



**PALM WEEVIL
PHEROMONES**

DISCOVERY

AND

USE



R. palmarum



R. cruentatus



R. phoenicis



R. bilineatus

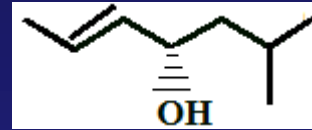


R. ferrugineus

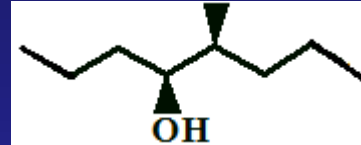


D. borassi

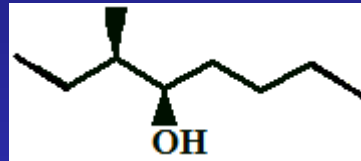
R. palmarum



R. phoenicus



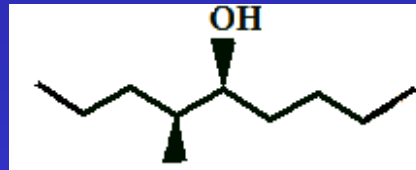
R. cruentatus



R. bilineatus

R. vulnaratus

R. ferrugineus



D. borassi

R. palmarum (synergist)

*

1990-91

**Coto, Costa Rica 142 / ha
6,600 ha ~900,000 palms**



20 tons/ha





Rhynchophorus palmarum - American Palm Weevil





Red Ring Nematode *Bursaphelenchus cocophilus* Cobb.



