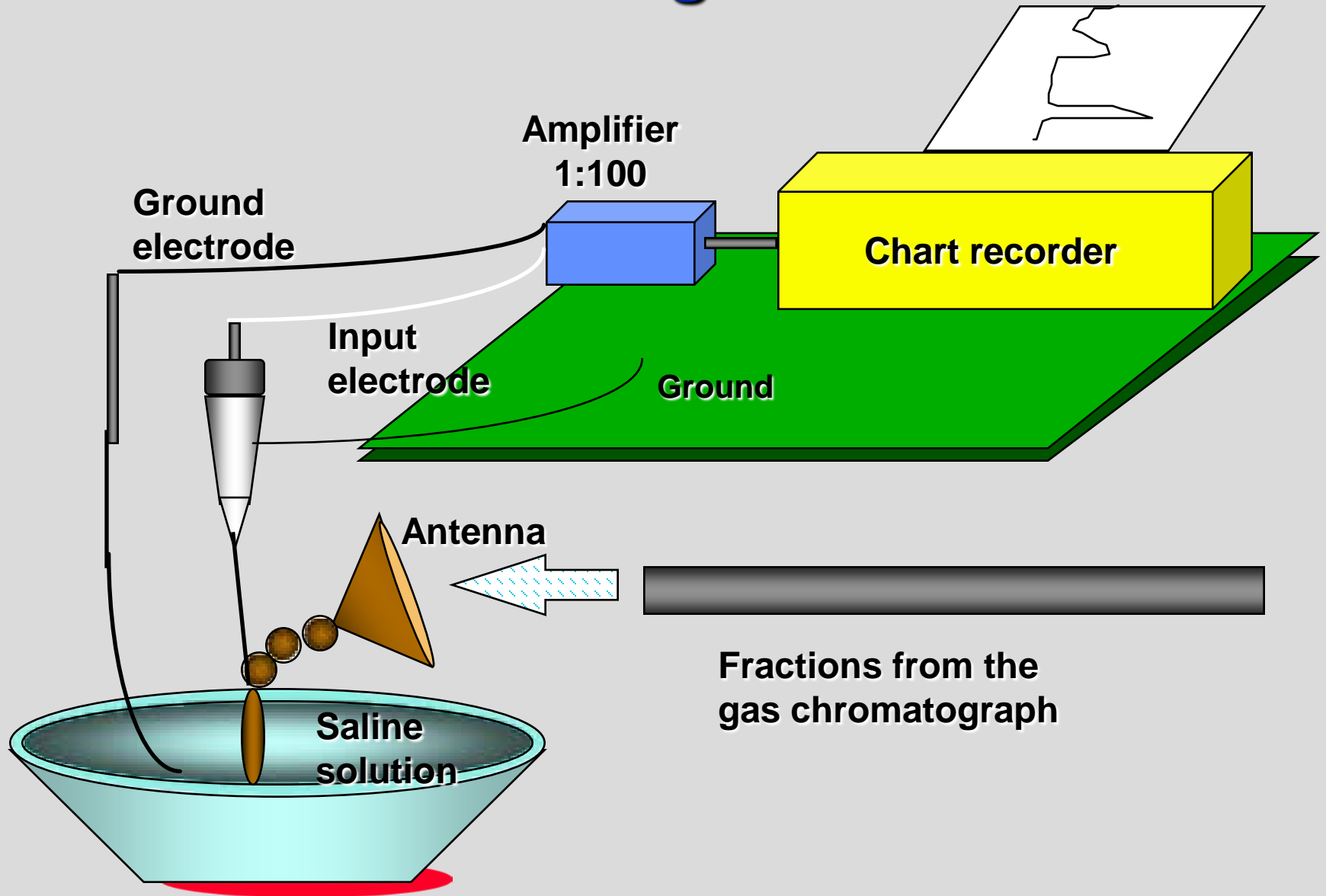
AERATION CHAMBERS



Gas Chromatograph with Electroantennographic Detector (GC-EAD)



Electroantennogram



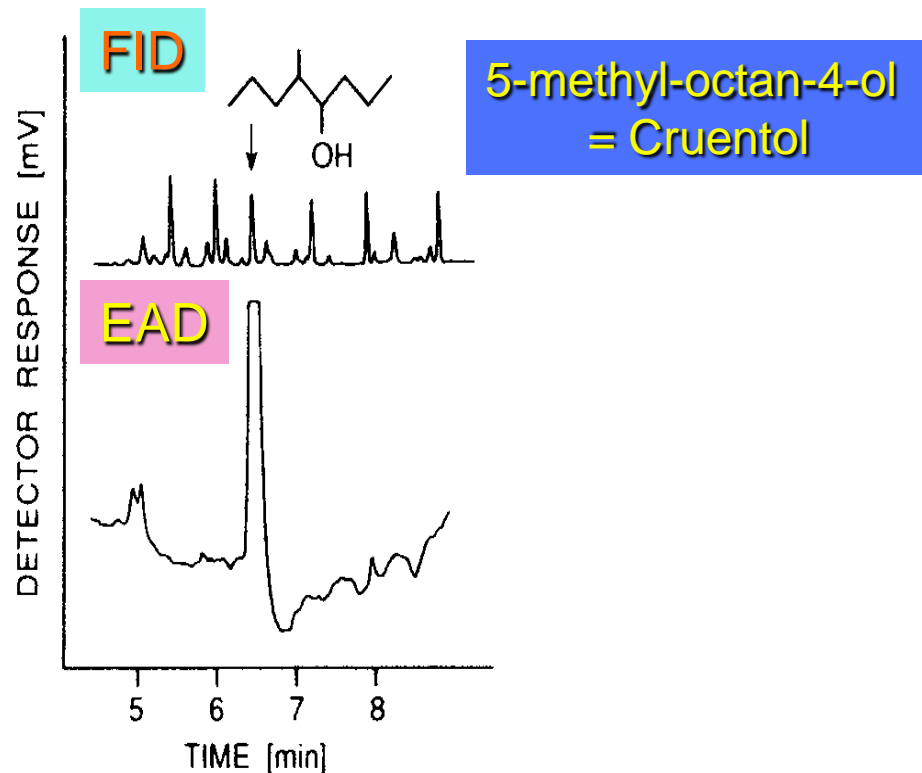
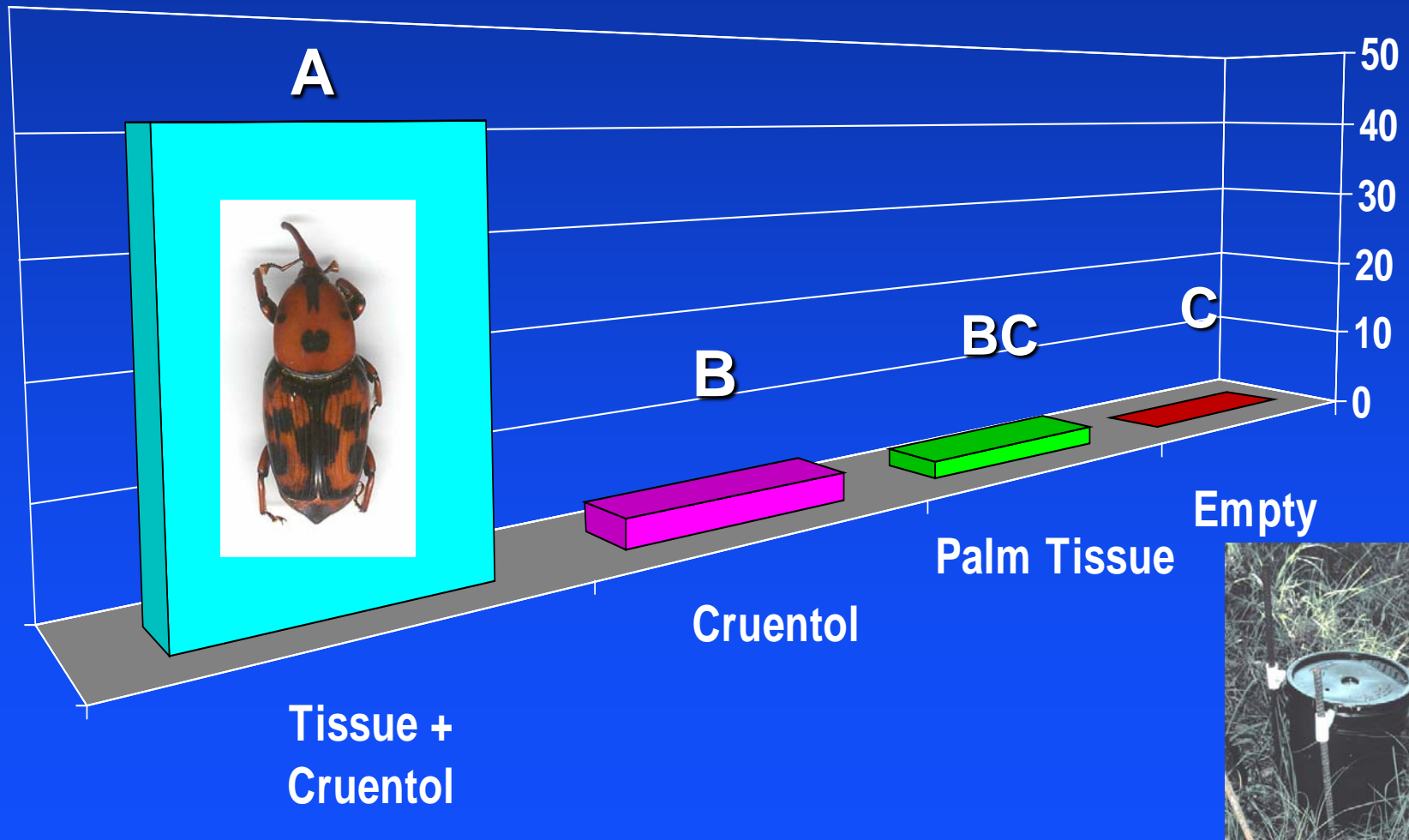


FIG. 1. Flame ionization detector (FID) and electroantennographic detector (EAD) responses to volatiles collected for seven days from unfed *R. cruentatus* males. The antennal recording (EAD) was carried out with a *R. cruentatus* male antenna. Gas chromatographic conditions: linear flow velocity: 35 cm/sec, injector and detector temperatures: 220°C, temperature programming: 70°C (1 min), 10°C/min to 240°C; DB-5 column (30 m × 0.25 mm ID).