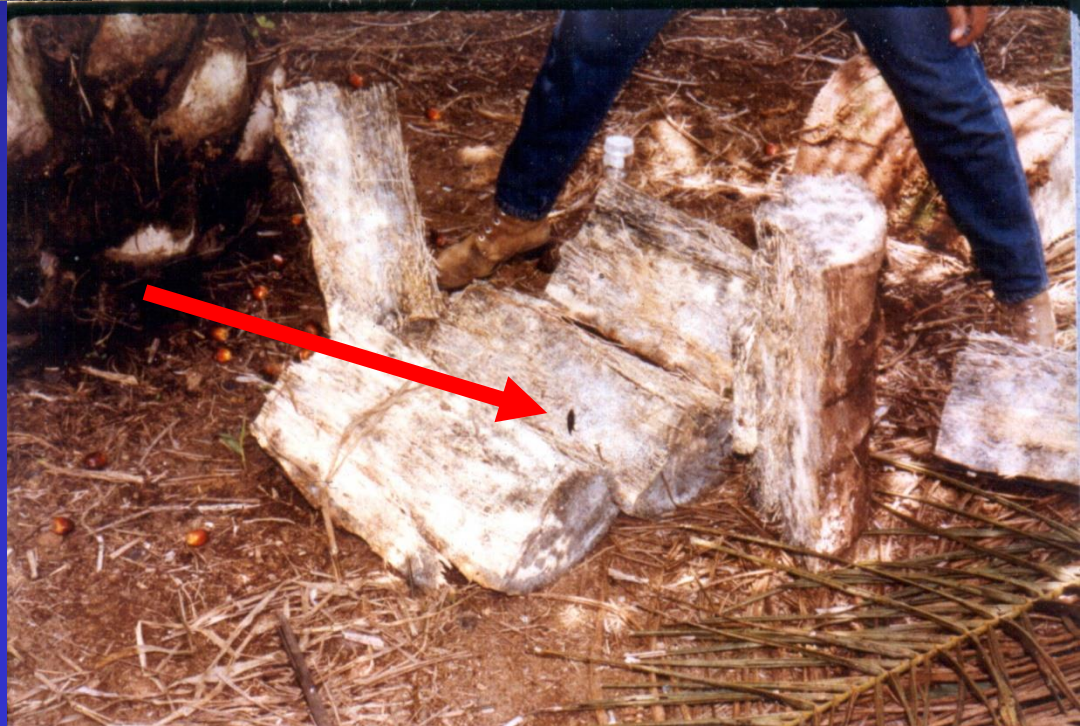


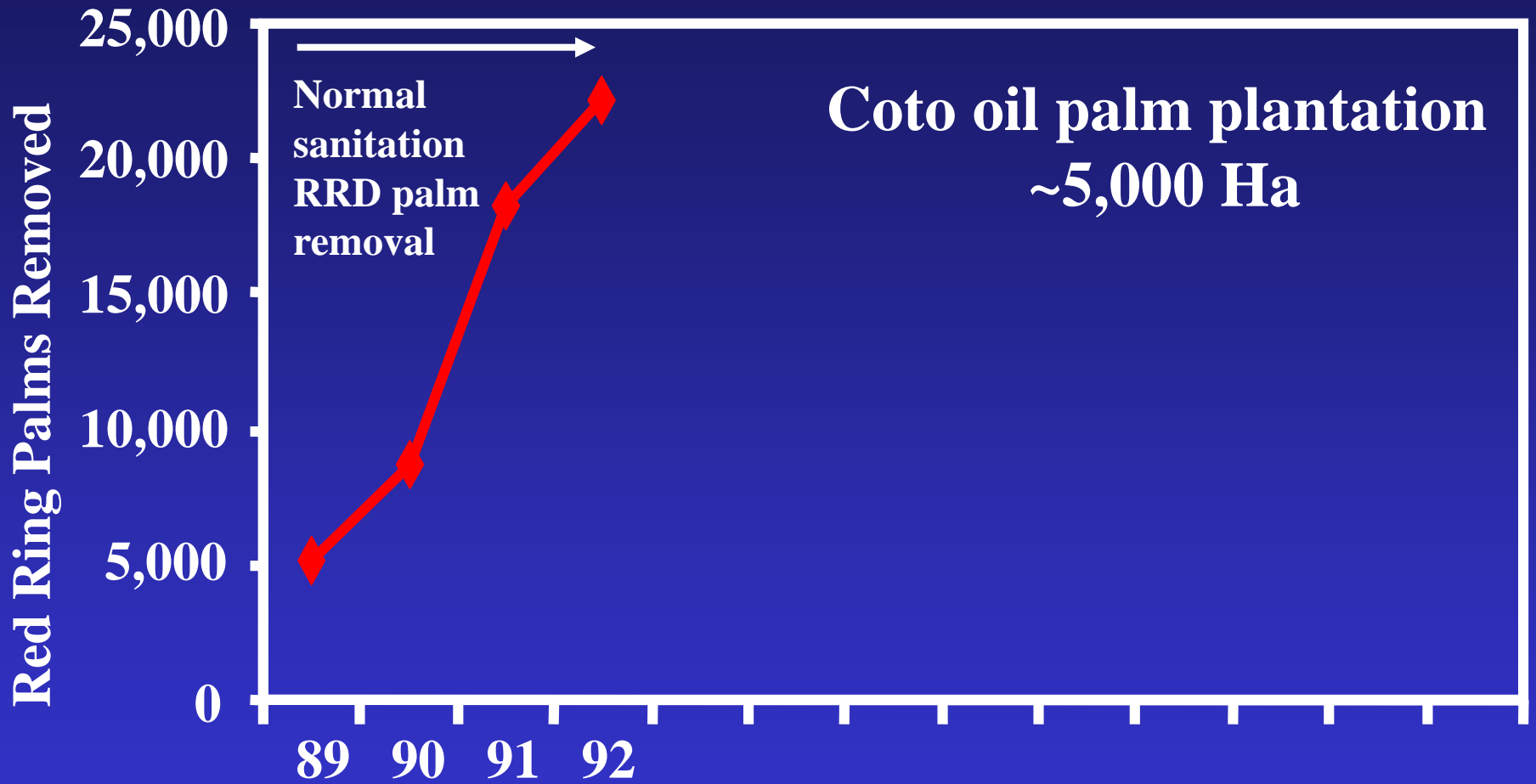




Stem traps did not capture sufficient weevils to reduce infestation

Photos courtesy C. Chinchilla





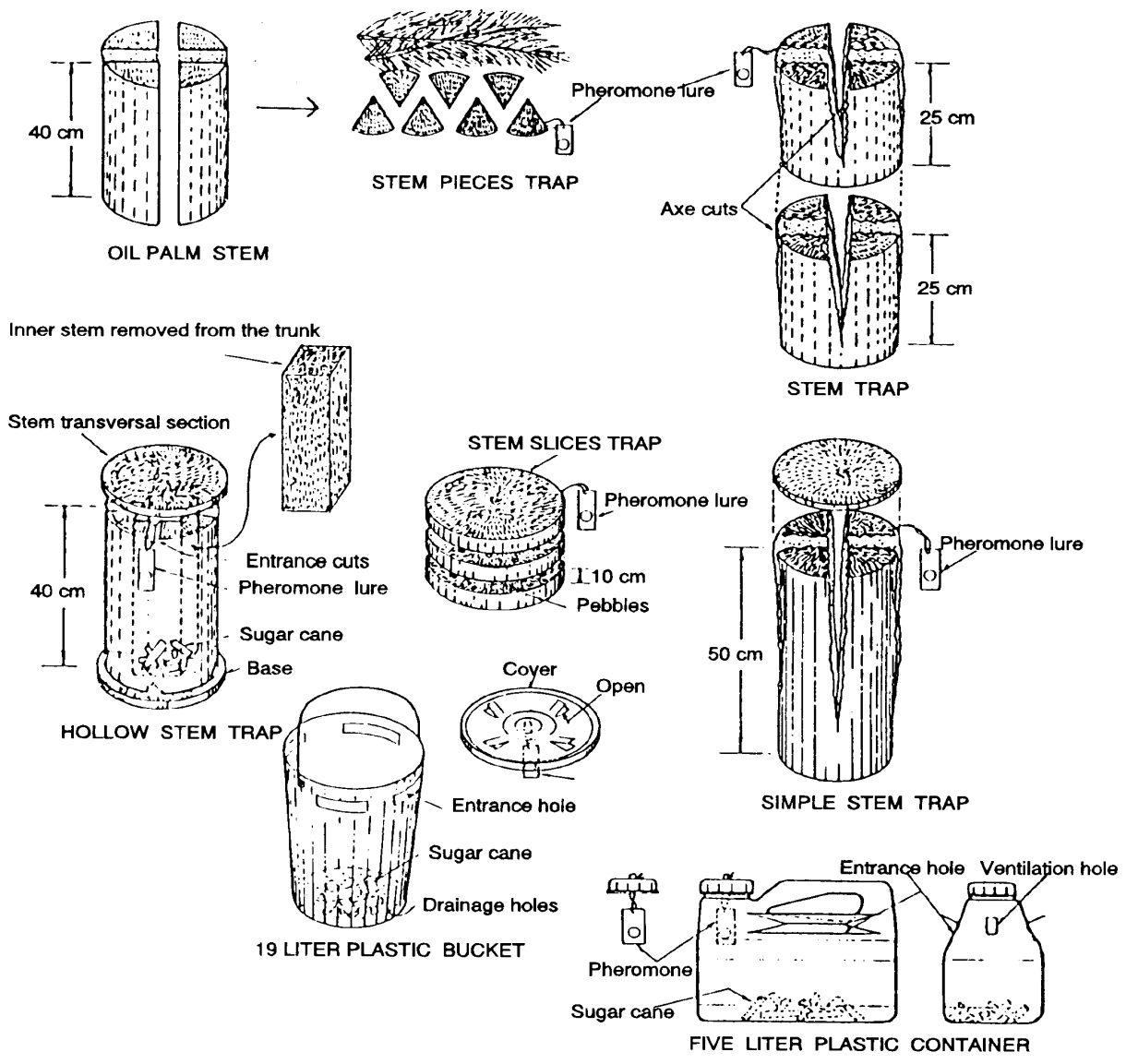
Rhynchophorus palmarum

male-produced aggregation pheromone
1991-1992



Coto oil palm

Stem traps with pheromone





Capture of *R. palmarum* in pheromone traps



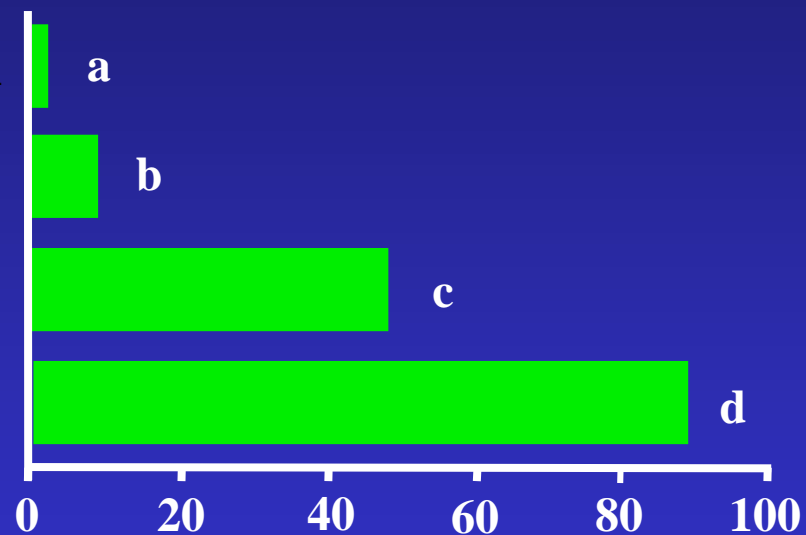
pheromone

sugarcane

pheromone + sugarcane

pheromone + sugarcane
+ ethyl acetate

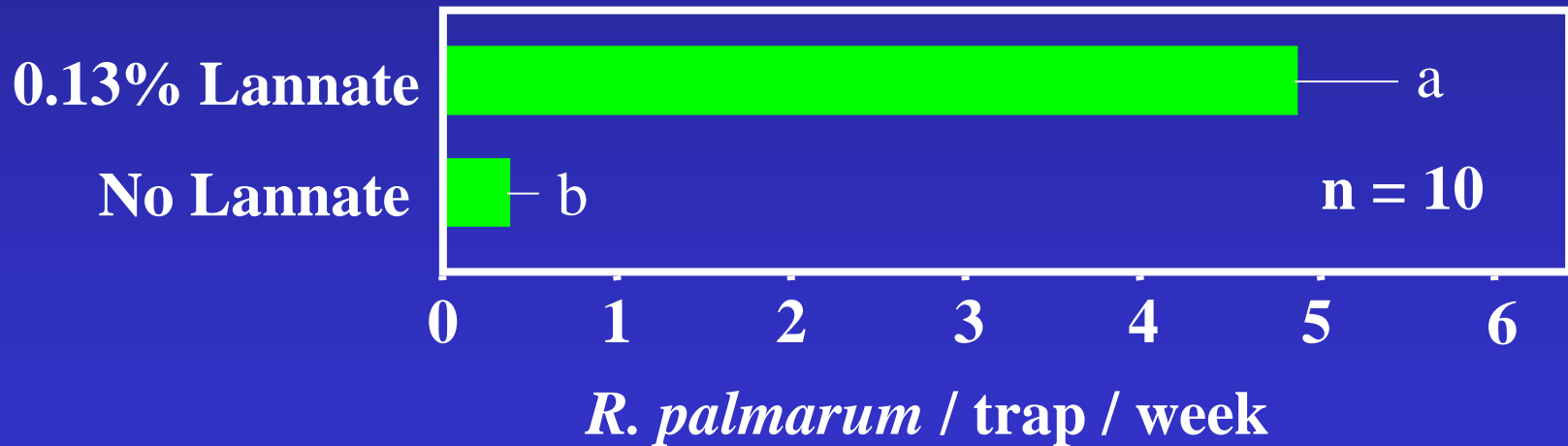
1998

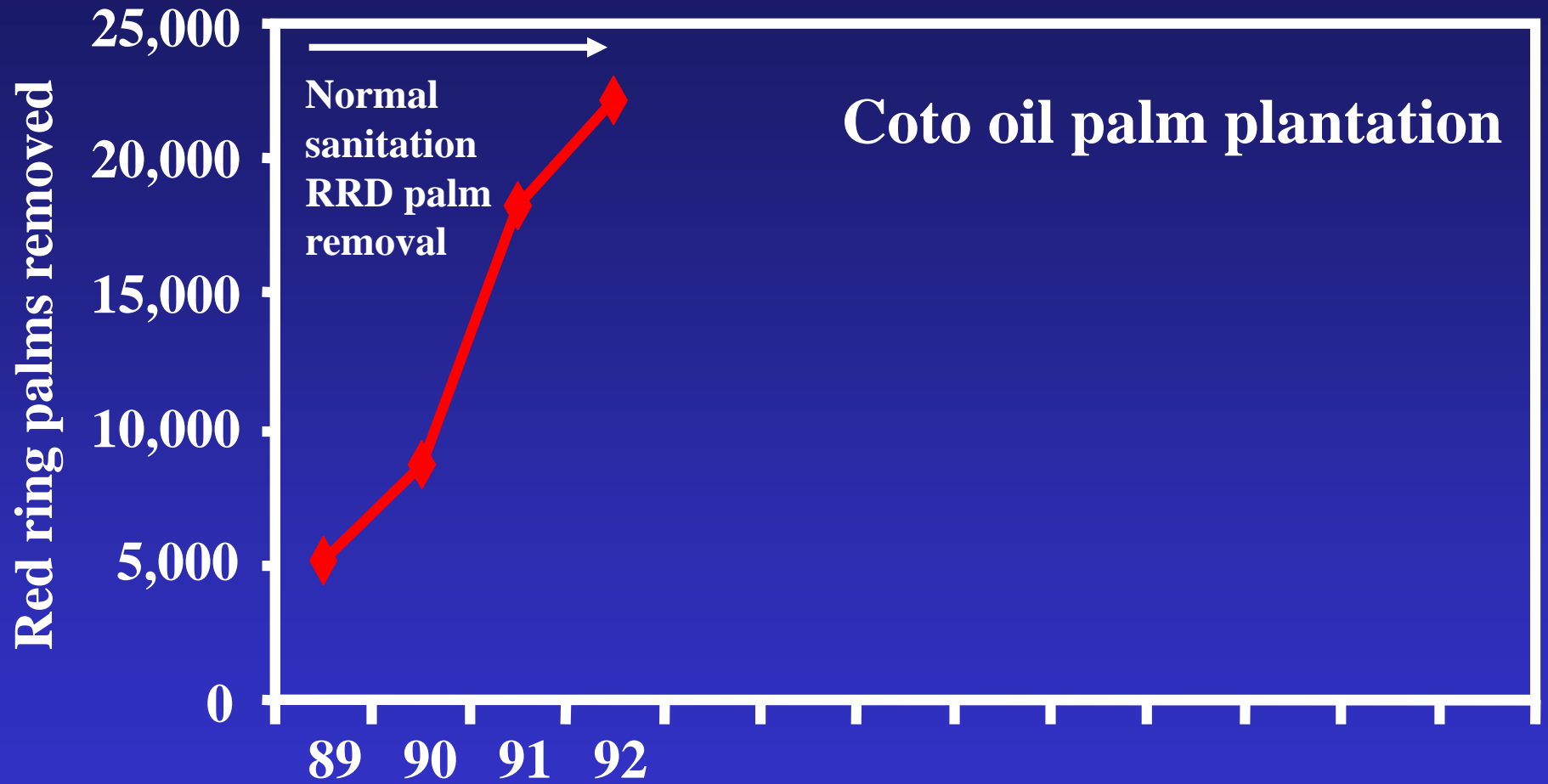


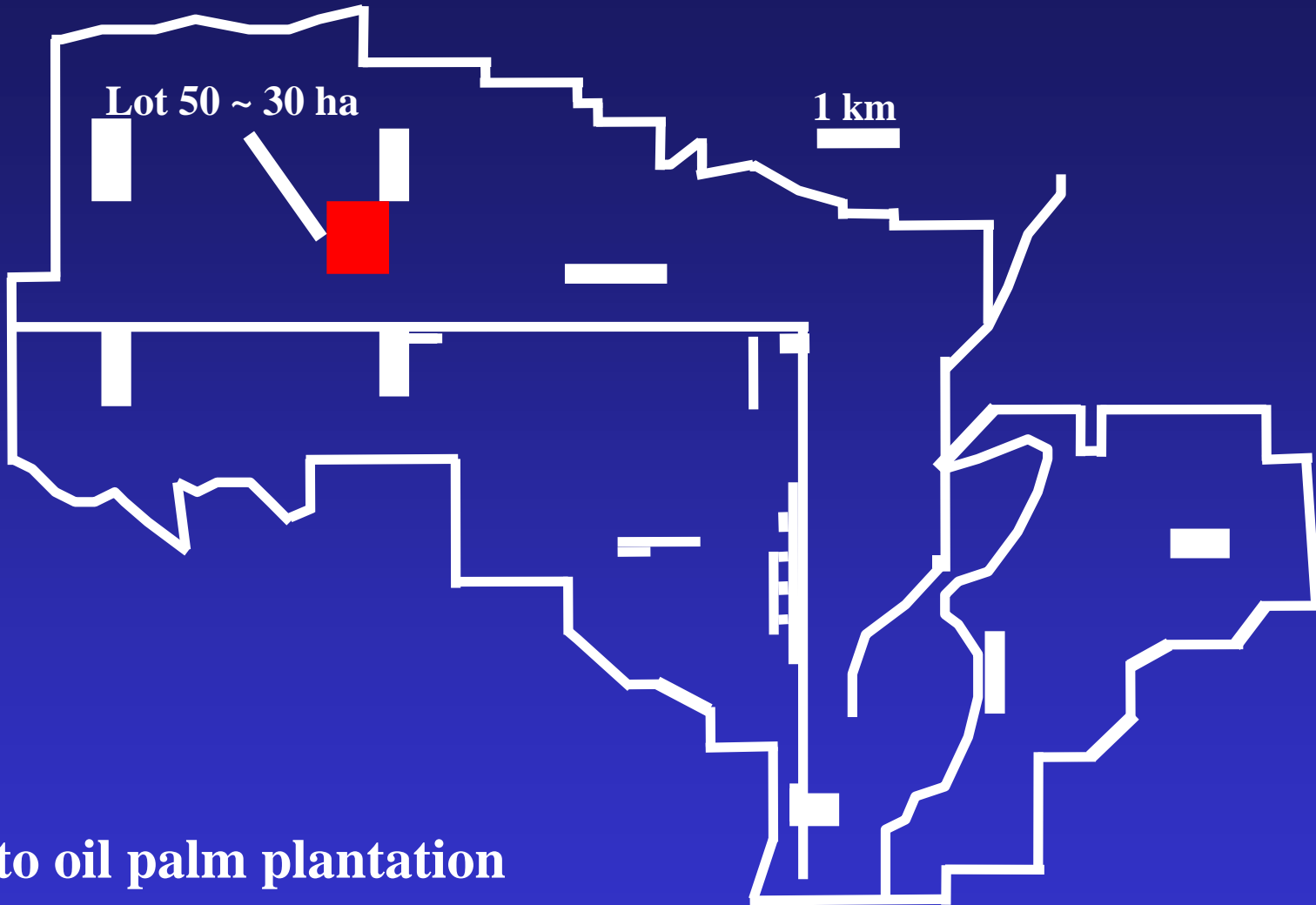
R. palmarum / trap / week

Capture of *R. palmarum* in pheromone traps requires insecticide

Pheromone + Sugarcane + Water

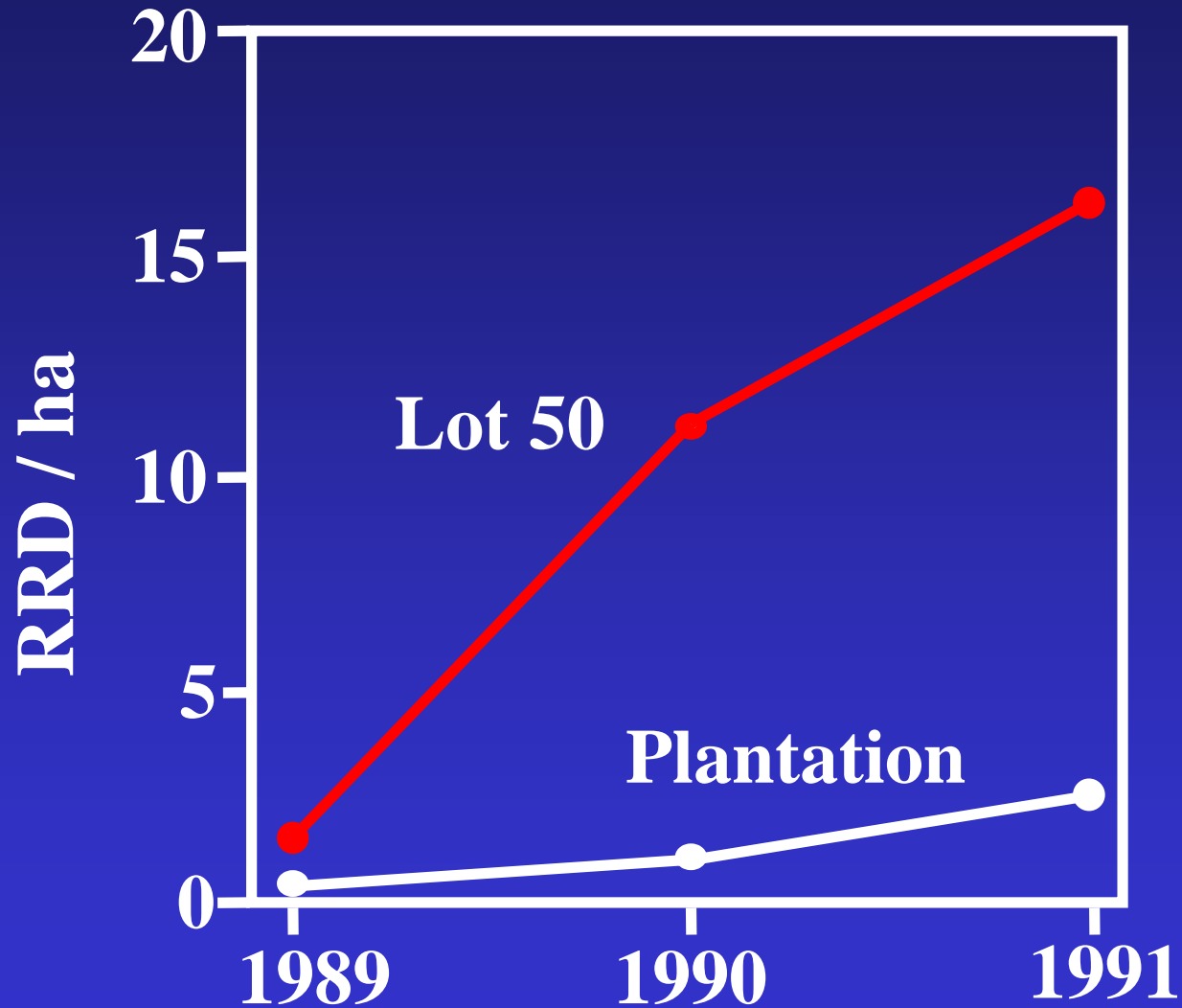




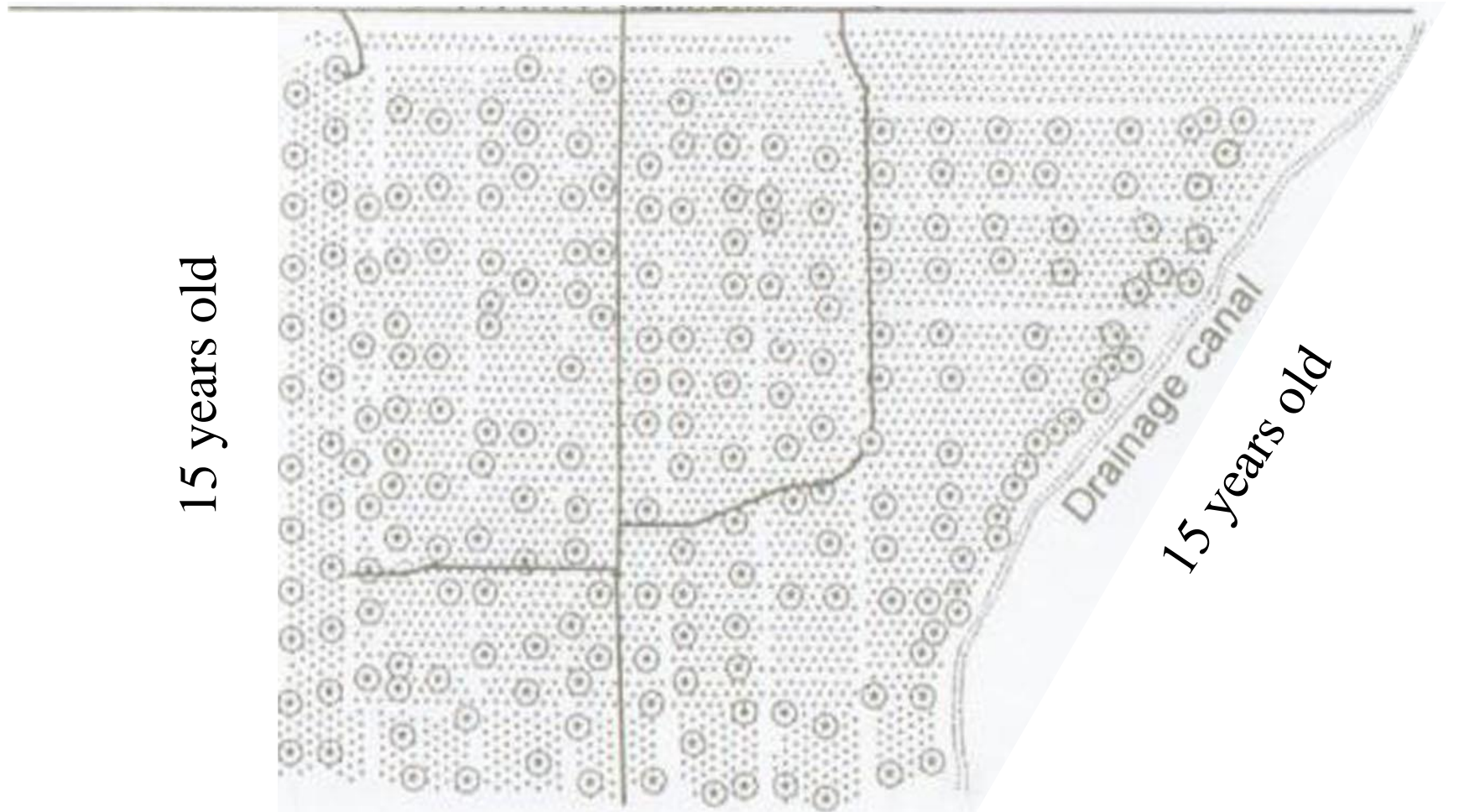


**Coto oil palm plantation
Costa Rica**

Initial Test of Mass Trapping



2 years old



15 years old

15 years old

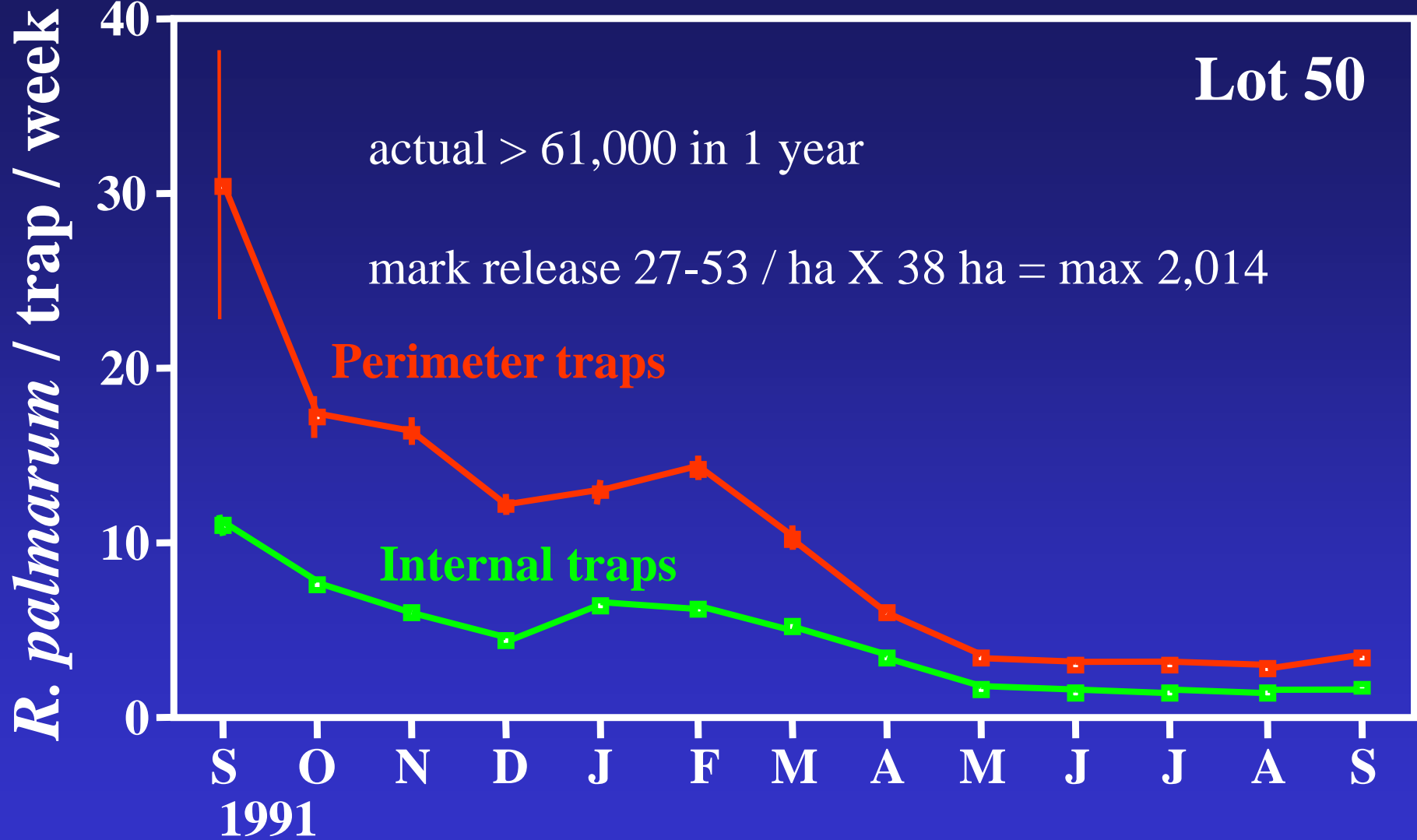
Drainage canal

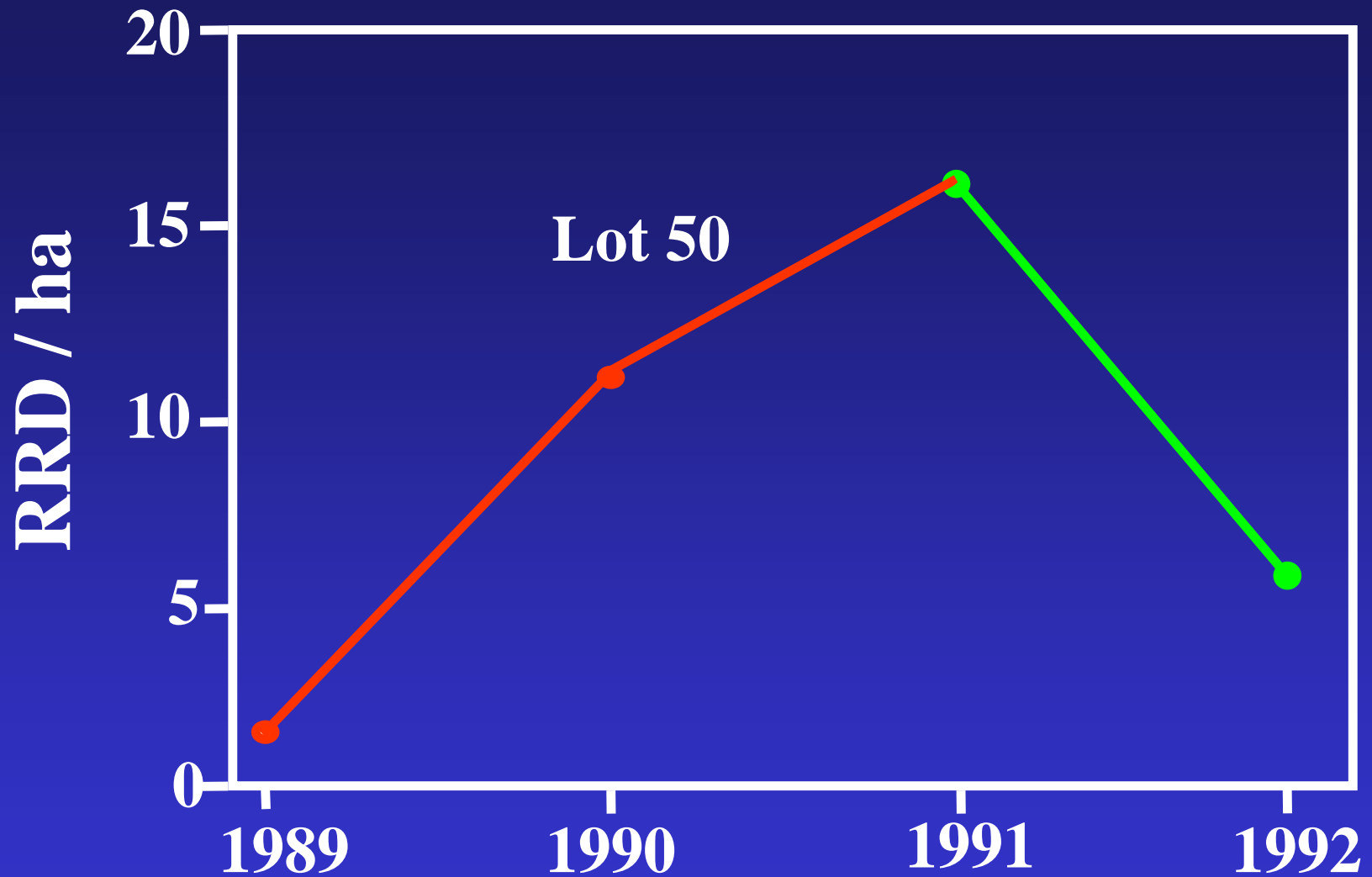
15 years old

220 traps ~38 ha

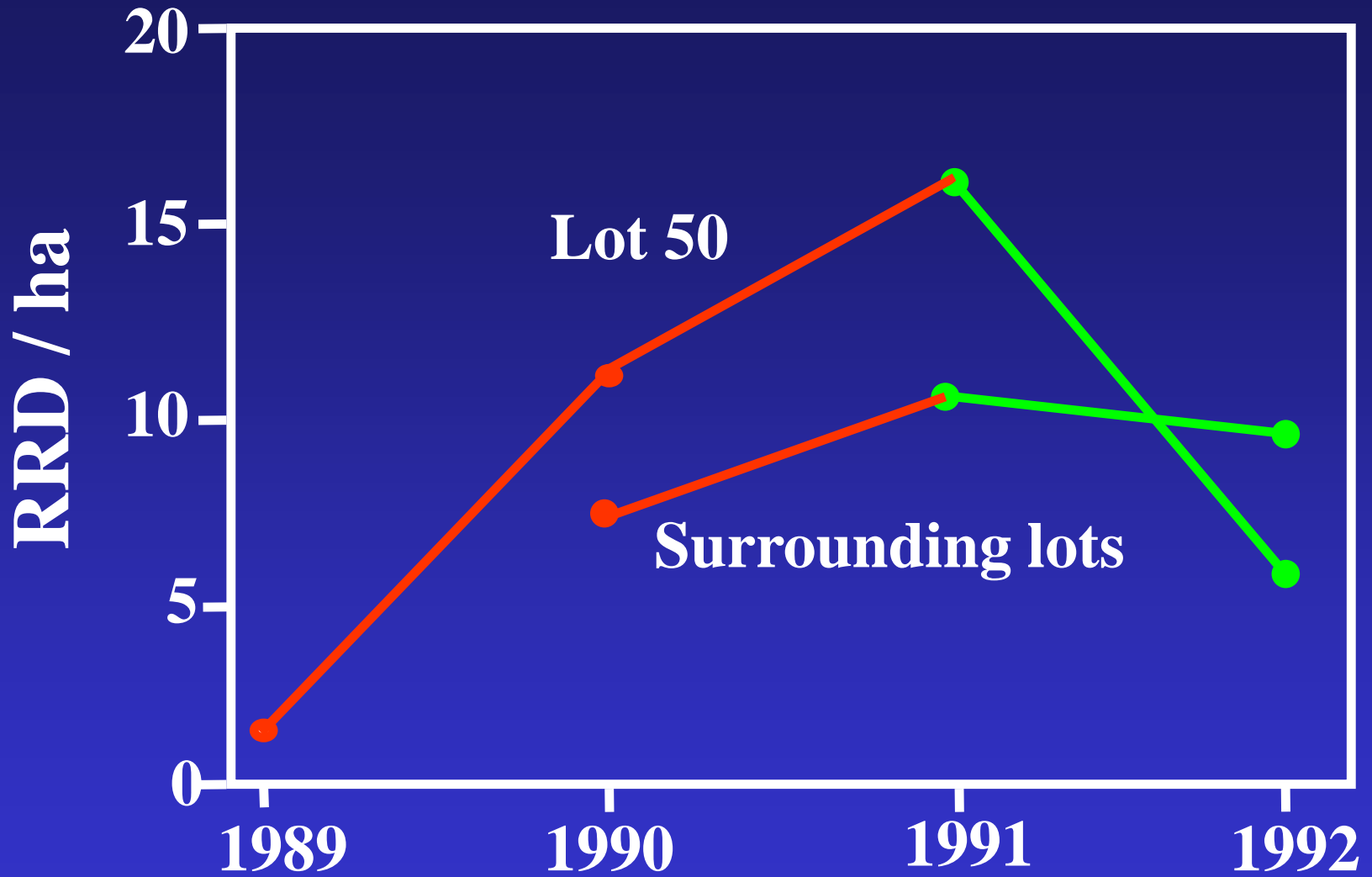
~6 traps/ha

50 meters between traps

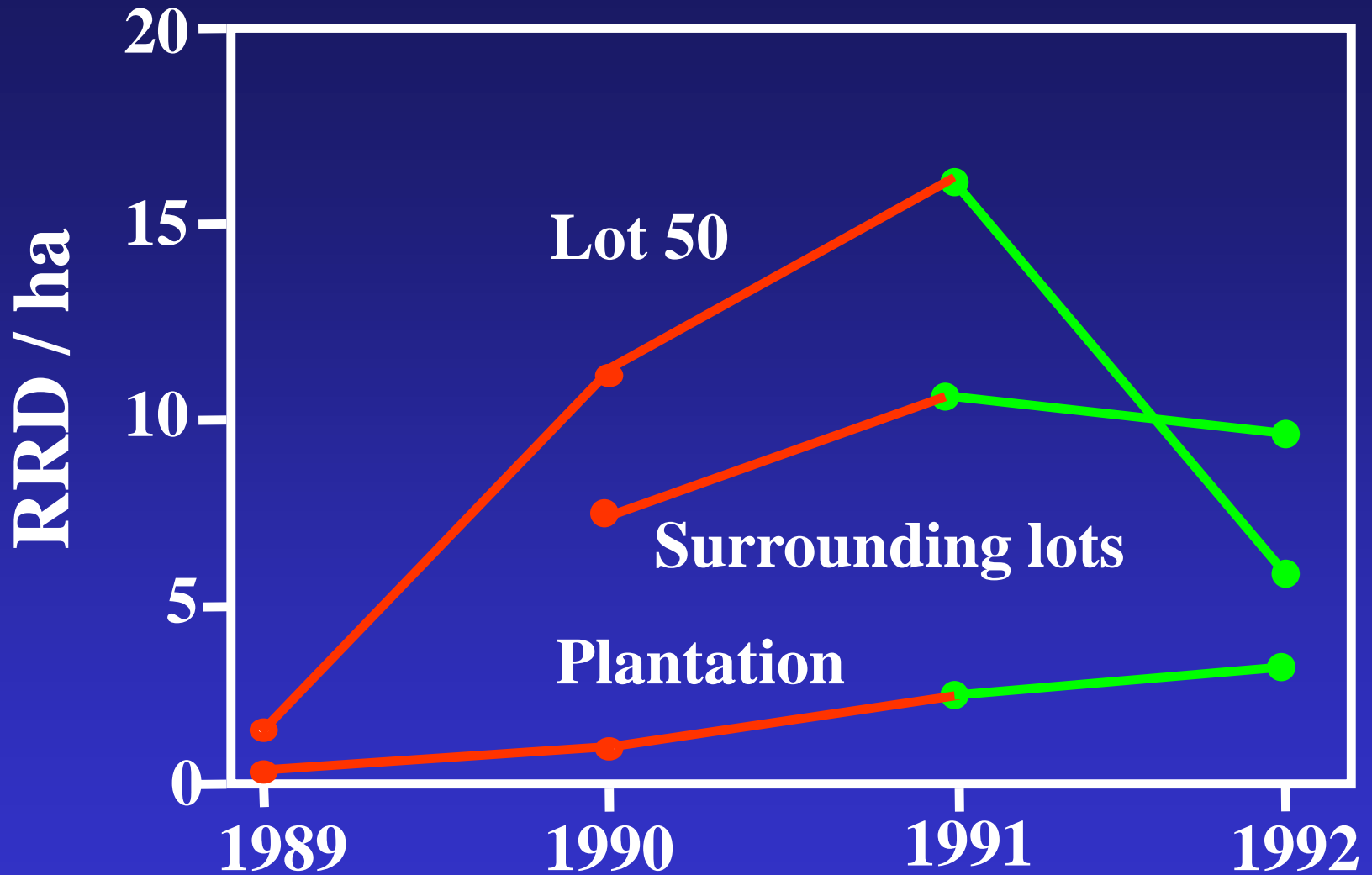




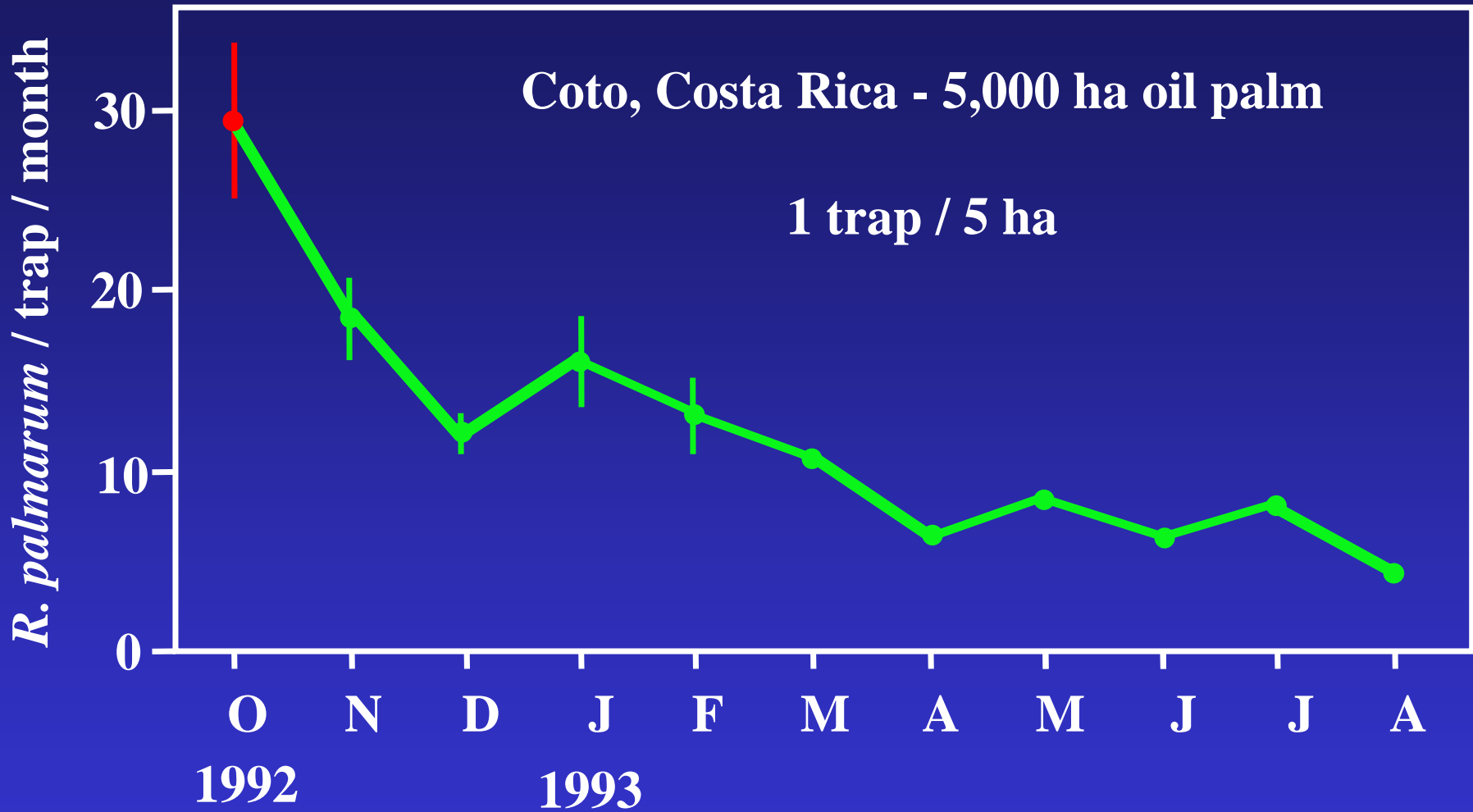
Oehlschlager, A.C., R.S. McDonald, C.M. Chinchilla and S.N. Patschke. Influence of a Pheromone-based Mass Trapping System on the Distribution of *Rhynchophorus palmarum* & the Incidence of Red Ring Disease in Oil Palm. *Environ. Entomol.* **24**: 1004-1012, 1995.

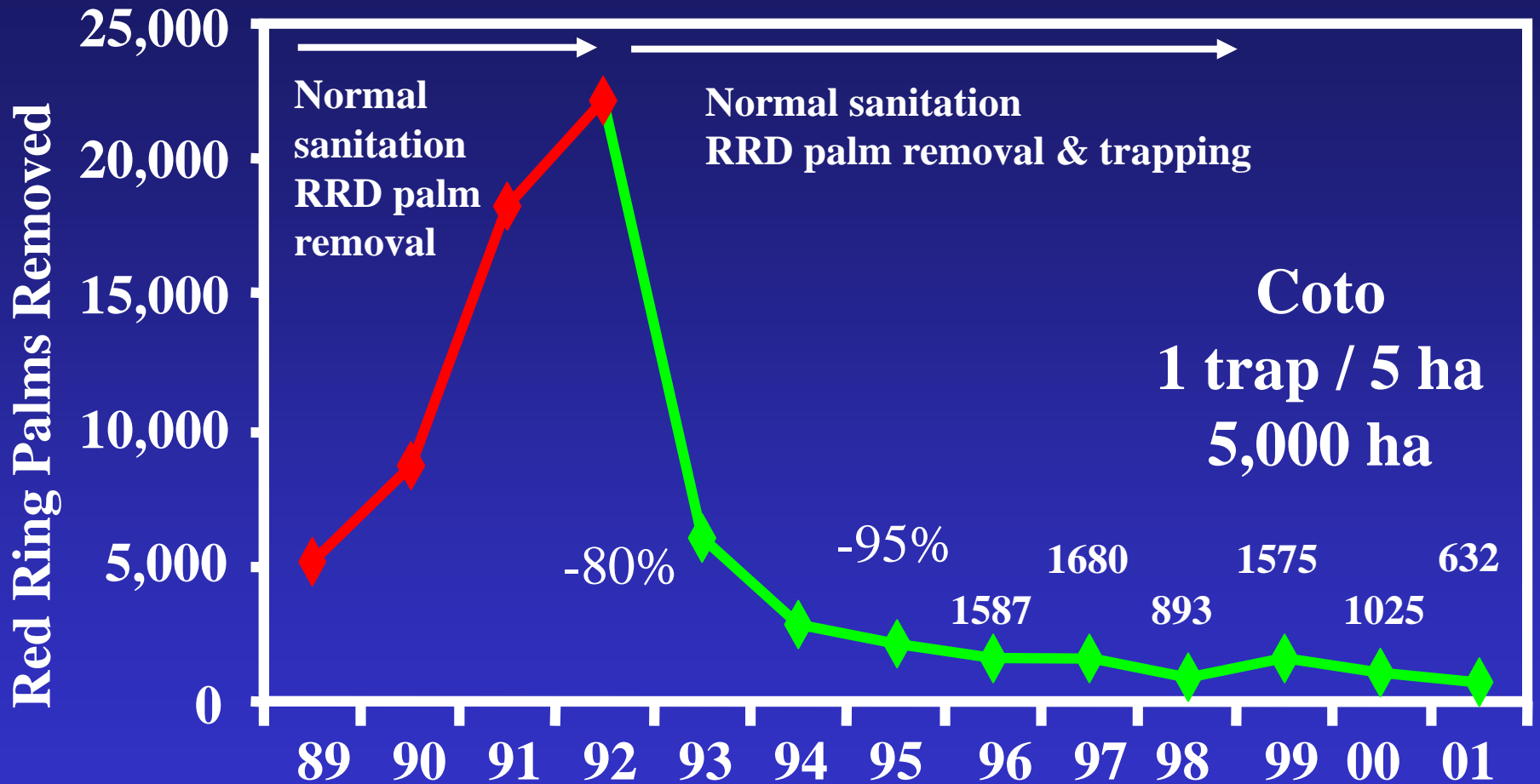


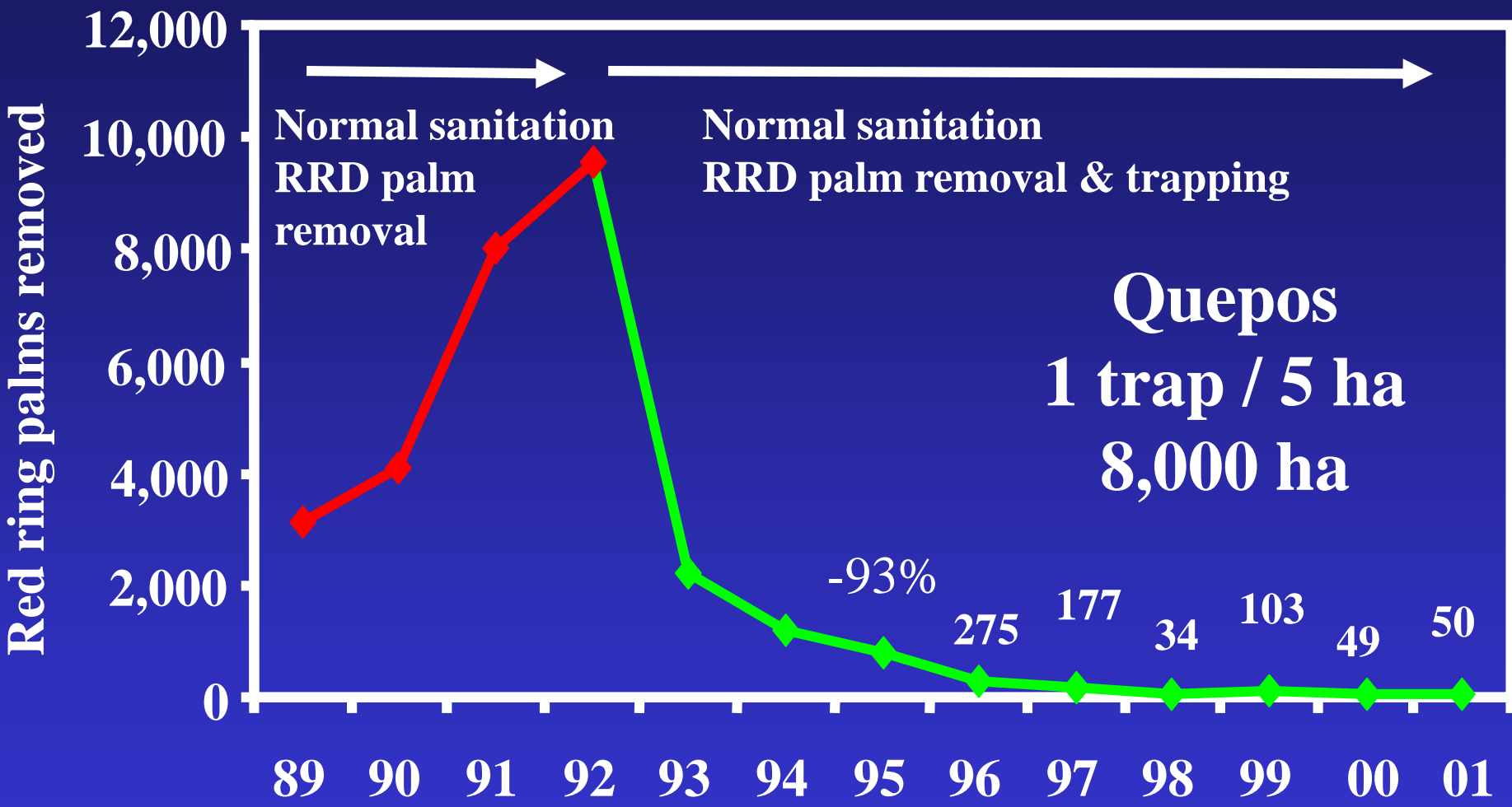
Oehlschlager, A.C., R.S. McDonald, C.M. Chinchilla and S.N. Patschke. Influence of a Pheromone-based Mass Trapping System on the Distribution of *Rhynchophorus palmarum* & the Incidence of Red Ring Disease in Oil Palm. *Environ. Entomol.* **24**: 1004-1012, 1995.