Weekly *Rhynchophorus cruentatus* Counts from Traps Baited with 5-methyl-octan-4-ol (0.4 mg/d) and/or 1.5 kg of *Sabal palmetto* Tissue



R. cruentatus



Rhynchophorus

Pheromone Distribution

R. ferrugineus



5-methyl-octan-4-ol

(2E) 6-methyl-hepten-4-ol

3-methyl-octan-4-ol

unknown

4-methyl-nonan-5-ol

4-methyl-nonan-5-ol



R. palmarum



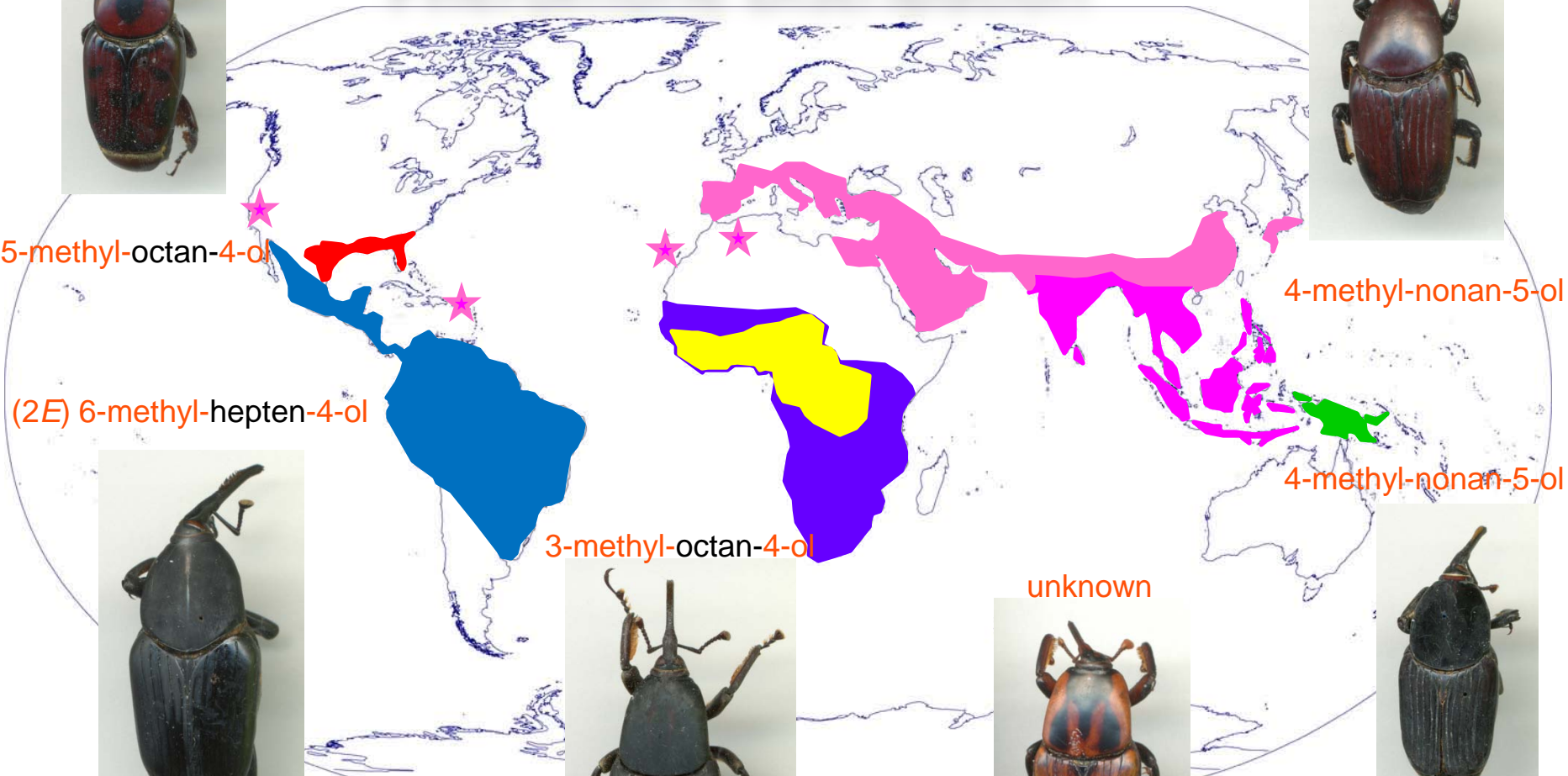
R. phoenicis



R. quadrangulus



R. bilineatus



R. cruentatus

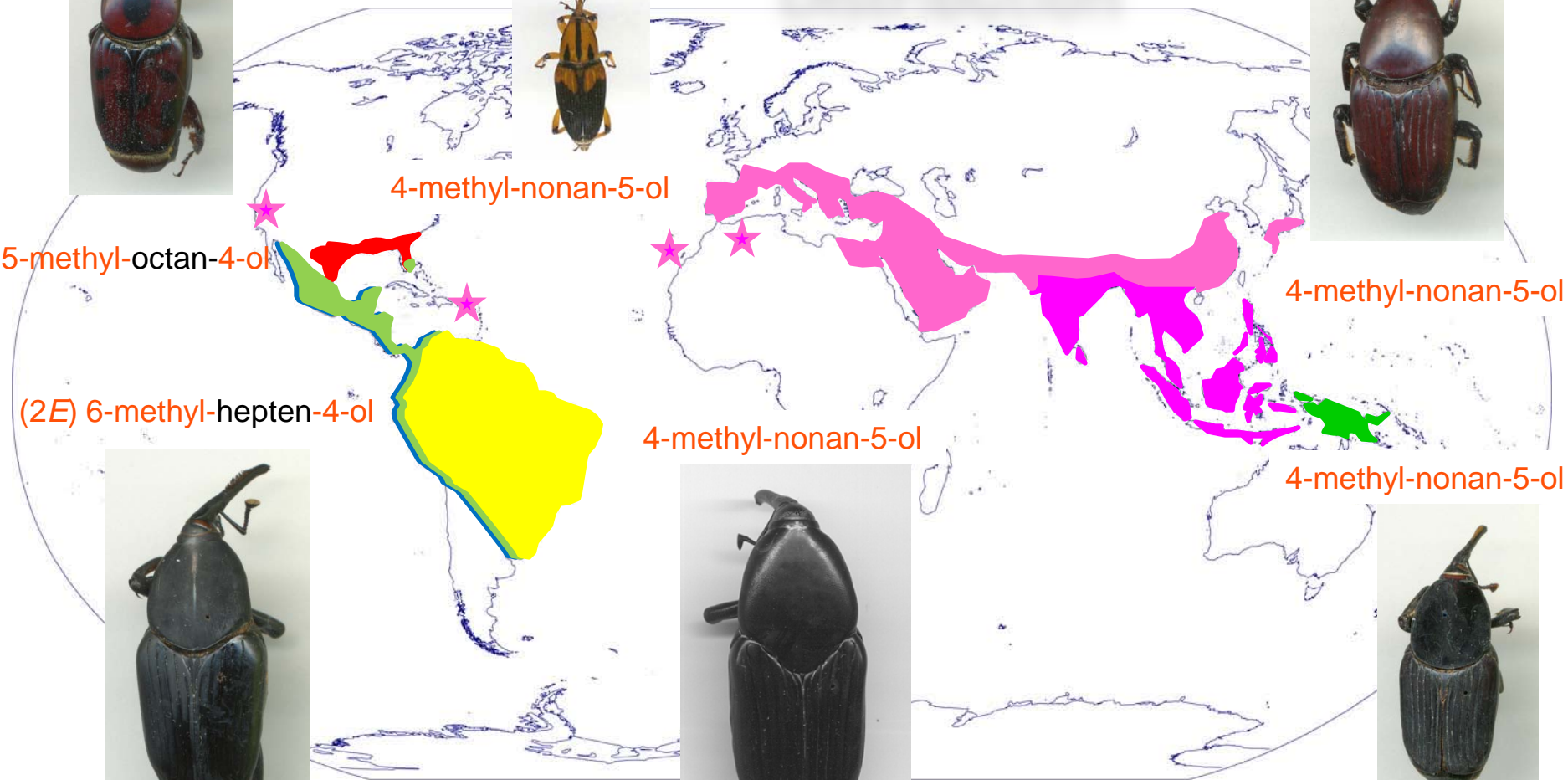


Metamasius hemipterus



“Ferrugineol” Distribution

R. ferrugineus



(2E) 6-methyl-hepten-4-ol



R. palmarum

4-methyl-nonan-5-ol



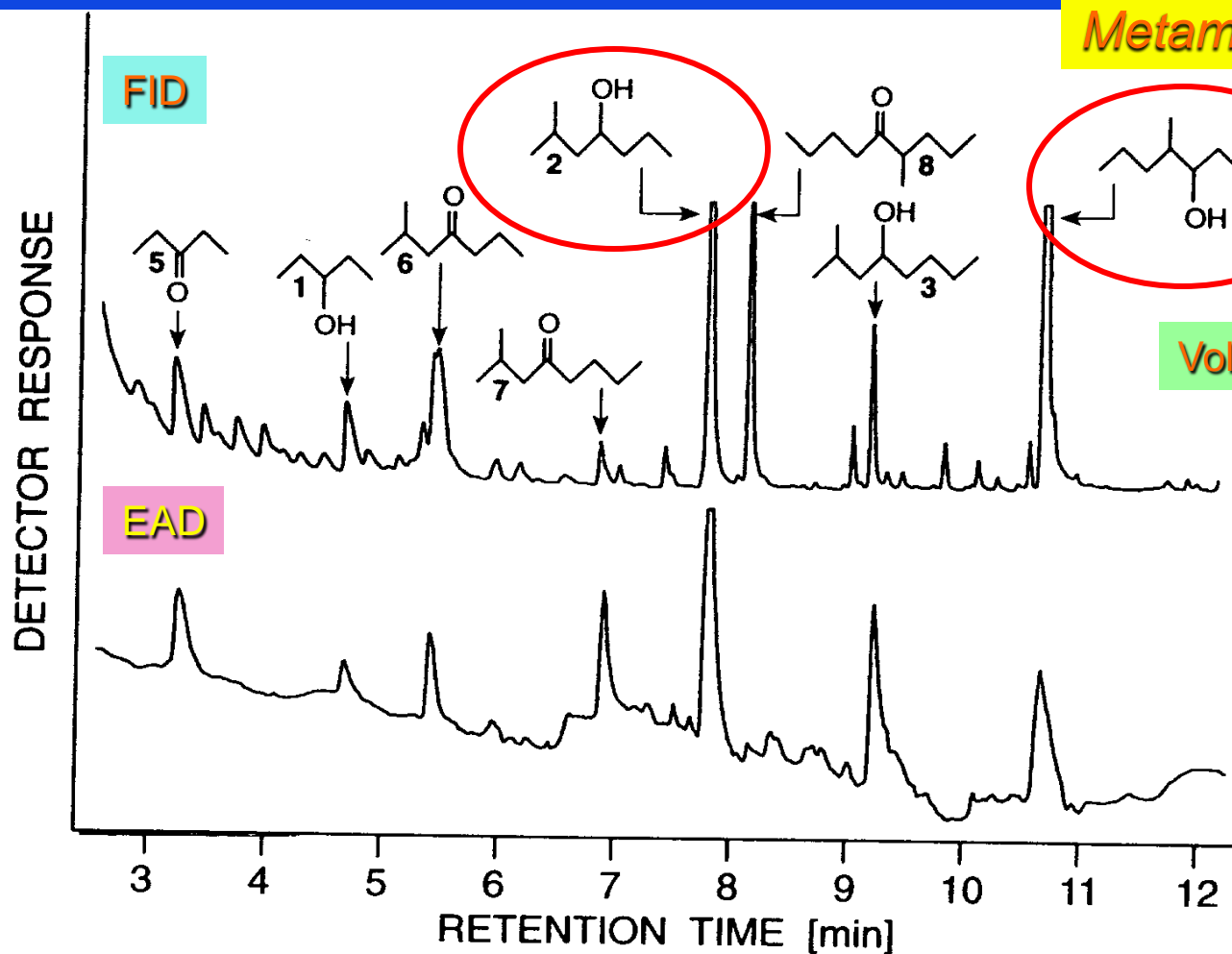
Dynamis borassi

4-methyl-nonan-5-ol

4-methyl-nonan-5-ol



R. bilineatus



Volatiles from unfed males



FIG. 2. Flame ionization (FID) and electroantennographic detector (EAD: female WISW antenna) responses to volatiles obtained from unfed male WISW. Chromatography: SP-1000-coated fused silica column; temperature program: 1 min at 50°C, 10°/min to 180°C. Carrier gas, He; linear flow 35 cm/sec; injector temperature 250°C; detector temperature 275°C. 1 = 3-pentanol; 2 = 2-methyl-4-heptanol; 3 = 2-methyl-4-octanol; 4 = 4-methyl-5-nonanol; 5 = 3-pentanone; 6 = 2-methyl-4-heptanone; 7 = 2-methyl-4-octanone; 8 = 4-methyl-5-nonanone.

Metamasius hemipterus

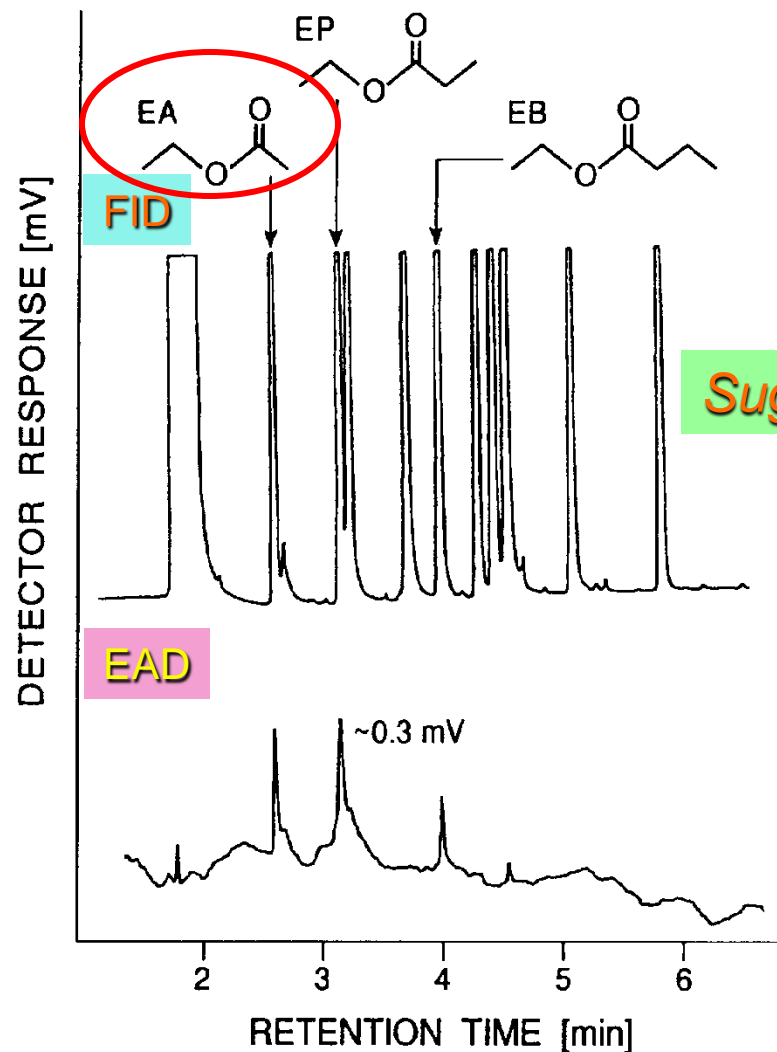
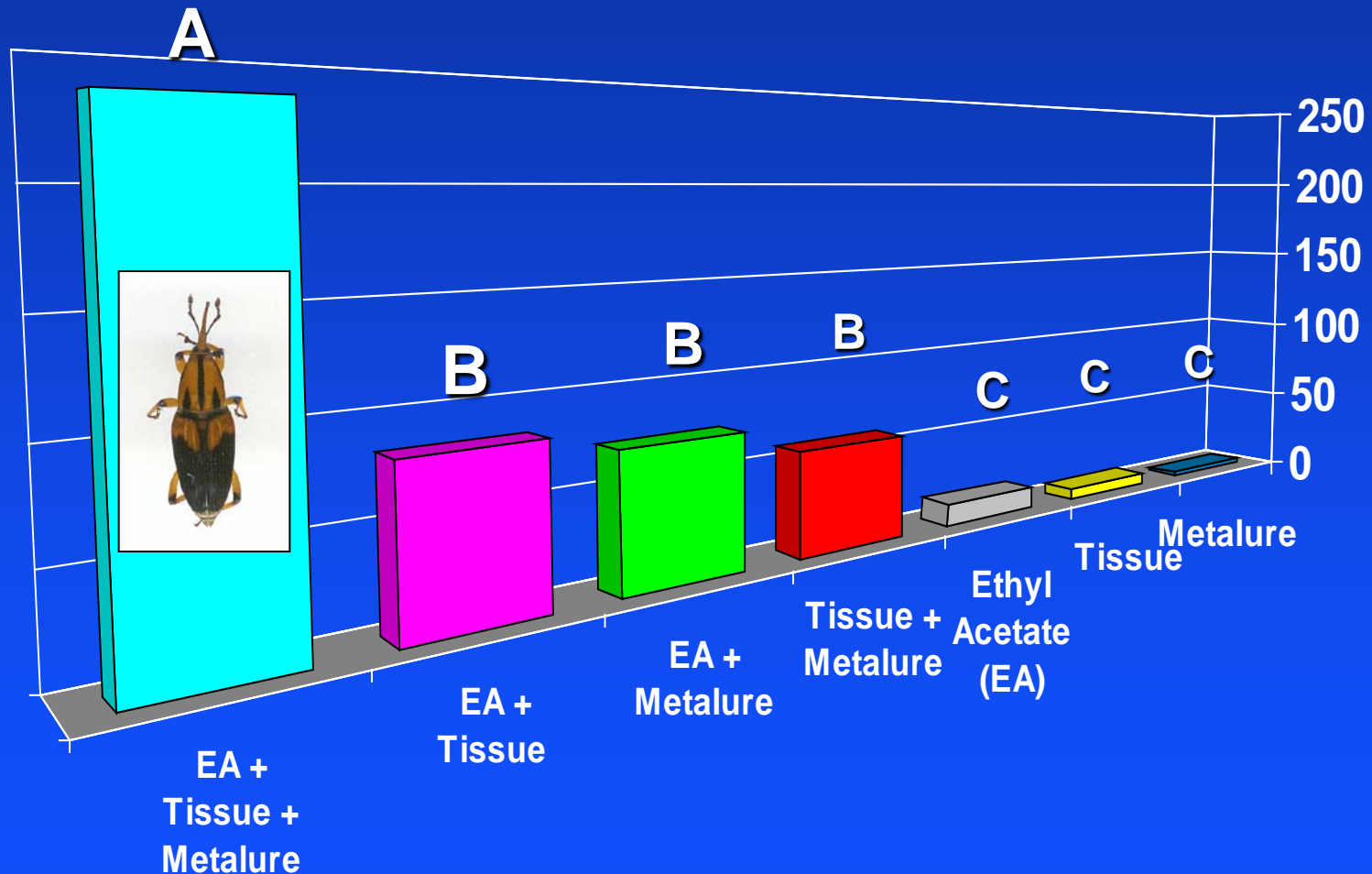
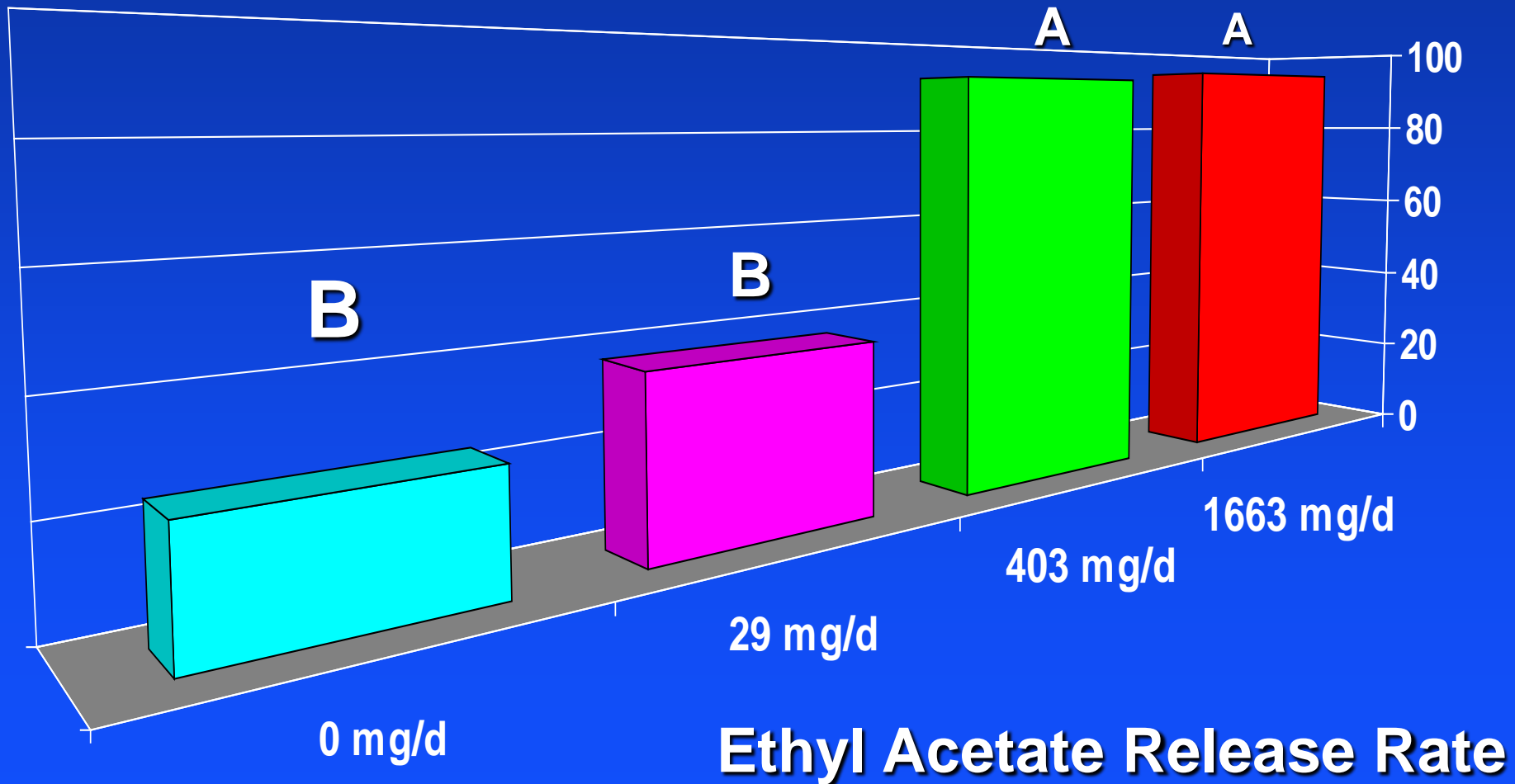


FIG. 4. Flame ionization (FID) and electroantennographic detector (EAD: female WISW antenna) responses to volatiles obtained from sugarcane. Column and chromatographic conditions as in Figure 2. EA = ethyl acetate; EP = ethyl propionate; EB = ethyl butyrate.