Oehlschlager, A.C., R.S. McDonald, C.M. Chinchilla and S.N. Patschke. Influence of a Pheromone-based Mass Trapping System on the Distribution of *Rhynchophorus palmarum* & the Incidence of Red Ring Disease in Oil Palm. *Environ. Entomol.* **24**: 1004-1012, 1995.







A. C. Oehlschlager, C. M. Chinchilla, G. Castillo and L. M. Gonzalez. Control of Red Ring Disease in Oil Palm by Mass Trapping *Rhynchophorus palmarum*, Florida Ent. 85: 507-513, 2002.

Trapping since 1993

cost of trapping 2016

trap + sugarcane + pheromone @ \$20.00

labor @ \$23.00 / Yr

= \$43 / Yr / 5 Ha = \$9.00 / Yr / Ha

2016
405,000 Ha

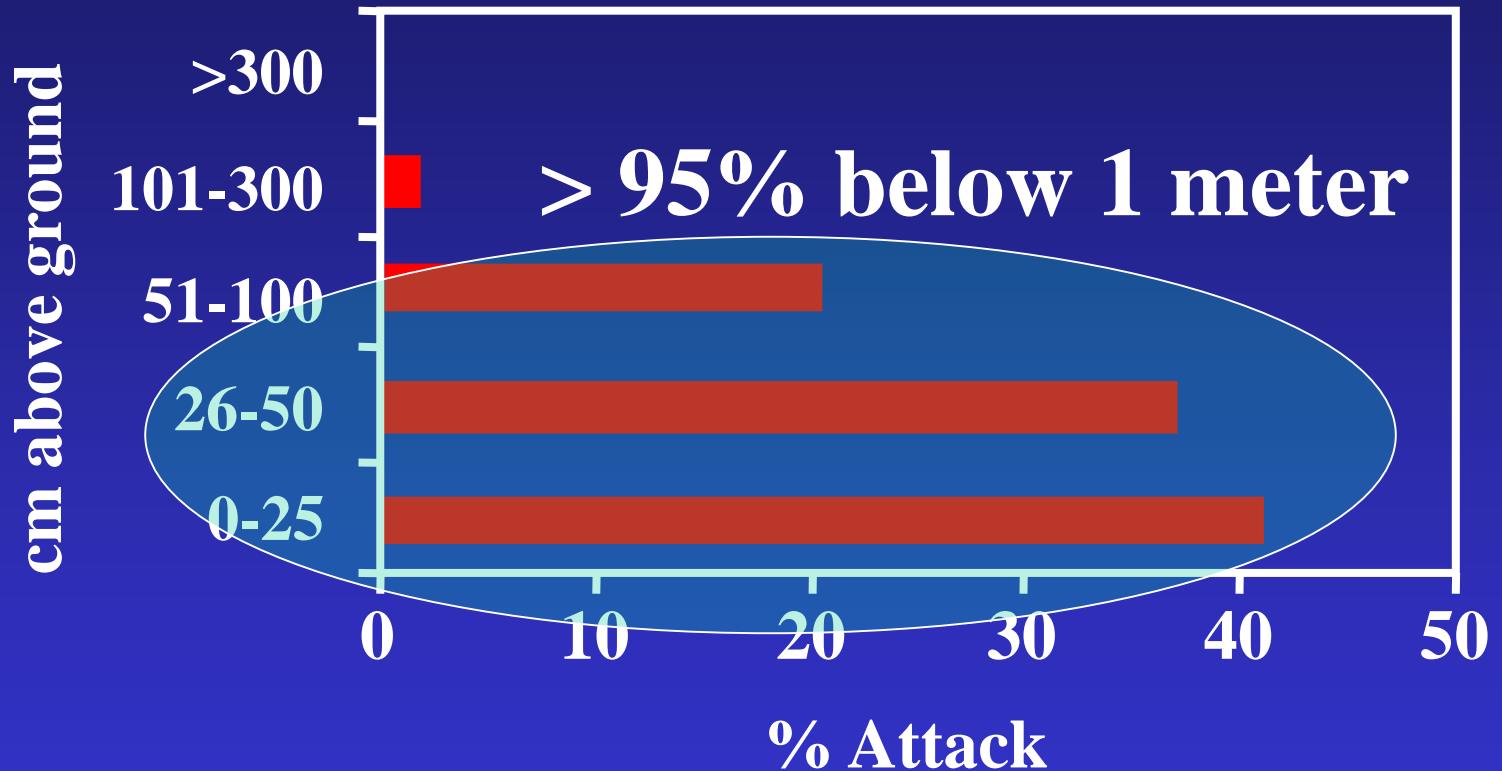




**Offshoot production
to year ~20**



R. ferrugineus attack of date palm during offshoot generation



Survey of **1,325,574 palms** in UAE 1998-2000, **2,296** were infested

O. Khalifa, A. H. Assal, F. A. Exaby, M. A. Amurse, S. M. Nuaimi, N. S. Zehli, Dept. Agric. & Livestock, Al-Ain, UAE, Database for Infestation of Date Palm by Red Palm Weevil, Second Int. Conf. on Date Palms, Al-Ain, UAE, March, 2001.