Metamasius hemipterus Counts from Traps Baited with Ethyl Acetate (600-720 mg/d), 250 g of Sugarcane, and/or Metalure



Metamasius hemipterus Counts from Traps Baited with Metalure, 250 g of Sugarcane, and Different Rates of Ethyl Acetate



Towards Making a Better Weevil Trap:

- ✓ **Semiochemicals:** (Critical...need aggregation pheromone(s) and host plant volatiles)
- ✓ **Design:** (Simple is best...a bucket works)
- ✓ **Moisture:** (Weevils seek high relative humidity to conserve water because of high cuticular permeability...Traps need moisture)
- ✓ **Size:** (Larger buckets are better)
- ✓ **Color of trap:** (Not critical)
- ✓ **Height:** (Not critical for *M. hemipterus*... Not critical for *R. cruentatus* if trap connected to tree base)

Rhynchophorus cruentatus life cycle



cocoon



last-instar larva



pre-pupa



pupa



female



male

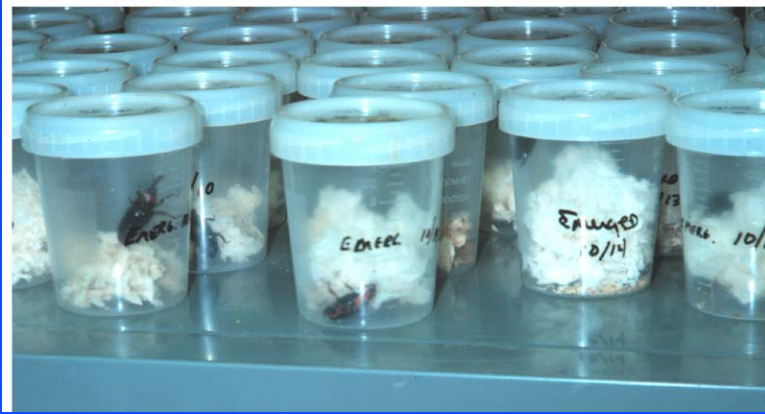
Palm Hosts of *R. cruentatus*

- ✓ *Sabal palmetto* stressed trees
- ✓ *Phoenix canariensis* healthy trees
- ✓ *Bismarkia nobilis* healthy trees
- ✓ *Serenoa repens* stressed trees
- ✓ *Phoenix dactylifera* rare
- ✓ *Washingtonia robusta* rare
- ✓ *Thrinax radiata* rare
- ✓ *Latania* rare
- ✓ *Roystonea* rare
- ✓ *Cocos nucifera* rare
- ✓ *Pritchardia* rare
- ✓ *Caryota* rare

Symptoms of *Rhynchophorus cruentatus* damage

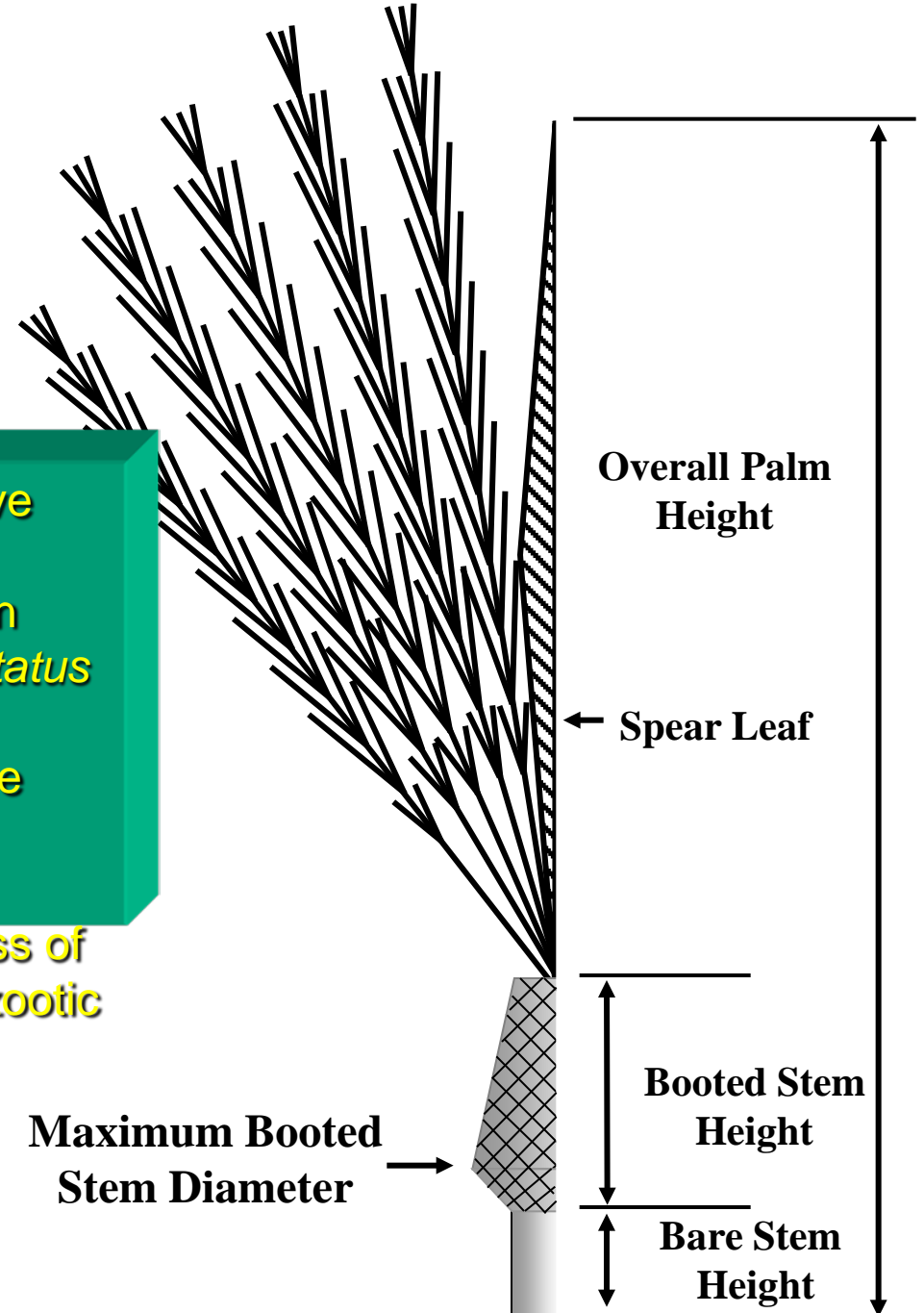


Laboratory culture of *Rhynchophorus cruentatus*

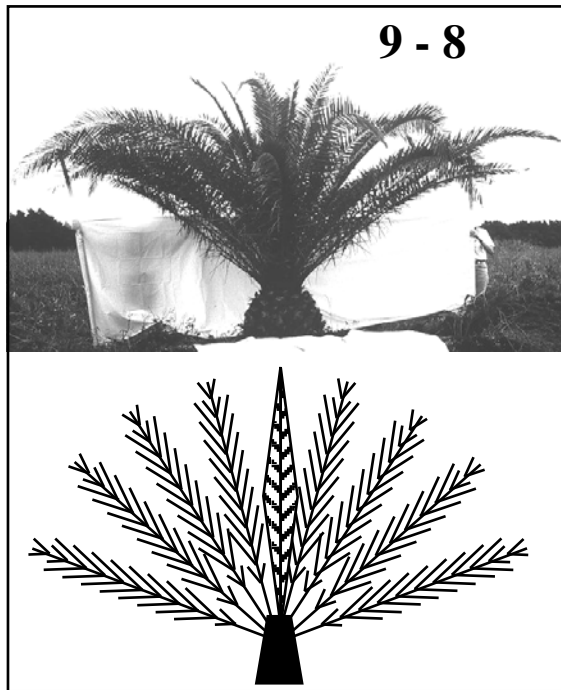


Canary Island date palm:
Phoenix canariensis

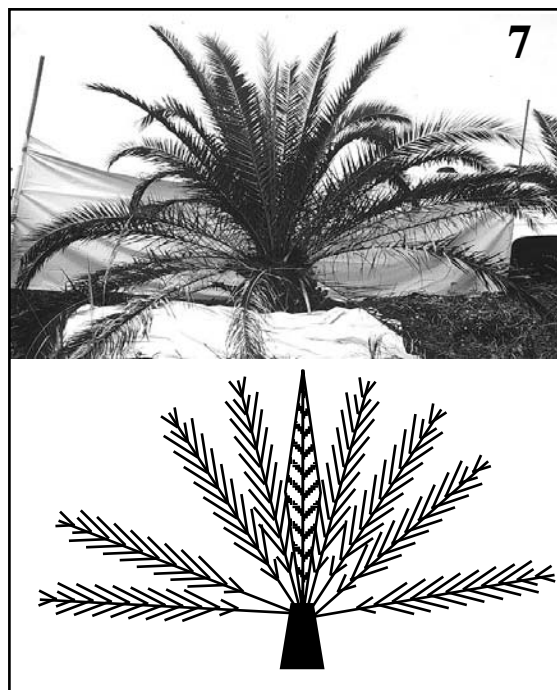
- 1) Non-native palm versus native weevil
- 2) Apparently healthy palms can decline rapidly with *R. cruentatus* infestation
- 3) 20-250 larvae per palm cause irreparable damage to apical meristem
- 4) We have documented the loss of entire palm groves once epizootic starts



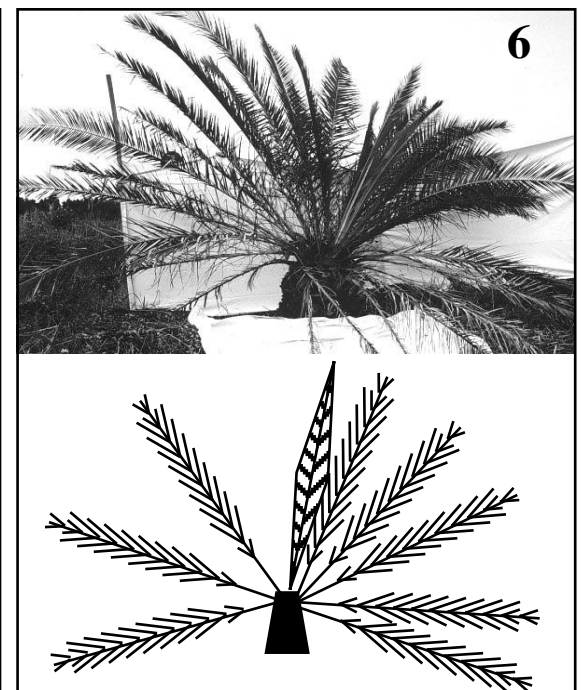
Categories of decline for Canary Island date palms infested with *Rhynchophorus cruentatus*



**Palms healthy,
asymptomatic,
(8) weevil frass first
detected in petioles**



**Dying, 3-4 oldest petioles
drooping, weevil frass
detected in petioles**

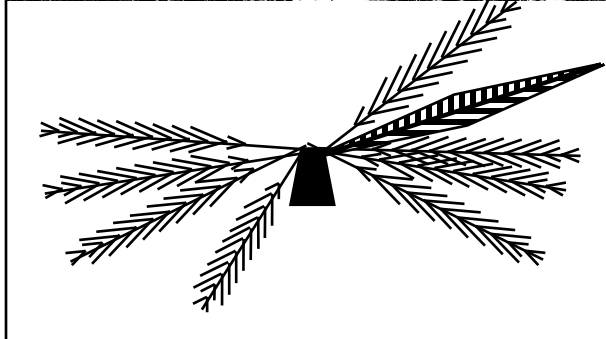


**Dying, spear leaf and
stem beginning to lean
(5-45°), weevil frass
detected in petioles**

Categories of decline for Canary Island date palms infested with *Rhynchophorus cruentatus*



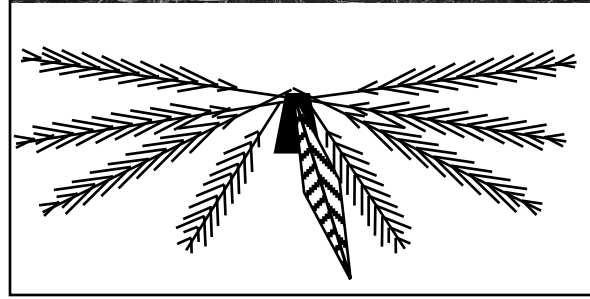
5



Dying, spear leaf and stem collapsing (>45°), lots of weevil frass



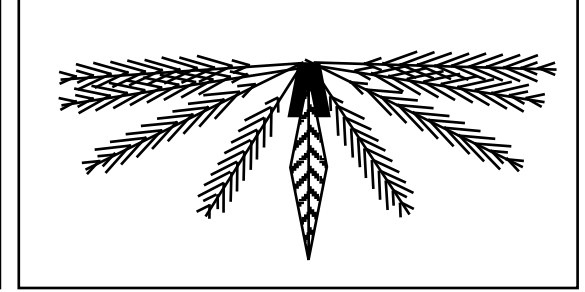
4 - 3



Dead/dying, crown and stem collapsed, spear green other fronds necrotic, lots of weevil frass