In Saudi Arabia 1992
log traps were used to capture
R. ferrugineus

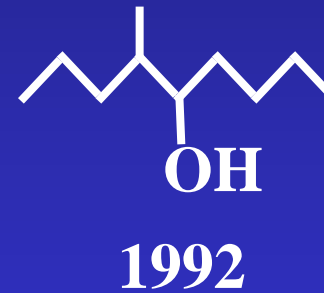


Photo by PSPV Vidyasagar

Food & pheromone necessary to maximize capture *R. ferrugineus*

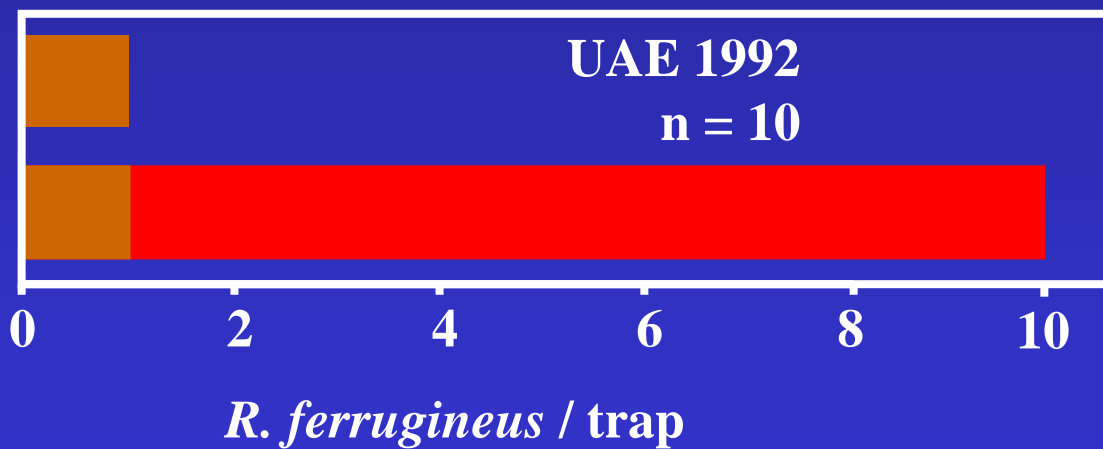


Rough on outside

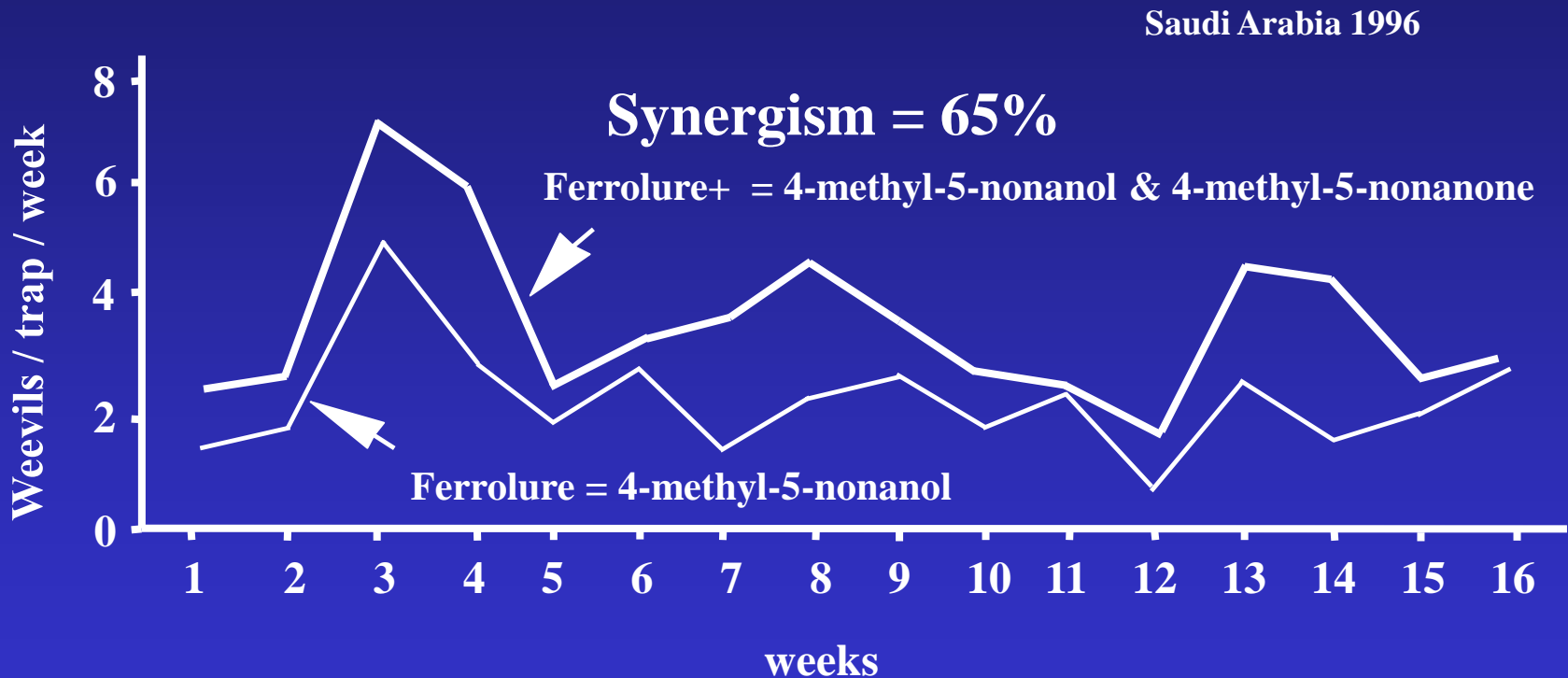
Traps



Smooth on inside

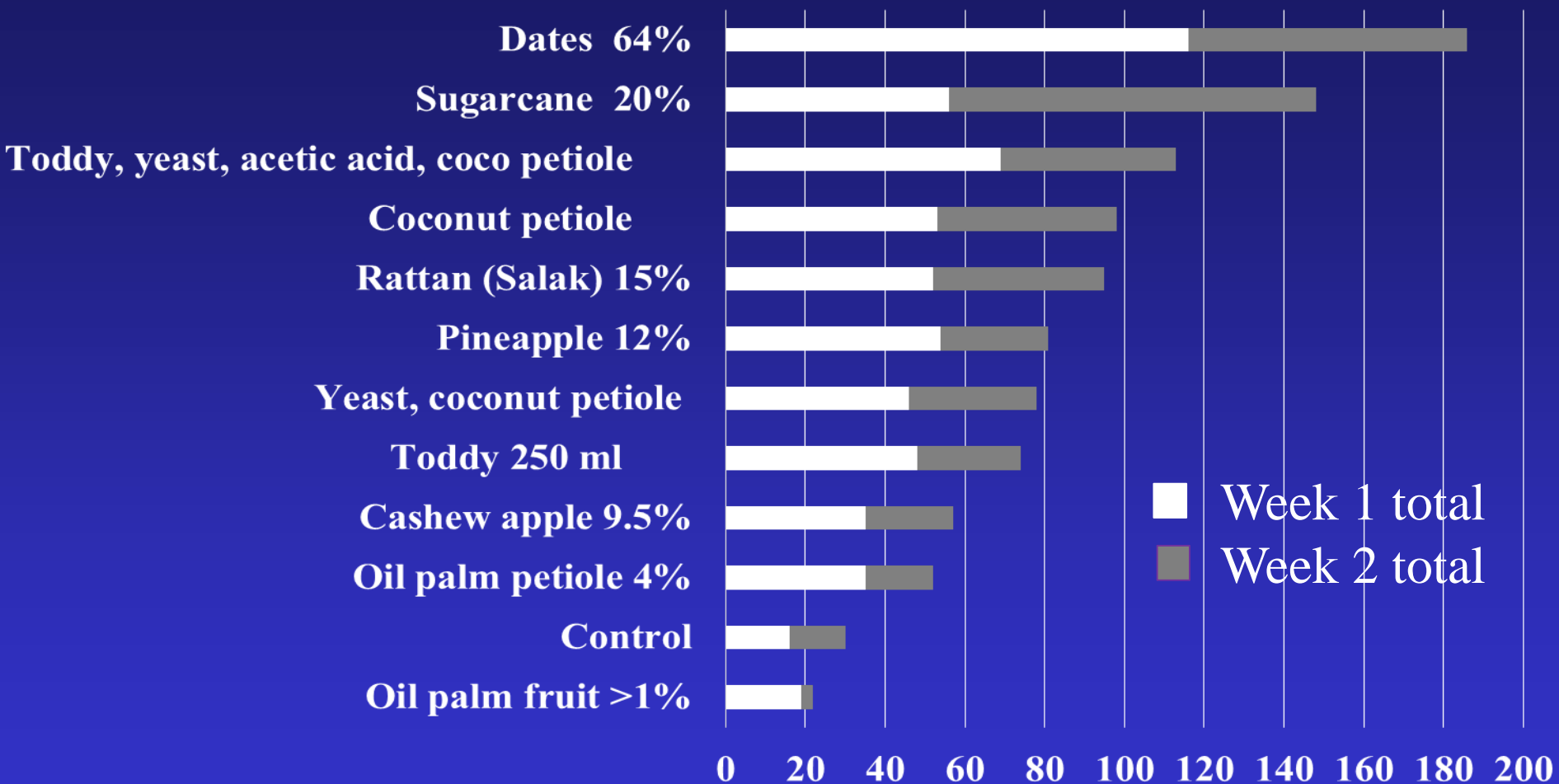


1993 aggregation pheromone of *R. ferrugineus* available 2 components

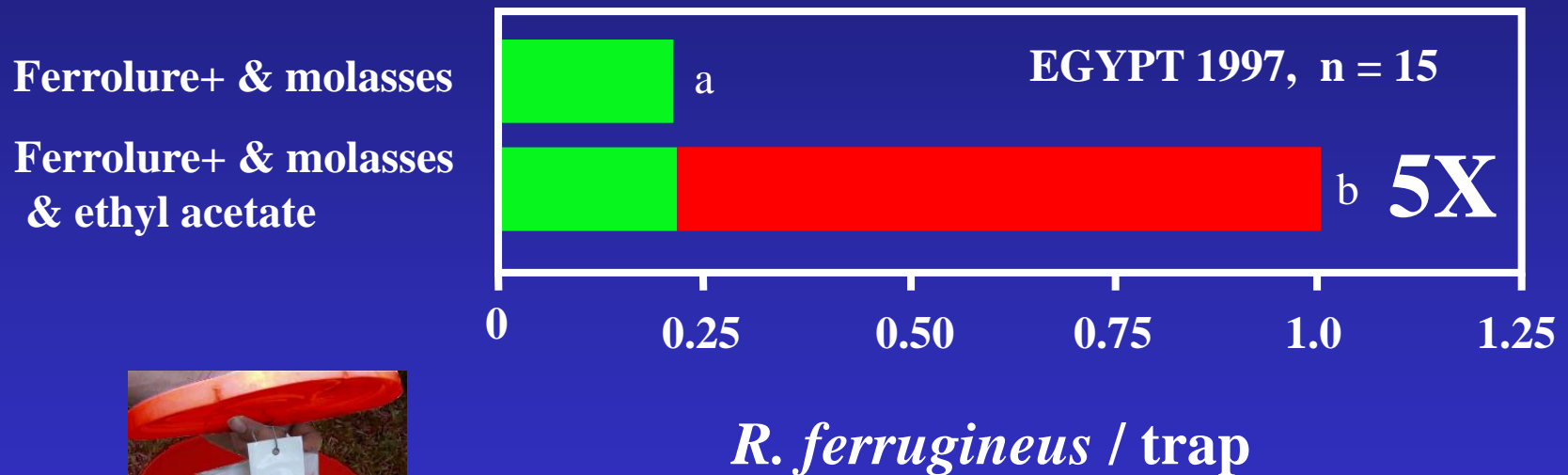


Test conducted in Al Qatif, Saudi Arabia, January-March 1996 by Dr. R. A. Abozuhairah, Dr. P. S. P. V. Vidyasagar & Dr. V. A. Abraham, Ministry of Agriculture & Water, Al Hassa, Kingdom of Saudi Arabia. All traps contained insecticide-treated date palm pieces

***R. ferrugineus* captures in pheromone traps containing different plant materials in coconut plantation in India, Faleiro, 2005.**