2 - 1



Dead, crown and stem collapsed, fronds necrotic, lots of weevil frass











Bud bundle completely severed from trunk and lying on top of head



Bud bundle pulled down with pole saw and lying in bed of truck



**Cocoon with Palm Weevil
(*Rhynchophorus cruentatus*)
inside**



Palm weevil damage to older *Washingtonia*

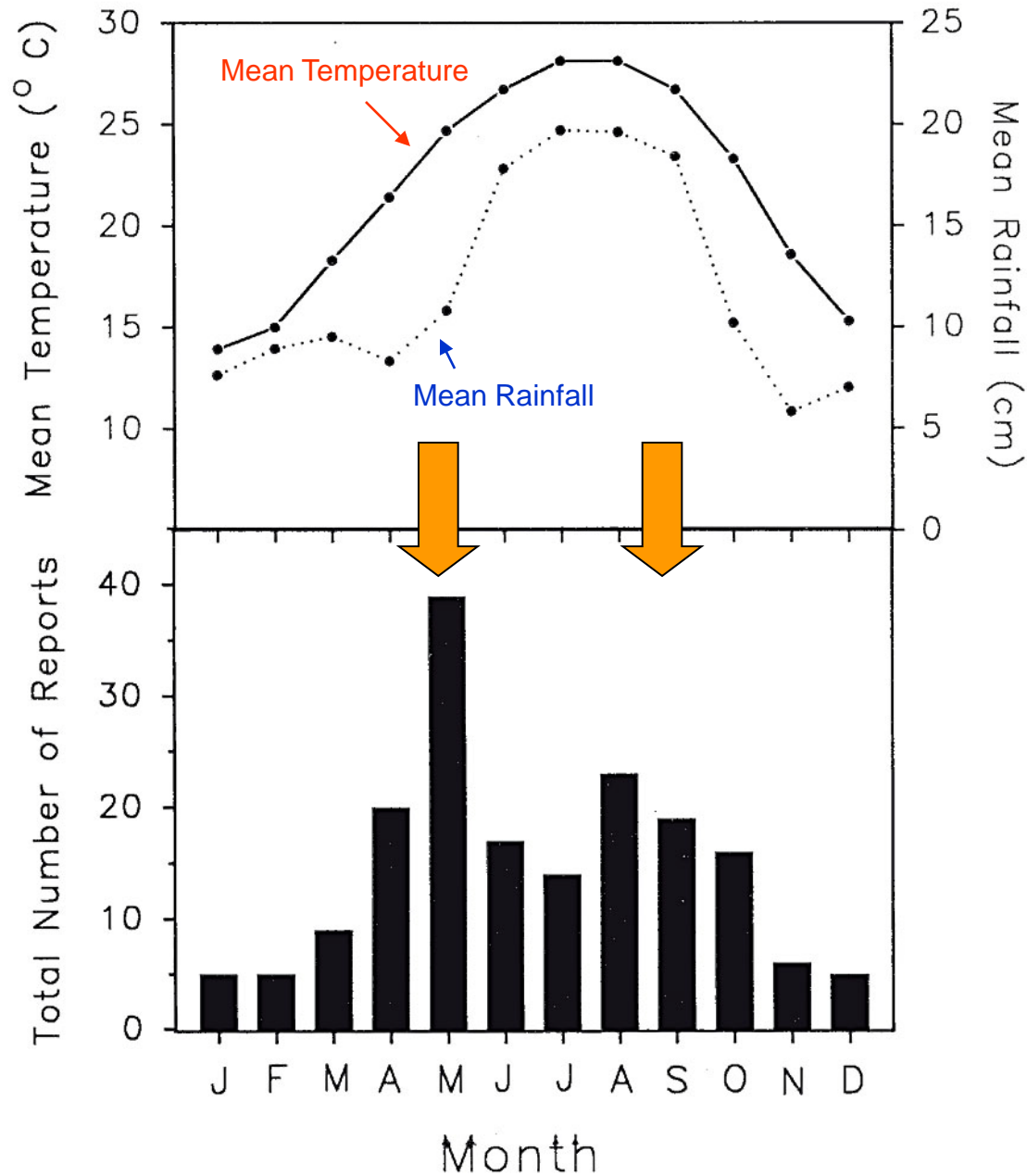


Florida woods cockroach (*Eurycotis floridana*) is often found in the leaf bases of *Sabal* and *Phoenix* palms. One of its first common names was “palmetto bug”. They do not do any damage to the palms.

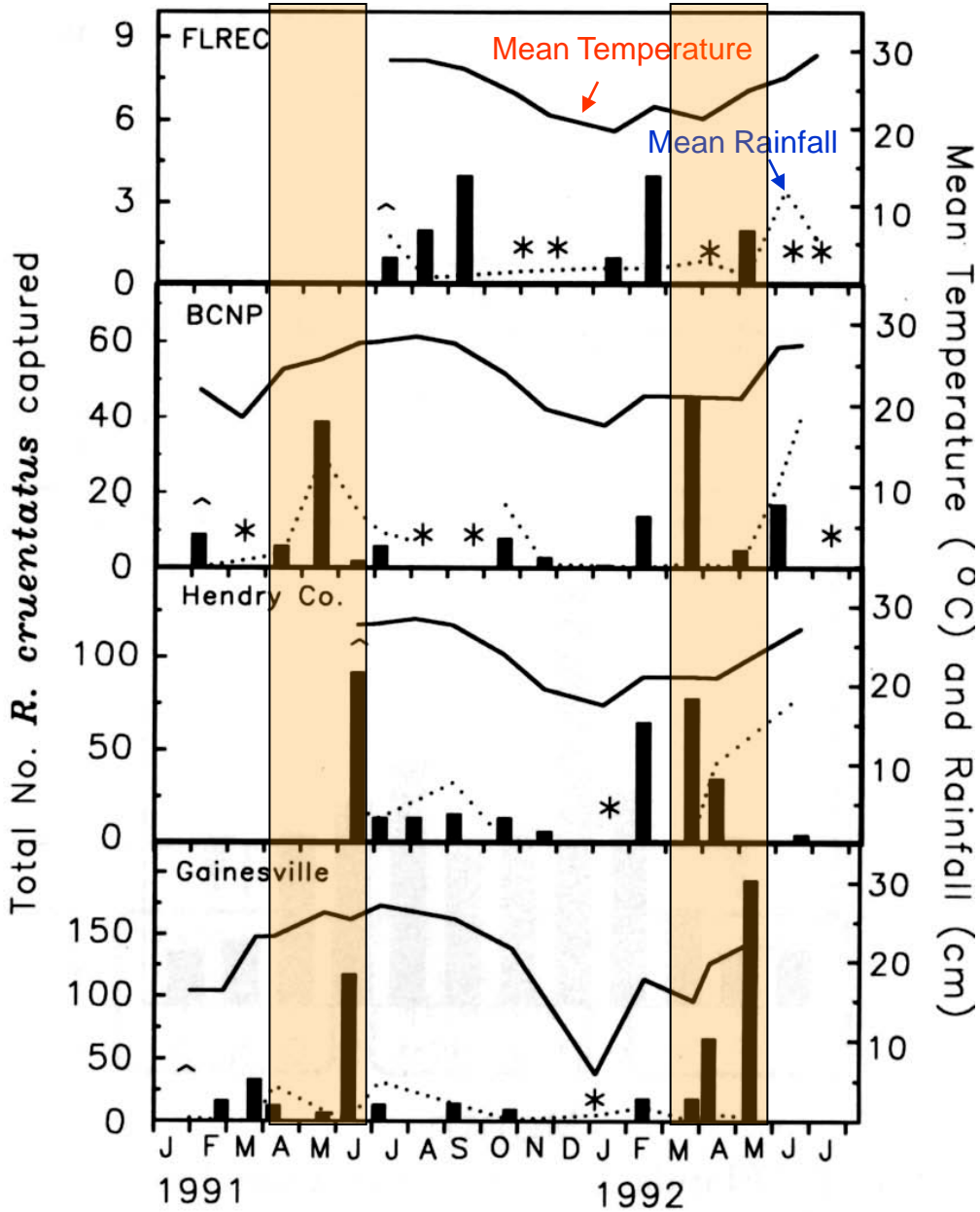


<http://www.youtube.com/watch?v=jTjFmXXRIGg>

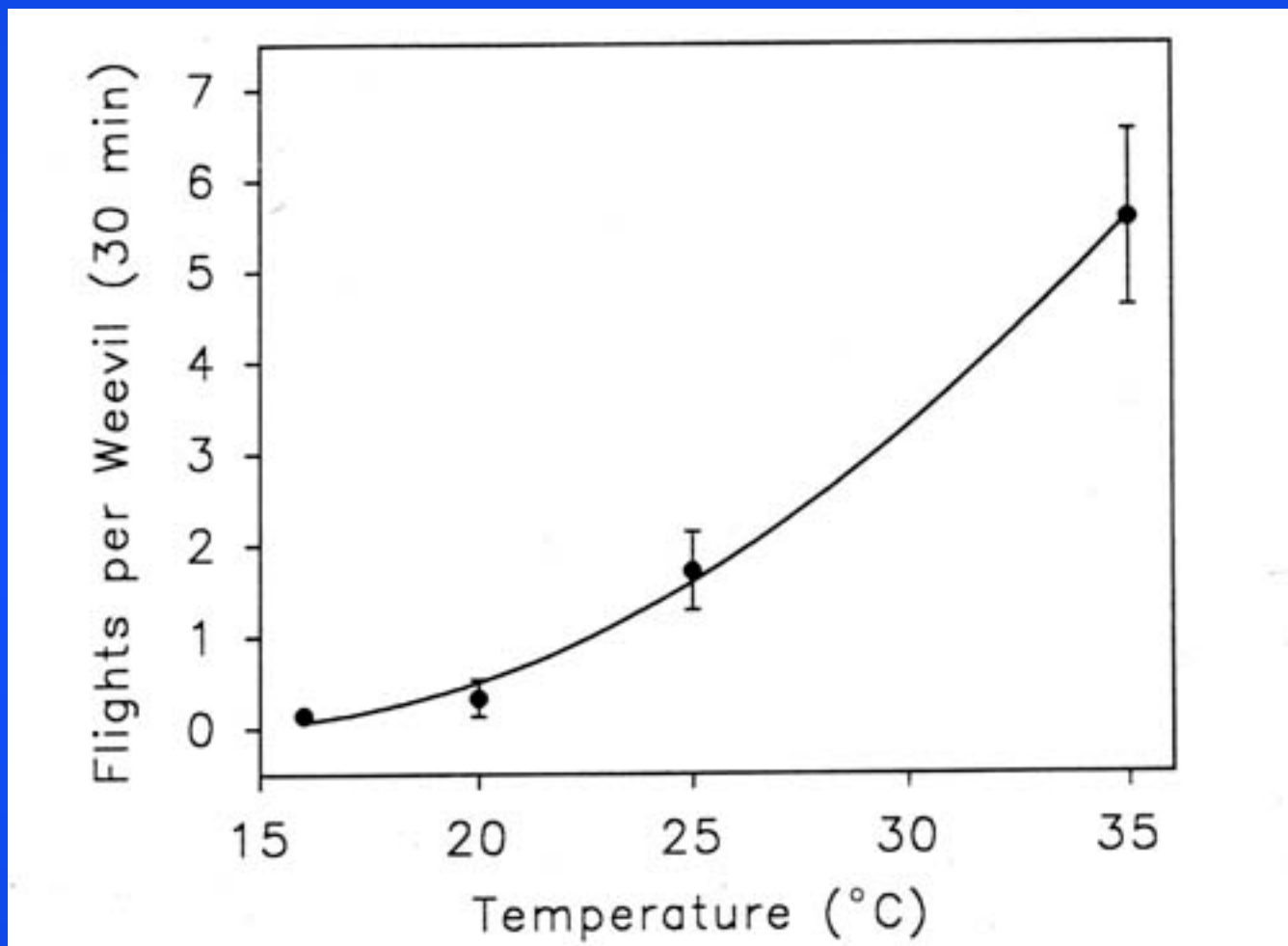
Florida DPI Reports of *Rhynchophorus cruentatus* Adults (1956-1991)



Seasonal Capture of *Rhynchophorus cruentatus* Adults to Traps Baited with 2.5 kg Chopped *Sabal palmetto* Crown and Stem Tissue



Flight Initiation of *Rhynchophorus cruentatus* at Different Temperatures



Management approaches for *Rhynchophorus cruentatus*:

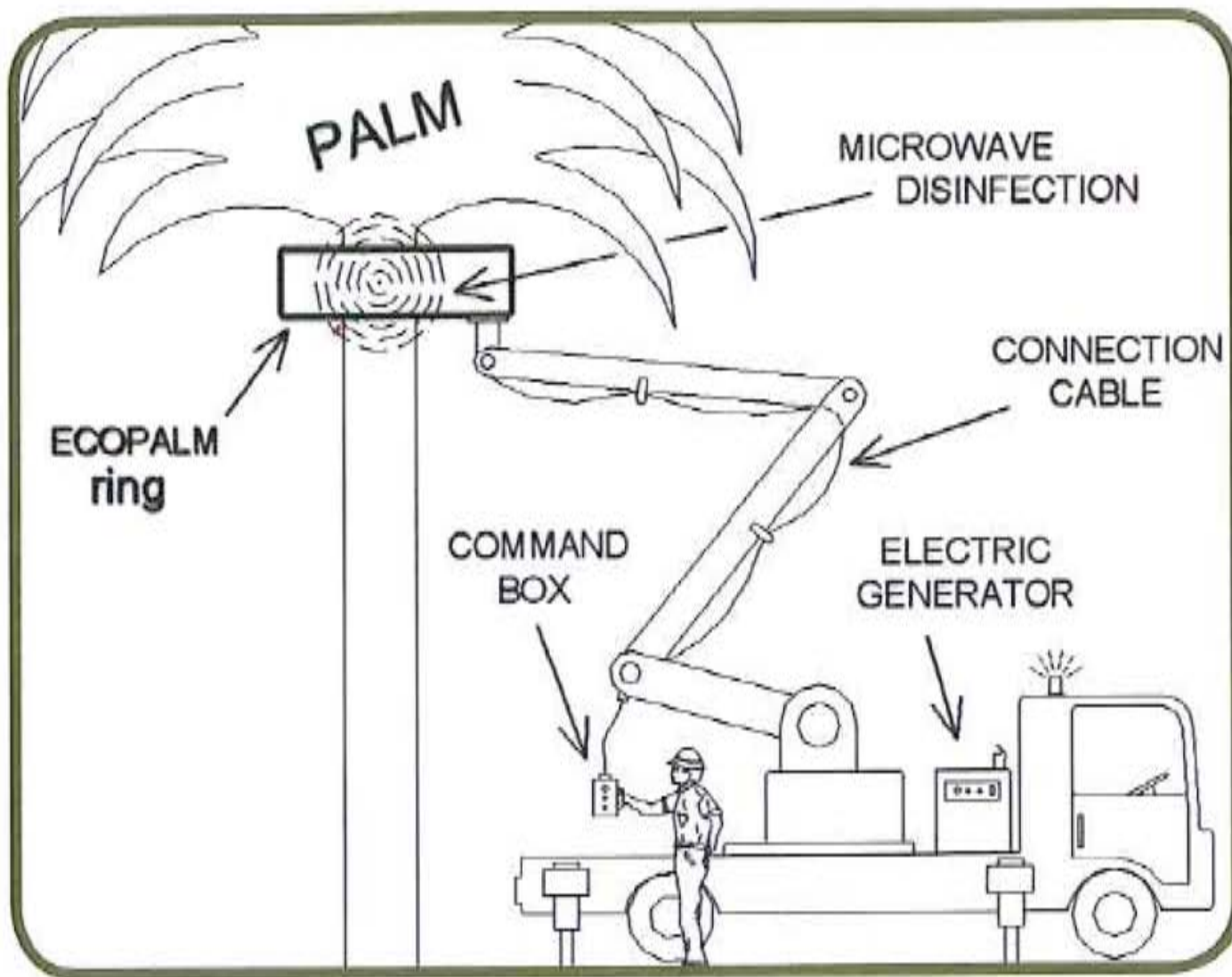
Promote plant vigor and protect from wounding.

Prophylactic treatment of transplanted or stressed palms.

Early detection and phytosanitation.

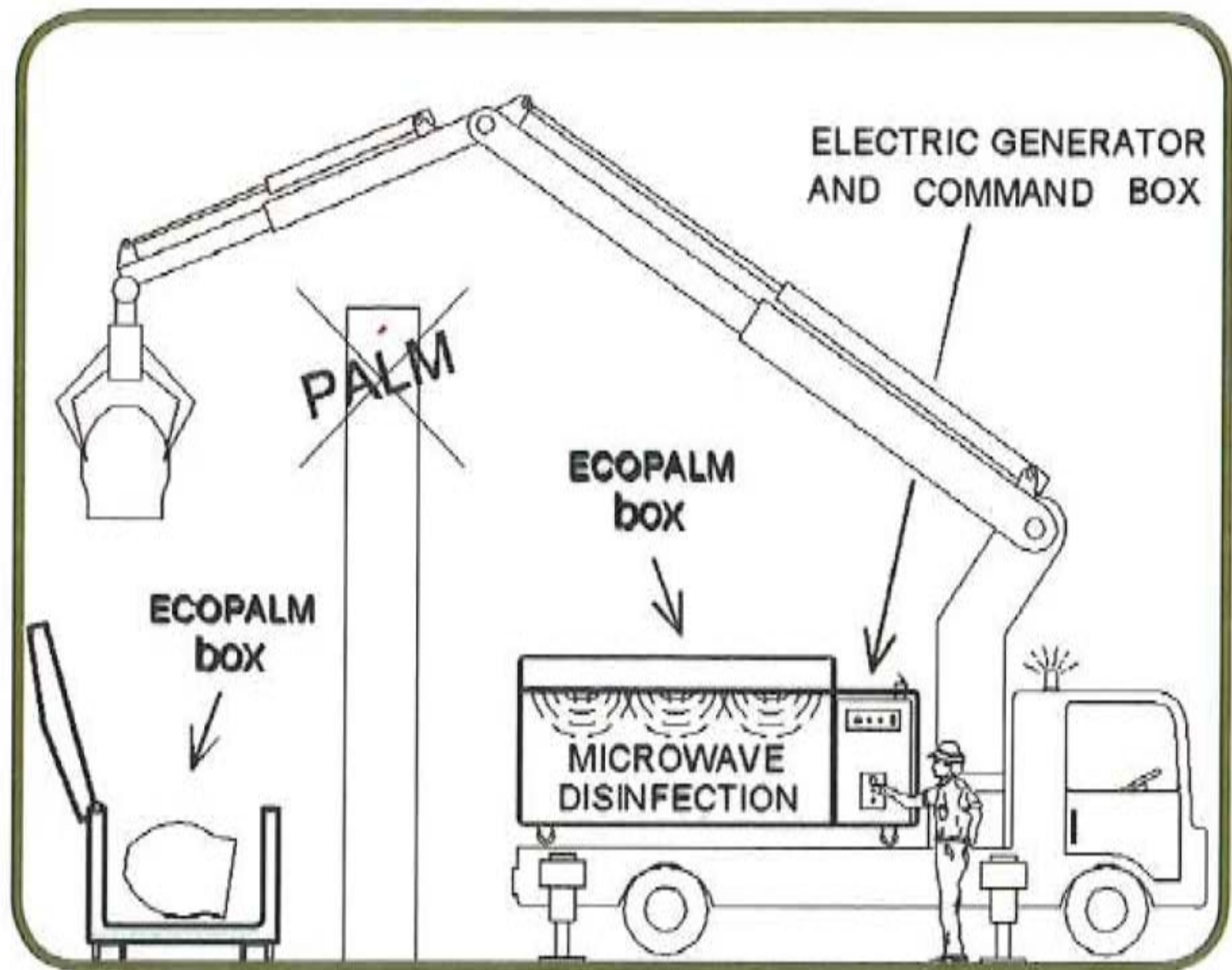
Awareness of susceptibility of *Phoenix canariensis*.

ECOPALM is an Italian Company that is marketing a physical method of disinfecting Canary Island date palms of *Rhynchophorus ferrugineus* in Europe.