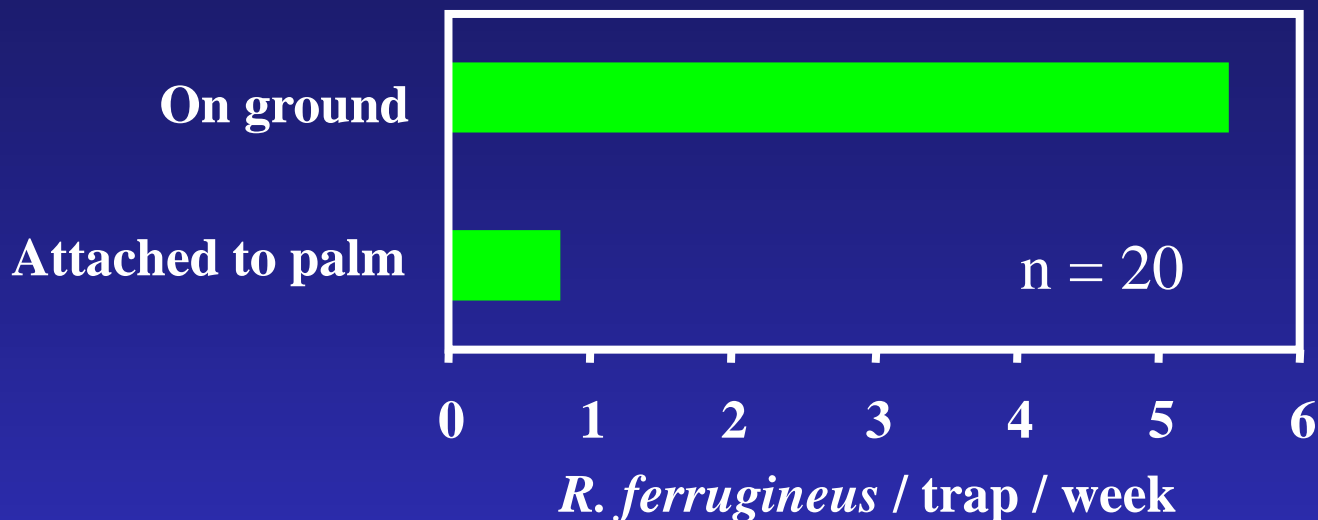


Addition of ethyl acetate increases capture of *R. ferrugineus*



Ground traps best for *R. ferrugineus*

9 tests confirm this – Ferrolure+ & molasses

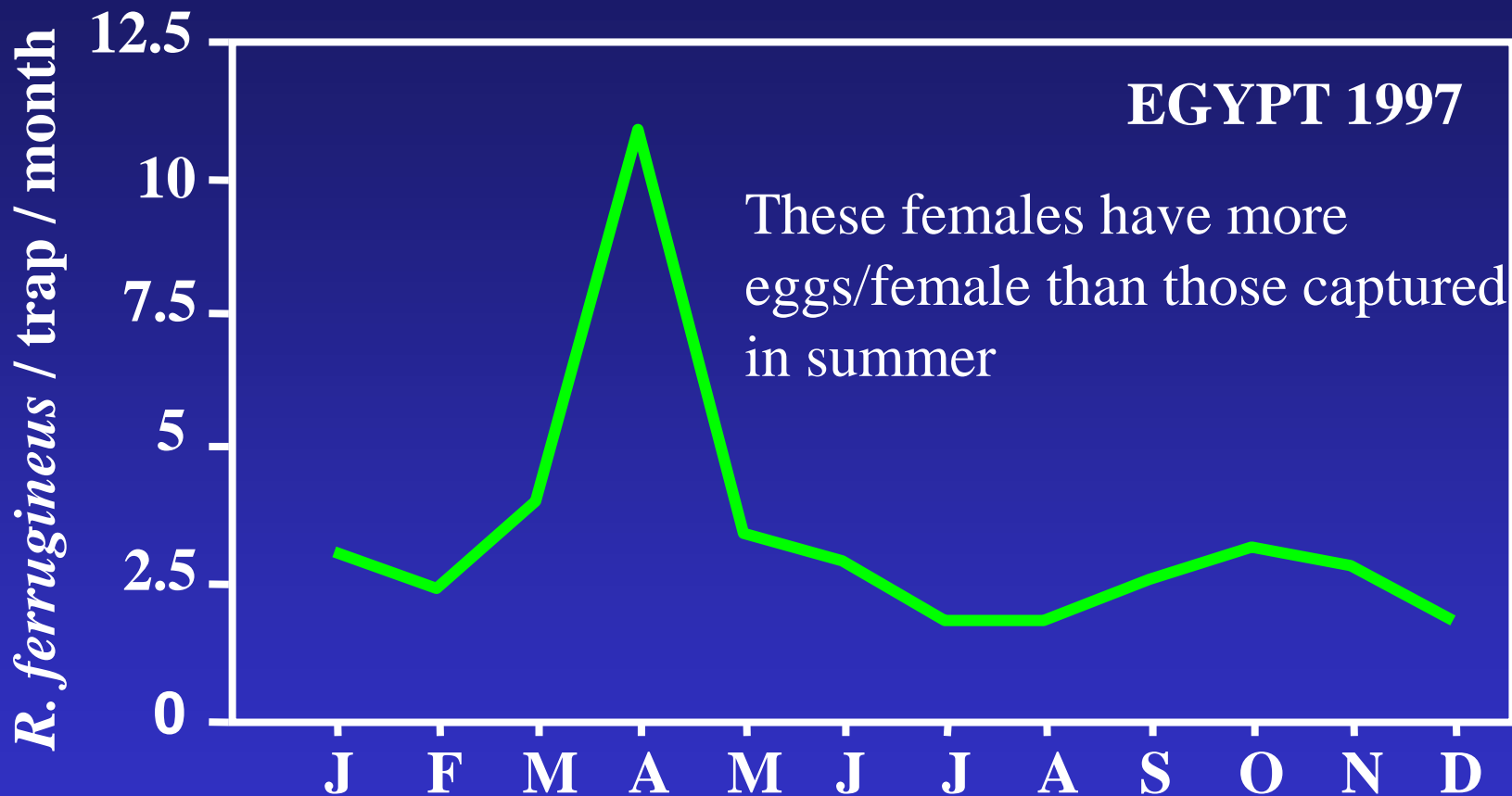


**~6X better
on ground**

KSA, More weevils
captured if traps are placed
in short palm stem



More weevils captured in March - May



Mass trapping conducted in Egypt by Dr. G. Moawad & Y. El-Sebay. 200-300 bucket traps on ground containing bigas, molasses & Ferrolure+ (Data from proceedings of FAO Workshop on Red Date Palm Weevil & its Control, Dec. 1999, Cairo).



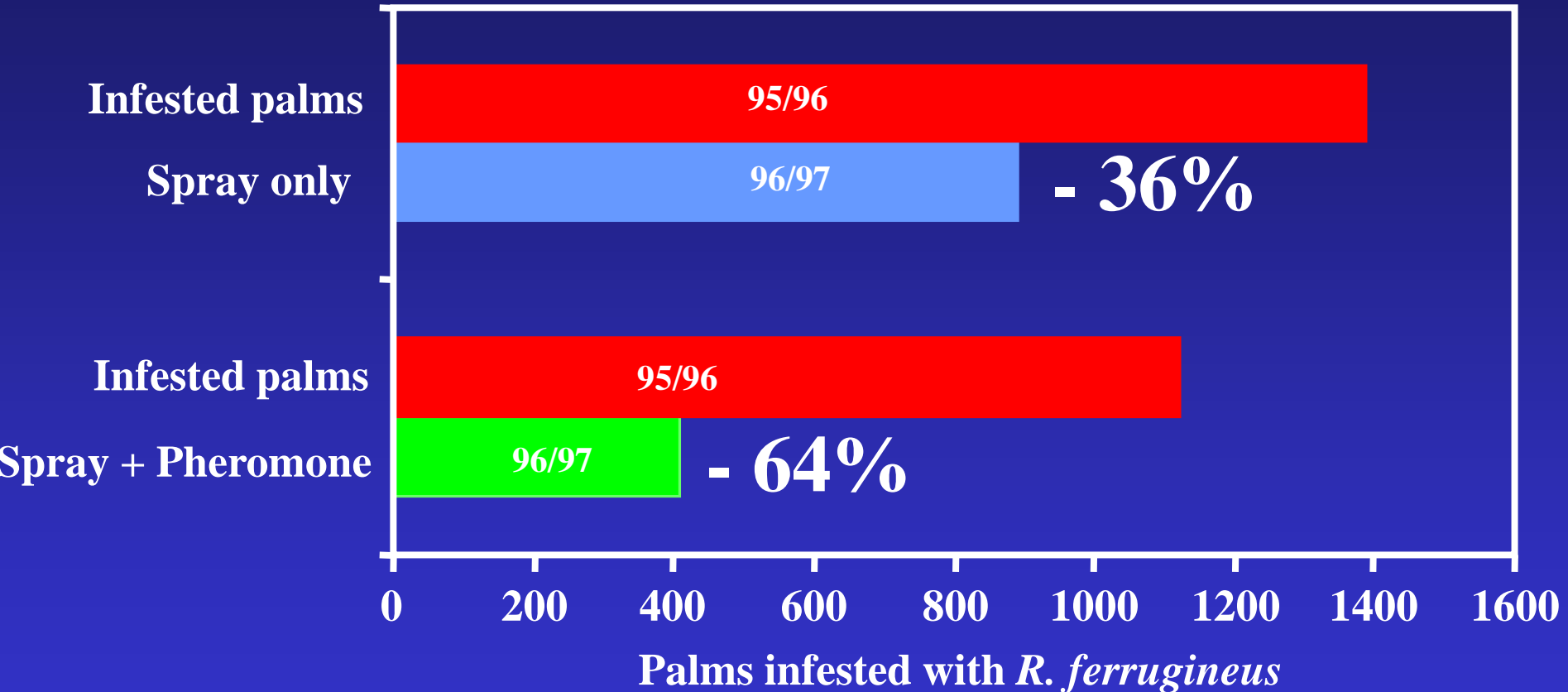
THE Middle East Red Palm Weevil Project
WORK SHOP
CAIRO 26~28 JANUARY 1999

Mass trapping *R. ferrugineus*
Is it beneficial when added to
other aspects of RPW
management?

Yes

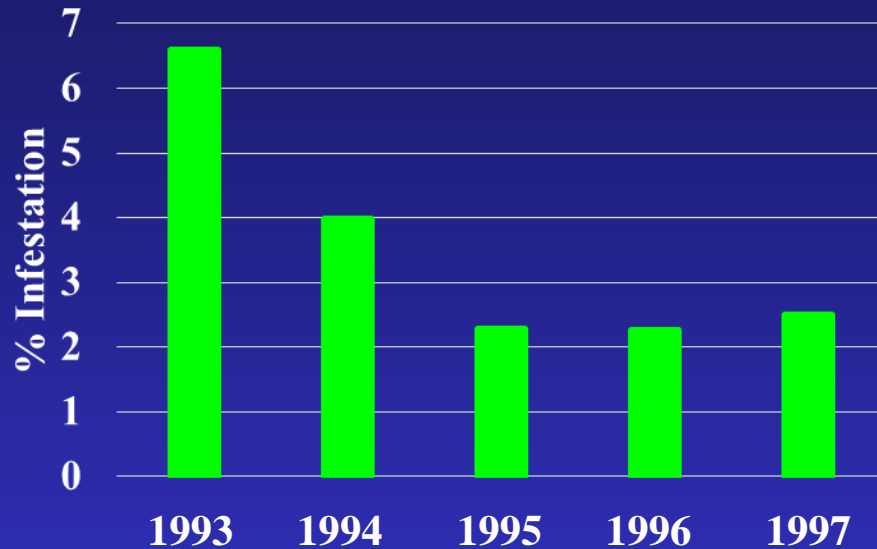
Examples

**Effect of pheromone trapping on date palm infestation in UAE, 1995-1997,
1,466 farms with 349,342 palms (1994)
Average 1994-5 infestation of 1.9%**



Mass trapping Saudi Arabia 1993-7

Date palm, Al Qatif, KSA



13,055 Gardens

464,785 palms

Inspection, treatment, spray
trapping

Vidyasagar et al 2000

Trap

Bucket with mat on outside, holes near
top, **on ground**

Pheromone, date fruits & water



Mass trapping Saudi Arabia 2006-2012

Al Haasa 185,000 palms

2006-2009 Low level management

1 trap/ 2.5 ha

~11,000 palms/yr sprayed

regular inspection & removal of infested palms

2009 → 3.7% infestation



Increase management level

Put trap in 50 cm stem base (approx 2X capture)

1/1.1 ha trap **AND**

2.9X / year spray

2012 → 0.36% infestation = ↓ 89%

Hoddle et al. 2013.



Israel RPW

IPM stopped infestation (for a while)