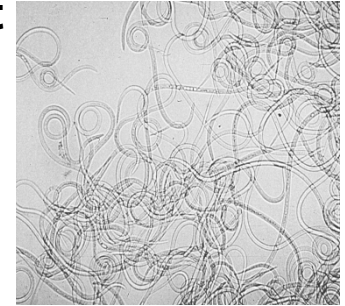








Rhynchophorus palmarum
adult



Red ring nematodes

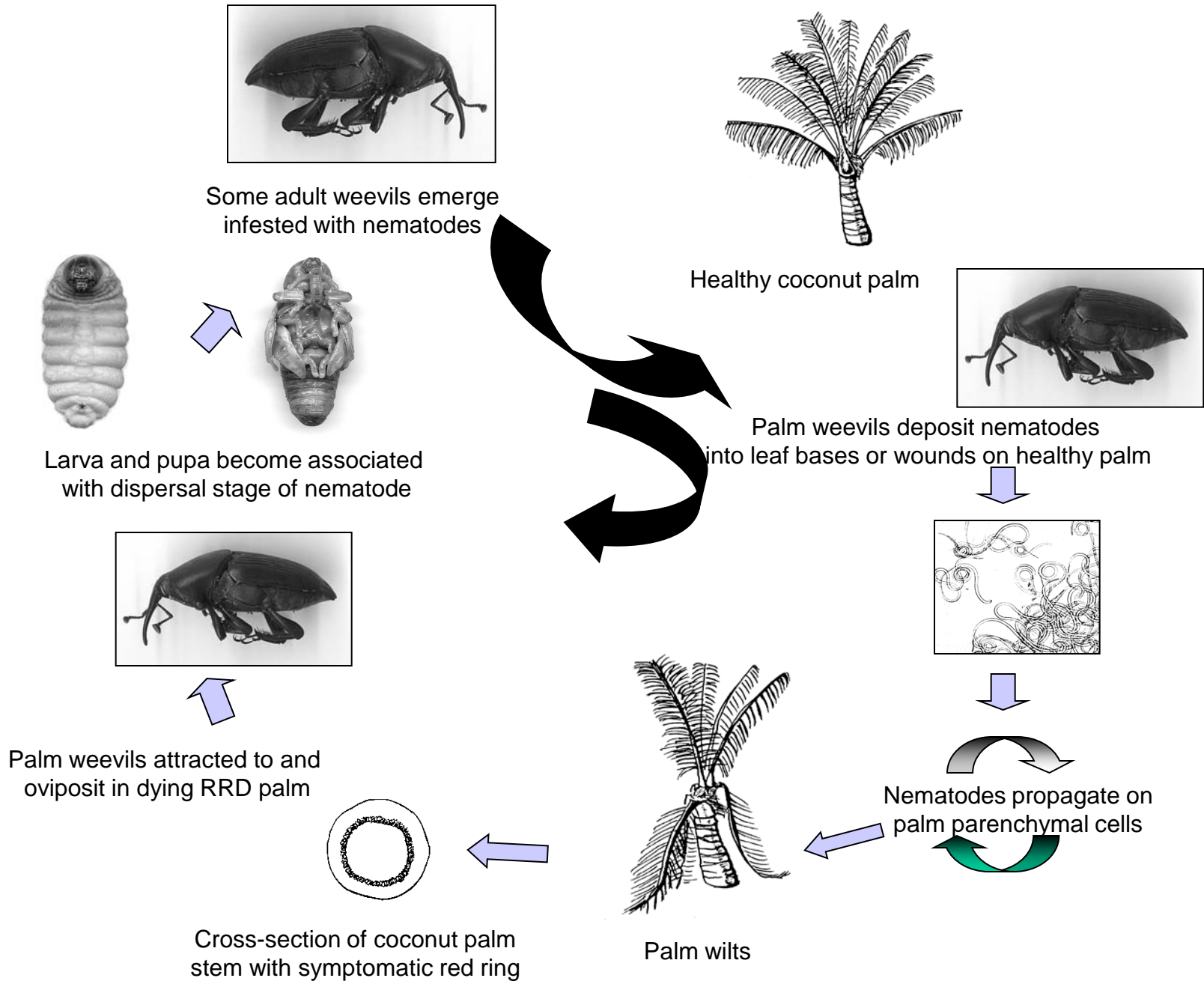


R. palmarum larvae



Classical Red ring disease symptoms

Red Ring caused by *Bursaphelenchus cocophilus*



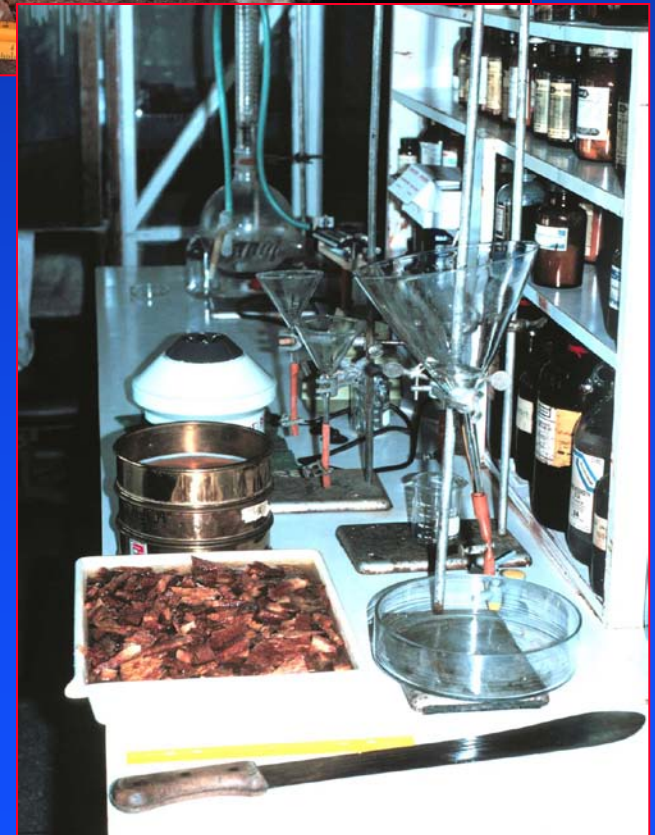
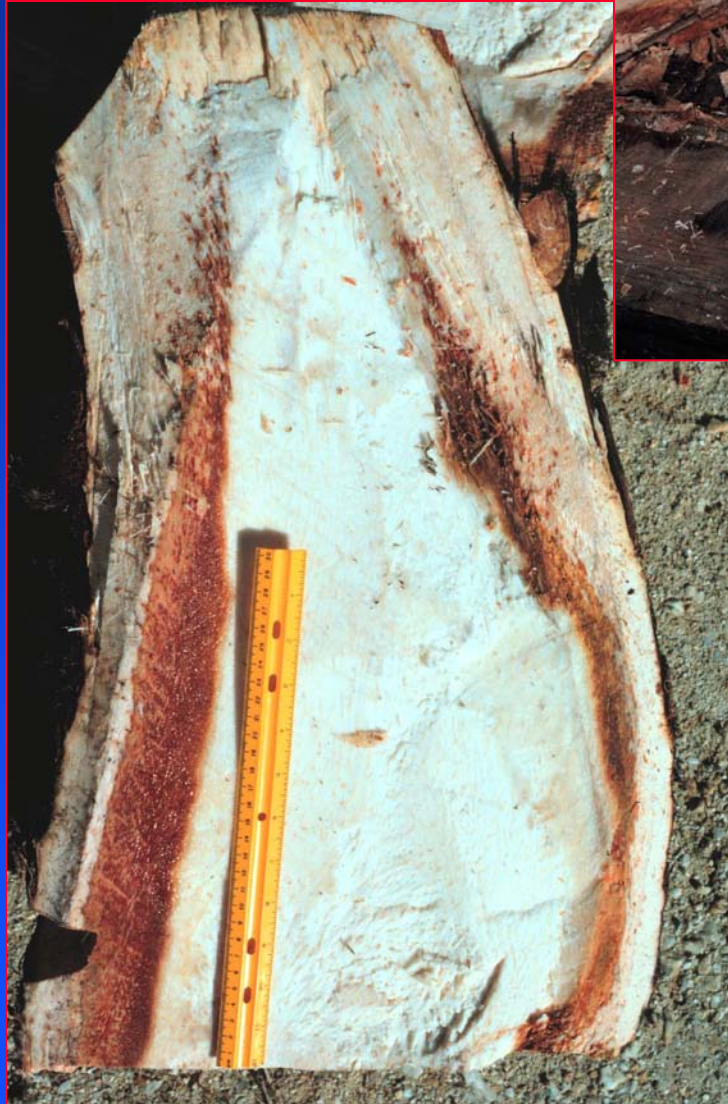
Red ring diseased
Cocos nucifera in
Trinidad.



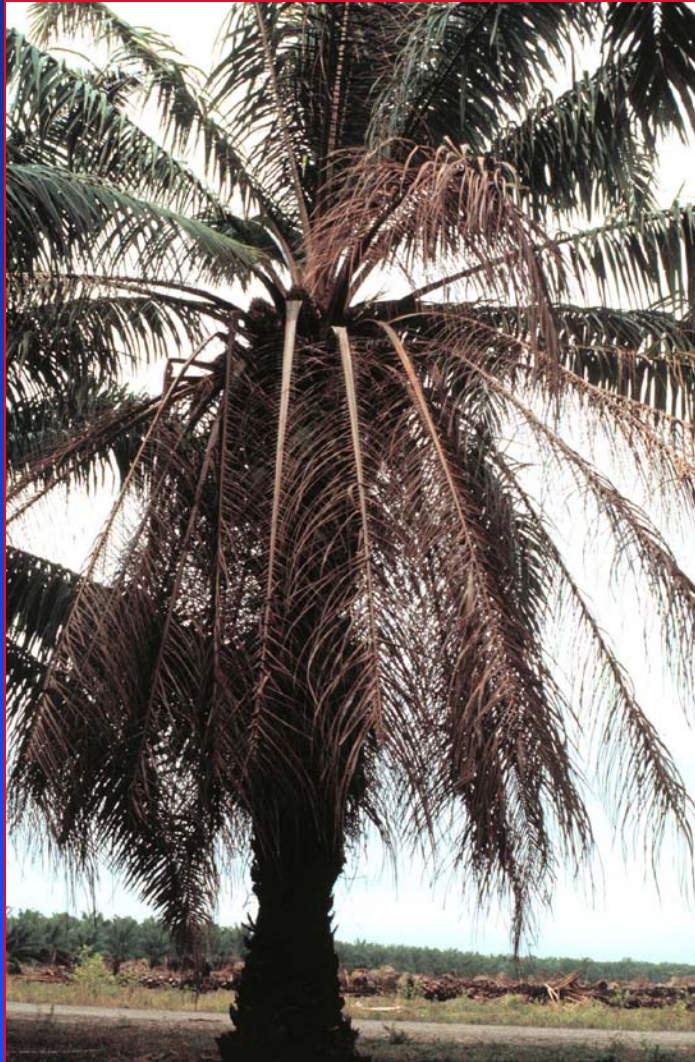
Red ring diseased *Cocos nucifera* symptoms



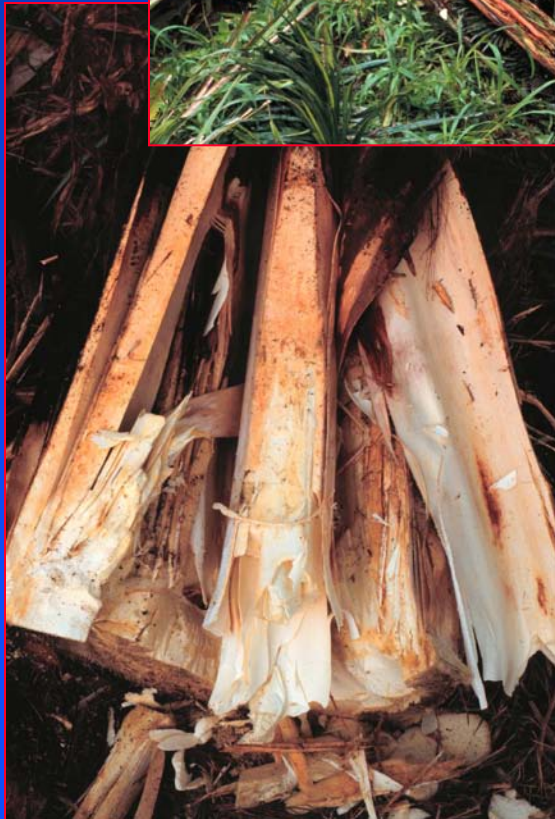
Red ring diseased *Cocos nucifera* tissue extraction



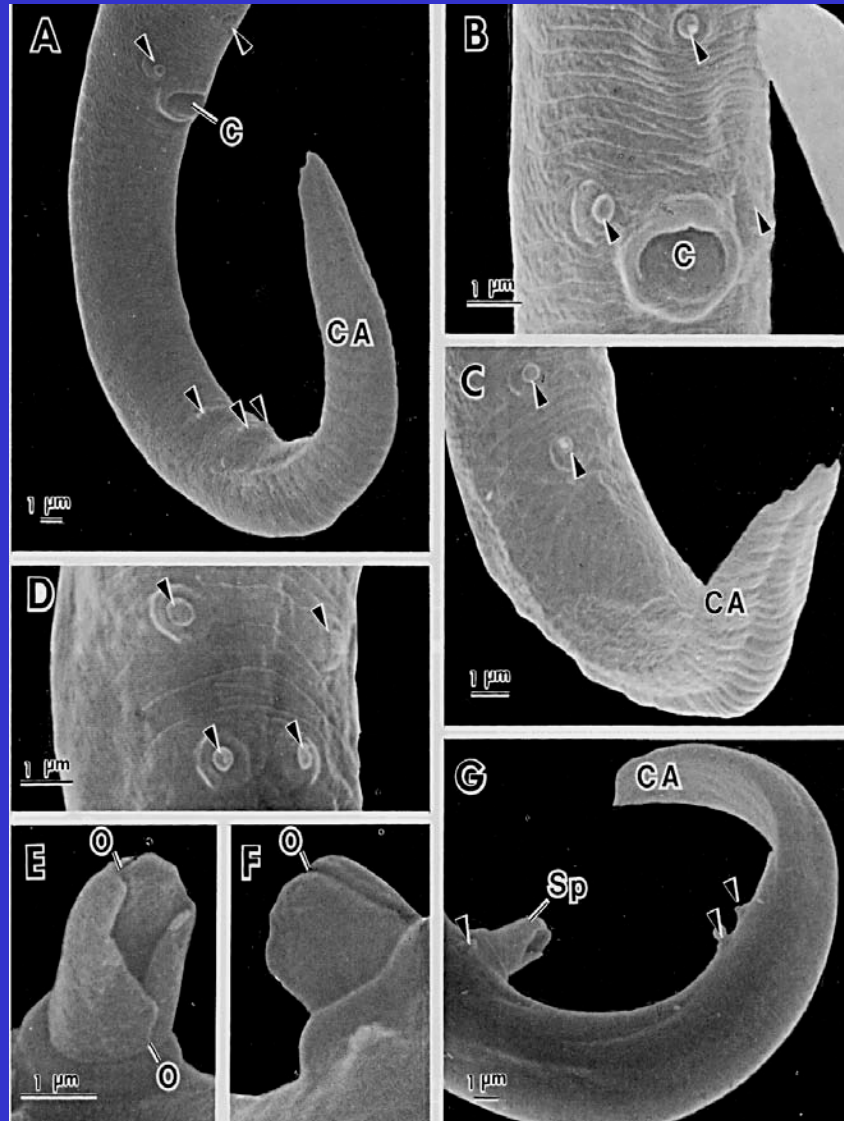
Red ring diseased *Elaeis guineensis* (African oil palm).



Little leaf symptoms in *Elaeis guineensis* (African oil palm).