Arrived 1999

Jordan Valley

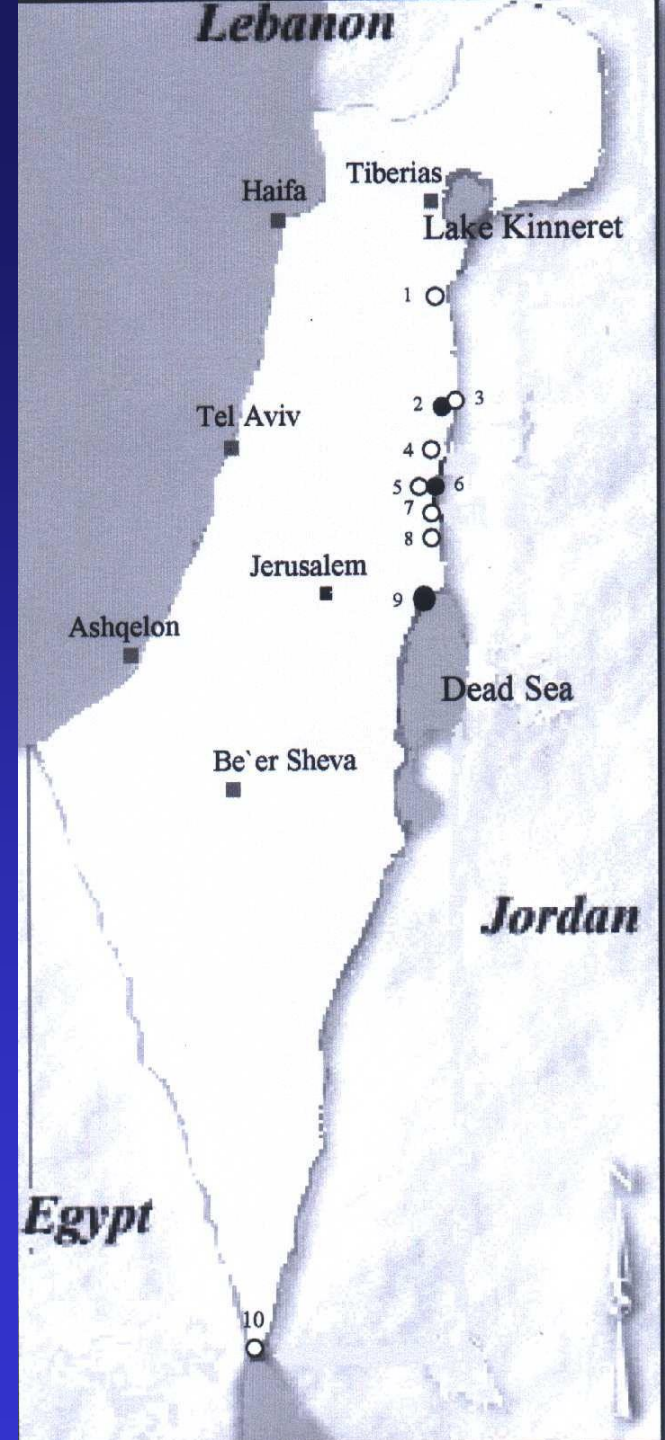
Aug 1999 to Sept 2001

Traps 5,000 in 450 ha 70,000 palms

Regular sprays @ 2X/ month Apr/Nov

Only to 2 meters to protect offshoots

Treatment & removal of infested palms



Traps

Ground traps 20 liter buckets next to palms

Pheromone

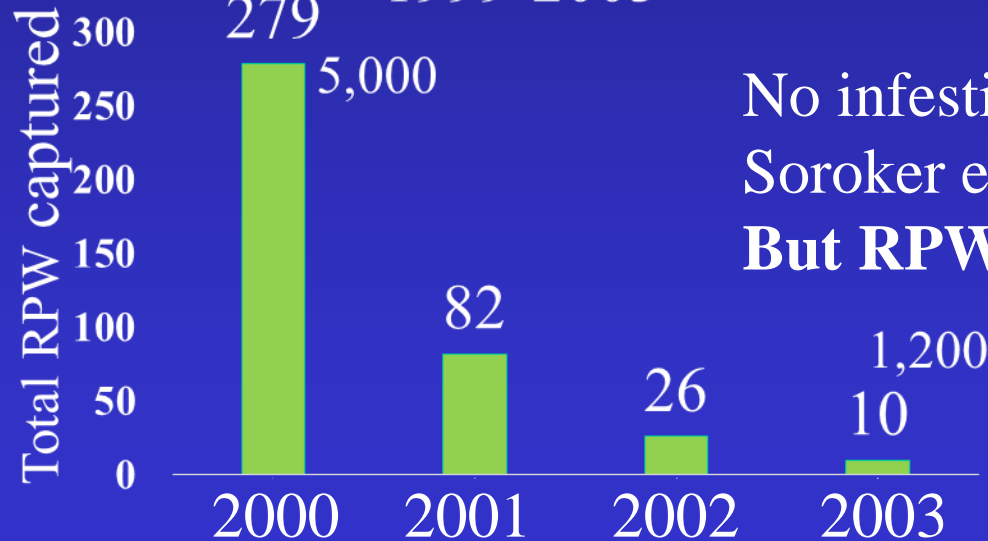
Ethyl acetate

Dates & sugarcane molasses

Water weekly Apr/Nov

Food replaced @ 2 months

RPW Trapping in Jordan Valley
1999-2003



No infestation in 2003-2005

Soroker et al. 2005

But RPW present in 2014

- 96%

OMAN

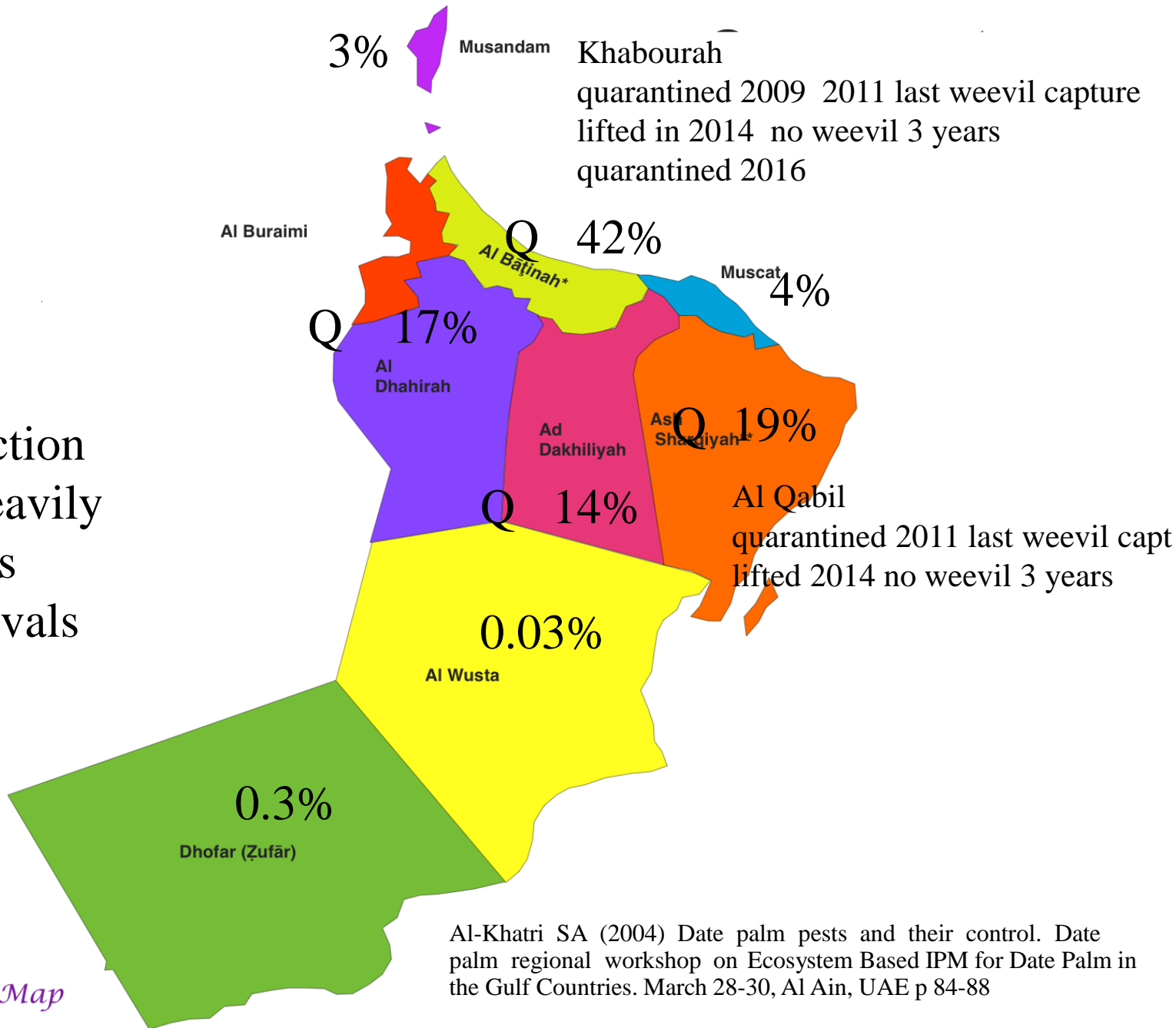
~290,000

date palms

trapping
regular inspection
removal of heavily
infested palms
reduced removals
24% in 1998
3% in 2003

-87%

GeoCurrents Base Map



Al-Khatri SA (2004) Date palm pests and their control. Date palm regional workshop on Ecosystem Based IPM for Date Palm in the Gulf Countries. March 28-30, Al Ain, UAE p 84-88

RPW Eradication Canary Islands

RPW first detected in Canary Islands Sept 2005
Program against RPW started Sept 2006

Sept 2006

A topographic map of the Canary Islands archipelago, showing the islands in shades of green and brown against a blue background representing the ocean. The text 'Sept 2006' is centered over the map. Several islands are marked with red and yellow circular icons, indicating the locations where RPW was first detected in September 2006. These locations are on Lanzarote, Fuerteventura, Gran Canaria, and Tenerife.

Slide from Moises Fajardo, Canary Islands SC HLM FAO Rome 2017

Escala: 1:1.784.372

IPM

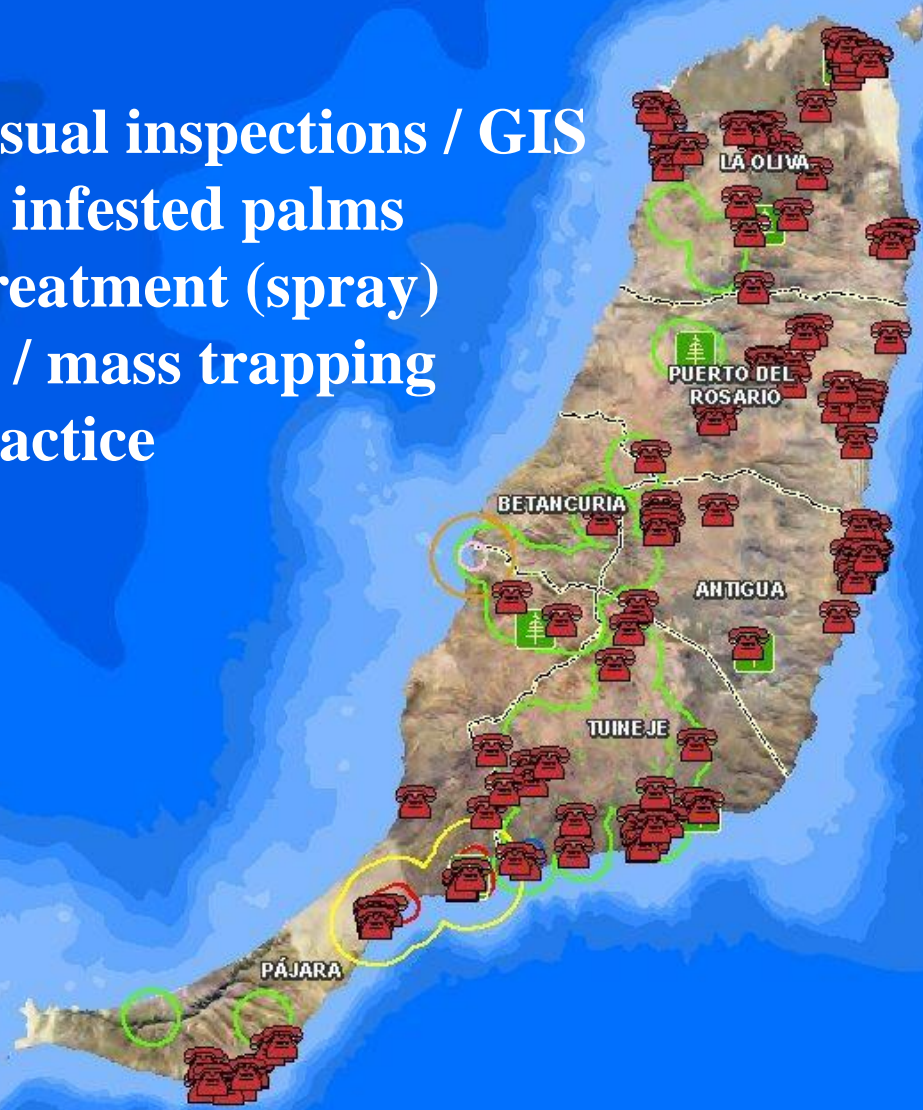
Intensive visual inspections / GIS

Removal of infested palms

Chemical treatment (spray)

Monitoring / mass trapping

Cultural practice



Slide from Moises Fajardo, Canary Islands SC HLM FAO Rome 2017



From Moises Fajardo, Canary Islands, SC HLM FAO Rome 2017



Canary Islands



Current Situation

May 2013

last infestation

&

last weevil captured

From Moises Fajardo,
Canary Islands SC HLM FAO Rome 2017

Future

Serviceless traps

GPS Monitoring

Attract & Kill

A&K

Trials Saudi Arabia 2011

Infestation level 2.81%

Trial 1 60 palms area 0.4 ha

3 g dollop in a bucket 100 buckets \longrightarrow total 2.47 / week

2 food baited pheromone traps \longrightarrow total 3.46 / week

70 dollop traps = 1 food trap

Trial 2 7 replicates

A&K 3 g no food \longrightarrow 0.14 / bucket

A&K 3 g food baited \longrightarrow 0.43 / bucket (1 dollup = 450 mg phero)

Ferrolure+ (700 mg) food baited \longrightarrow 1.14/bucket

Authors note A&K should not be applied to susceptible palms.

Bait-Free Attract and Kill Technology (Hook™ RPW) to Suppress Red Palm Weevil, *Rhynchophorus Ferrugineus* (Coleoptera: Curculionidae) in Date Palm 2011 El-Shafie HAF, Faleiro JR, Al-Abbad AH, Stoltman L, Mafra-Neto A, Fla Ent 94(4):774-778