Red ring nematode: *Bursaphelenchus cocophilus*



Red ring nematode: *Bursaphelenchus cocophilus*

C.I.H. Descriptions of
Plant-parasitic Nematodes
Set 5, No. 72

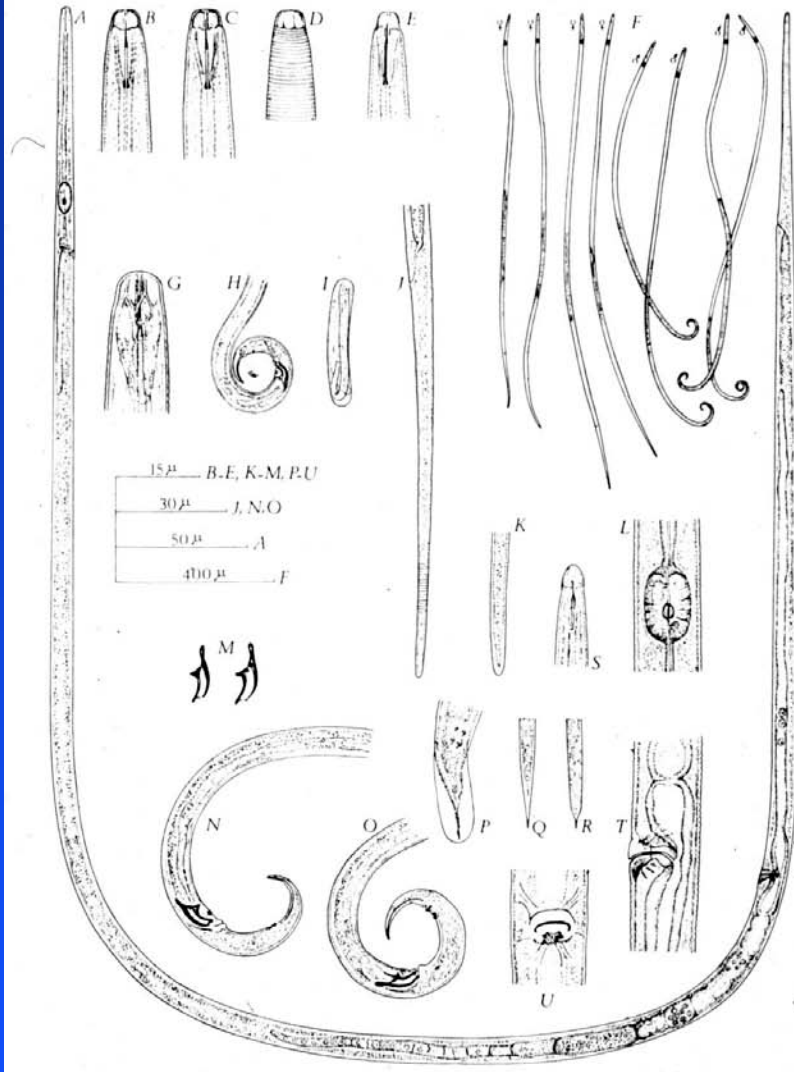


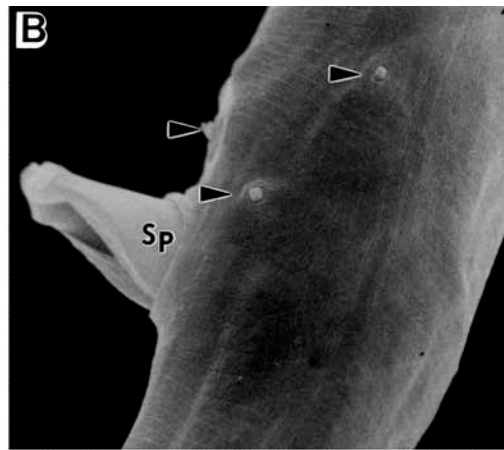
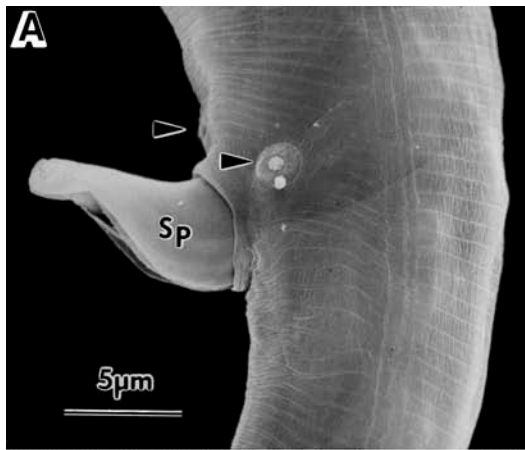
Fig. 1. *Rhadinaphelenchus cocophilus*. A & F. Adults. B-D & G. Female head ends. E. Male head end. H, N & O. Male tail ends. I. Egg. J. Female tail. K. Female tail tip. L. Female median oesophageal bulb. M. Spicules. P. Bursa in dorsal view. Q & R. Larval tail tips. S. Larval head end. T & U. Vulva in lateral and ventral view, respectively. (G, H & I after Cobb (1919); rest M.R. Siddiqi, original.)

Rhadinaphelenchus cocophilus (Cobb, 1919) J. B. Goodey, 1960.



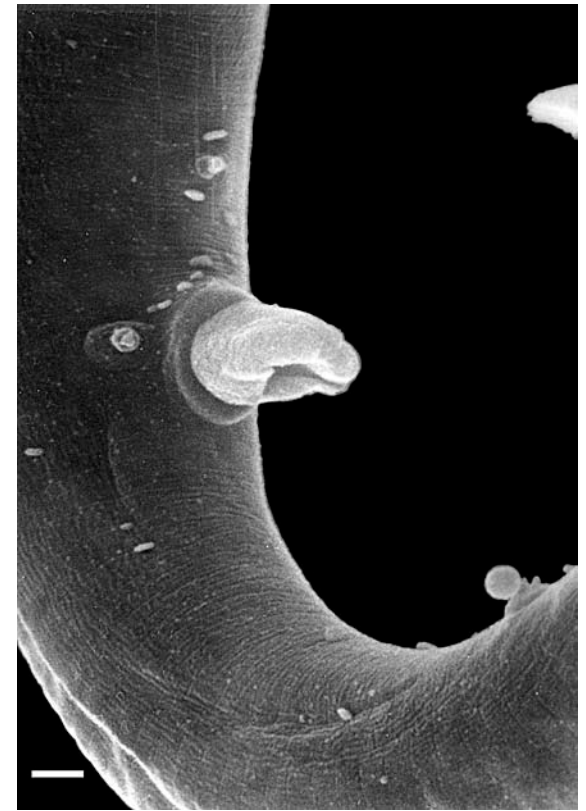
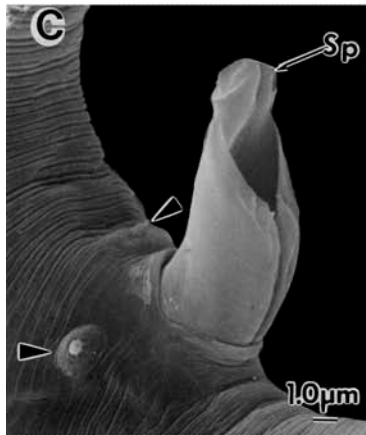
SSU molecular phylogeny





Bursaphelenchus platzeri male

B. cocophilus male



Distribution of *Metamasius*

hemipterus (Florida, Caribbean, Mexico,
Central and South America)



Metamasius hemipterus



Metamasius hemipterus



Rhynchophorus cruentatus



Palm Hosts of *M. hemipterus*

- ✓ *Ravenea rivularis* ←
- ✓ *Hyophorbe verschaffeltii* ←
- ✓ *Phoenix canariensis* ←
- ✓ *Phoenix dactylifera*
- ✓ *Roystonea*
- ✓ *Cocos nucifera*

Symptoms of *Metamasius Hemipterus* infestation



Royal palm



UF



UF

Spindle palm



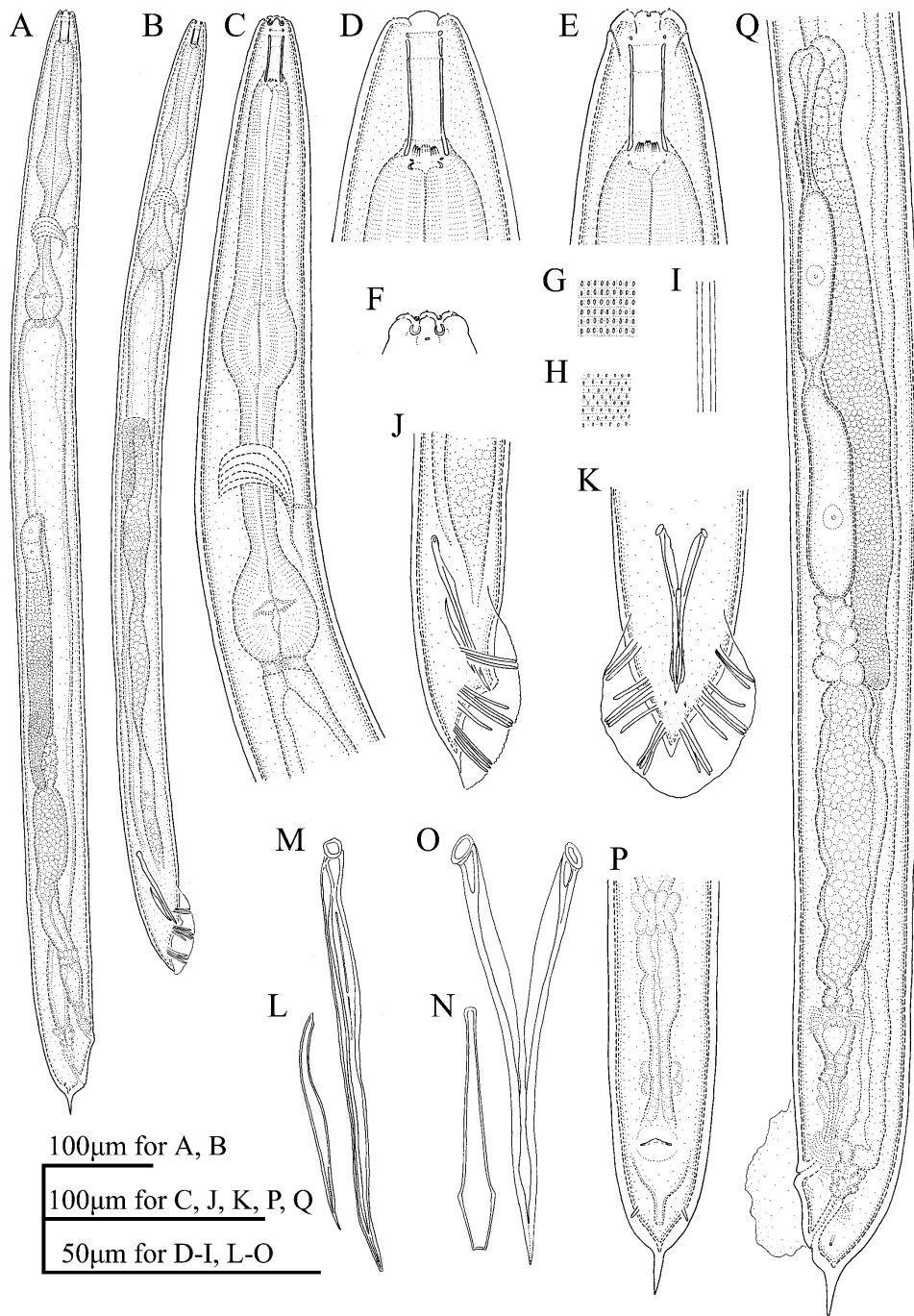
Sugarcane



Canary Island date palm



Teratorhabditis synpapillata from *Rhynchophorus ferrugineus*



100µm for A, B
100µm for C, J, K, P, Q
50µm for D-I, L-O