A&K on palm



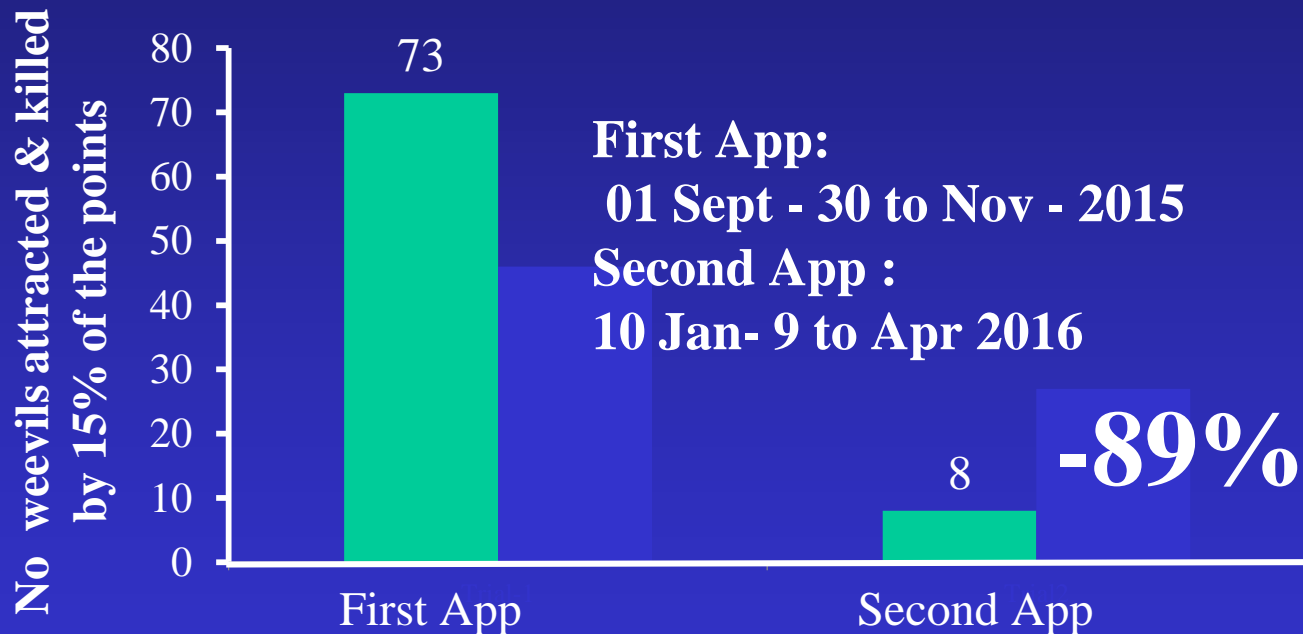
Attract & Kill

Wax emulsion

15% pheromone

5% cypermethrin

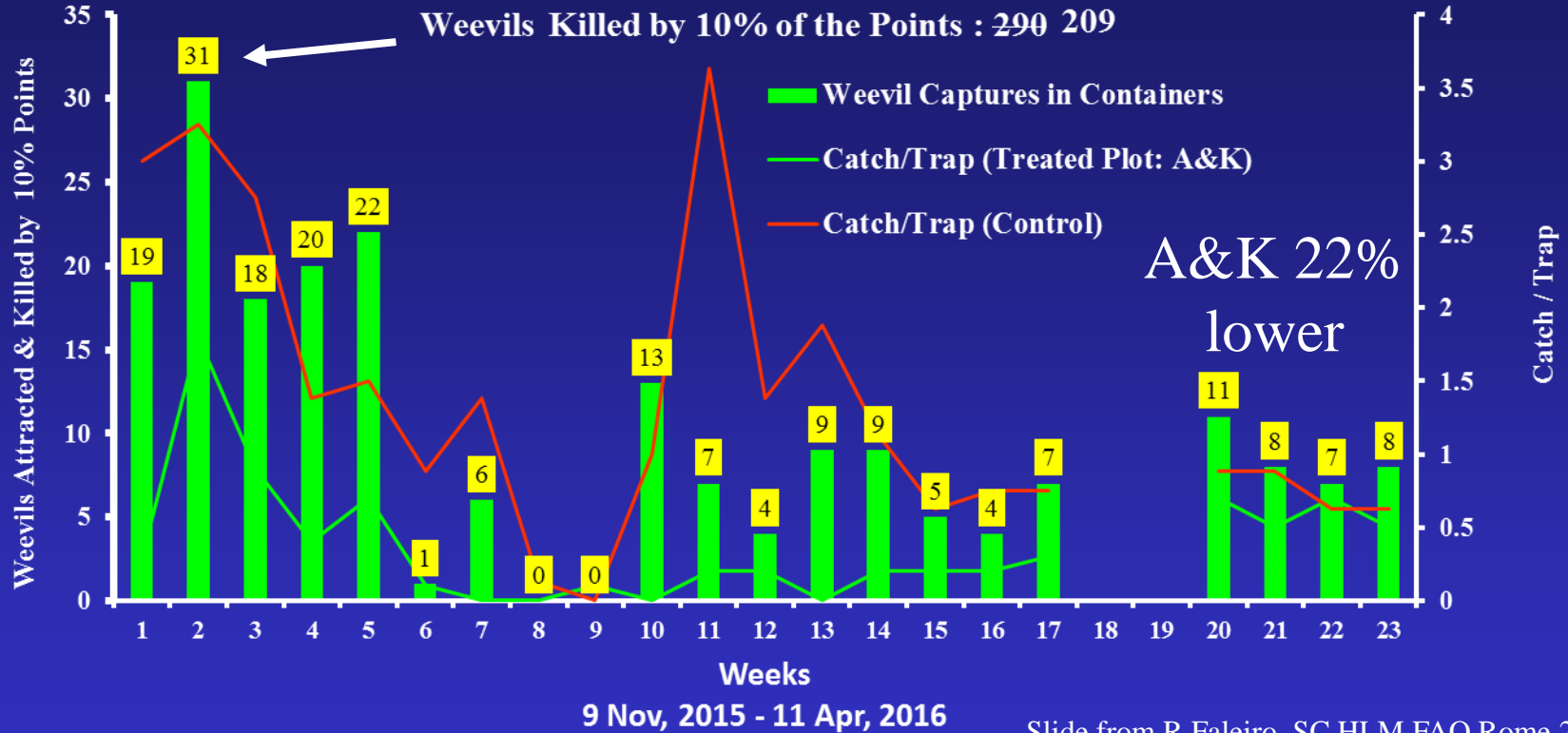
SMART Ferrolure+ 250 points/ha in oil palm in Goa, India



Faleiro JR, Al-Dandan AM, Raikar SP, Abdallah AB, Al-Abdullah I, Gadi AL, Oehlschlager AC, Calvo C (2016) Attract and kill technology to control red palm weevil: experiences on date palm in Saudi Arabia and oil palm in India 2nd Egyptian *Date Palm Festival* - SIWA ,Siwa ,Matruh, Egypt 27 - 29 October.

A & K Trial with Hook-RPW in Al-Qassim Saudi Arabia 10 ha

400 points / ha A&K vs 1 std trap/ha



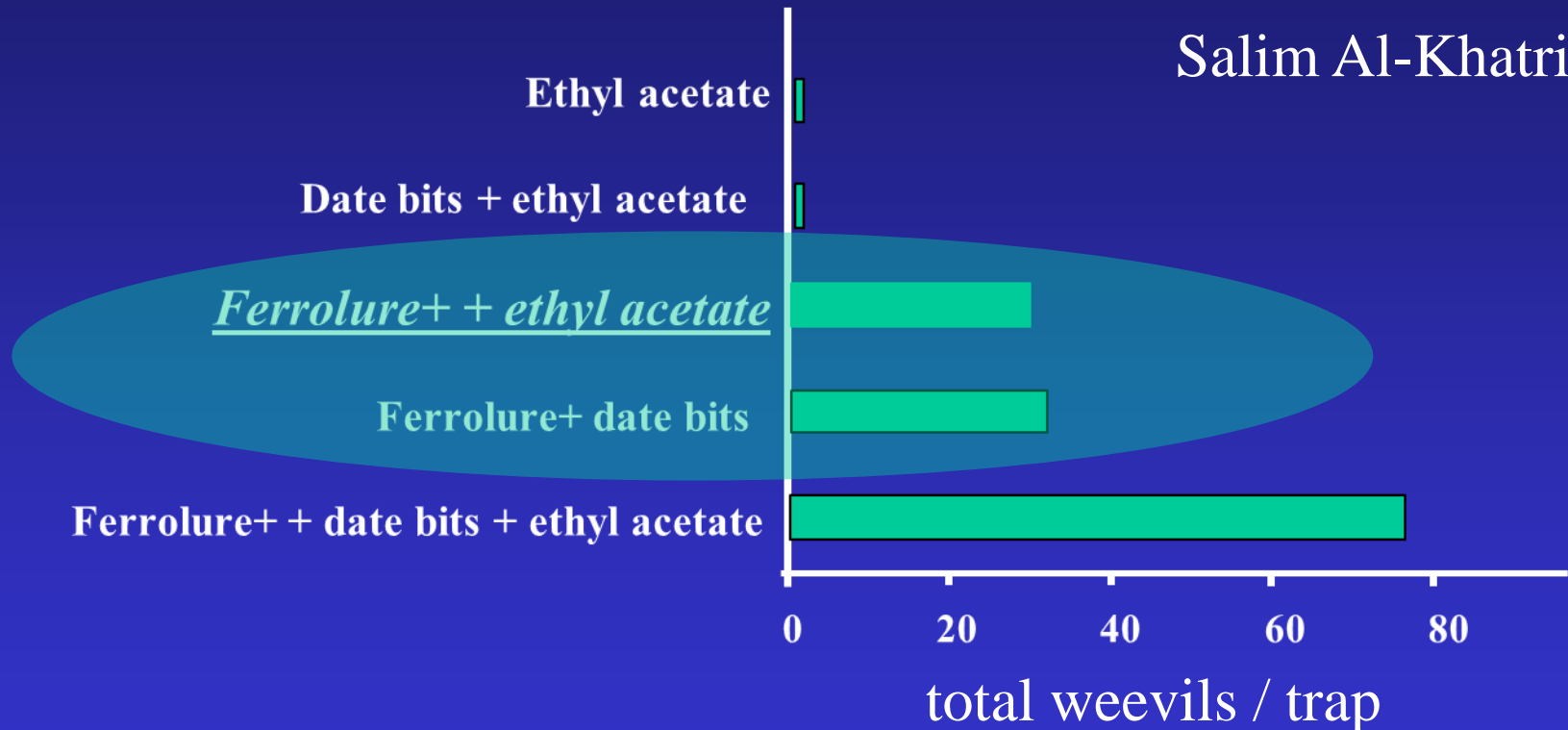
Slide from R Faleiro, SC HLM FAO Rome 2017

- Control 286 RPW in 10 pheromone+food traps
- A&K buckets (400) and palm dollops (3,600) = $209 \times 10 / 6 = 348$
- 10 A&K pheromone+food traps 80 A&K killed 62 more RPW

Serviceless traps

Synthetic co-attractants for RPW pheromone traps Oman May to September 2000

Salim Al-Khatri



Abdallah FF, Al-Khatri SA (2005) The effect of pheromone, kairomone and food bait on attracting males and females of red palm weevil in date palm plantations. Egypt J Agric Res 83: 169-177

Synthetic co-attractants for RPW pheromone traps Goa, India Dec 30 to Jan 13 (2 weeks)

Ethyl acetate only

Date bits only

Pheromone only

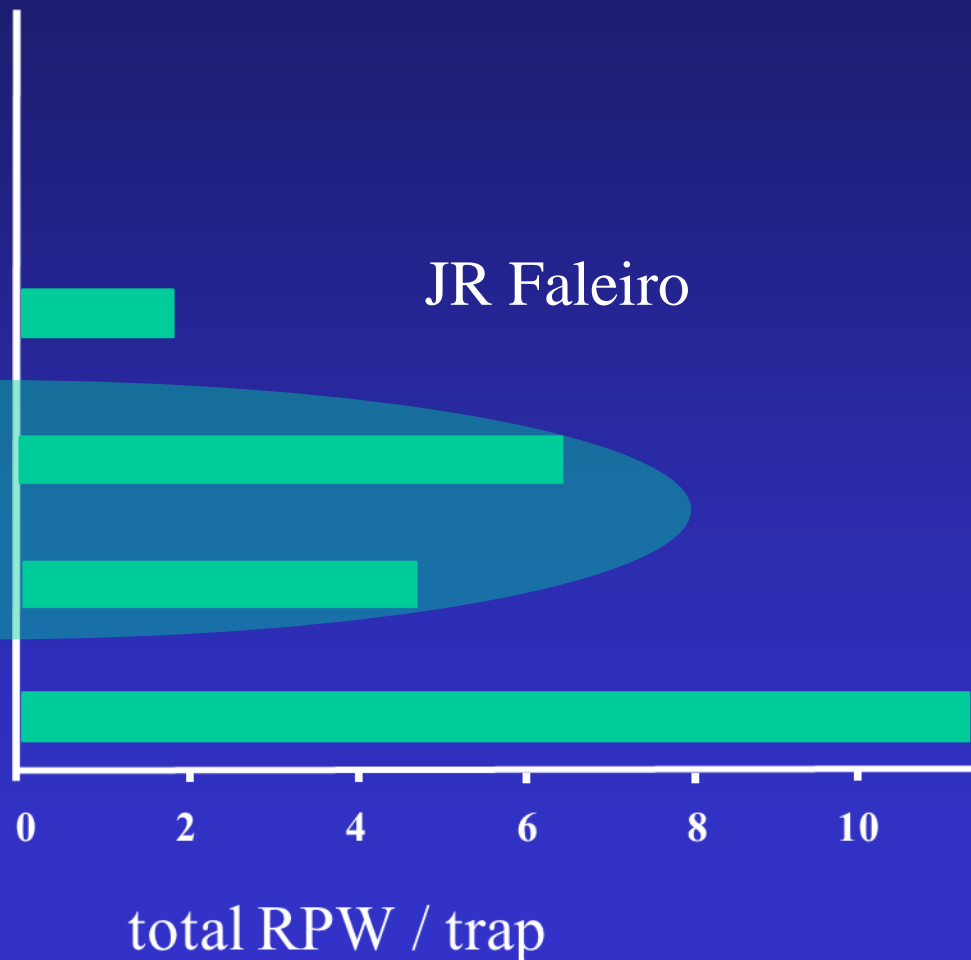
Date bits + ethyl acetate

Pheromone + ethyl acetate

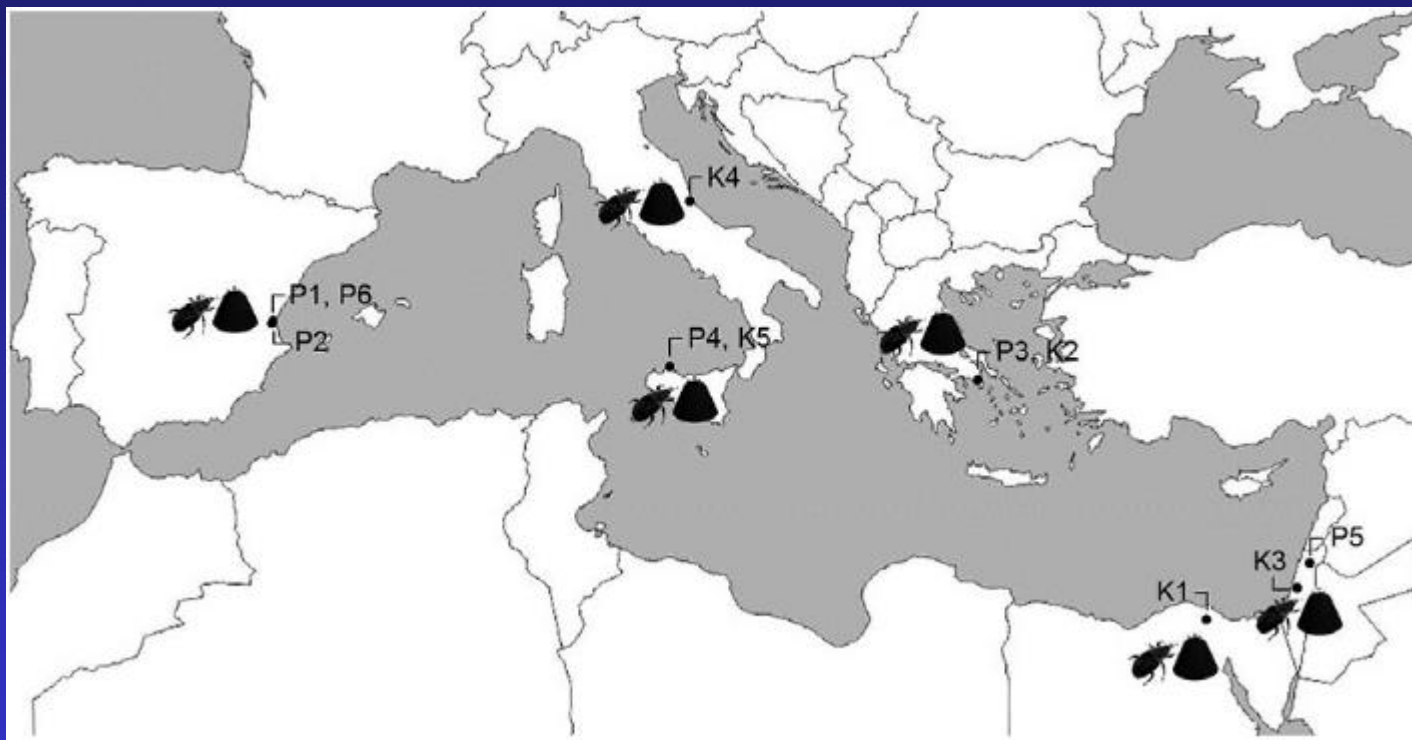
Pheromone + date bits

Pheromone + date bits + ethyl acetate

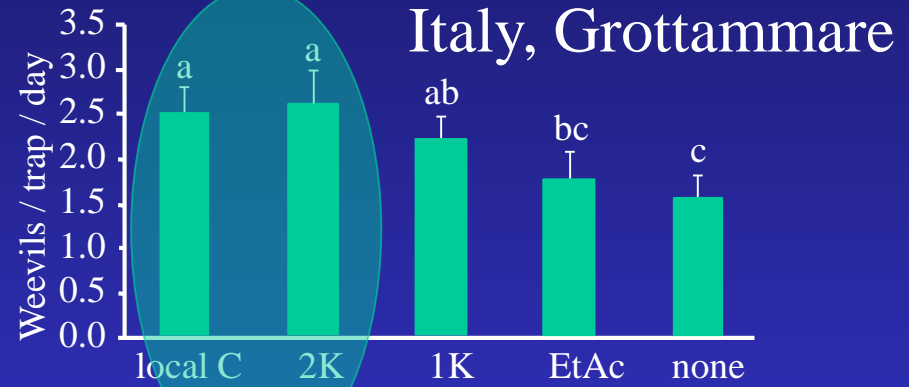
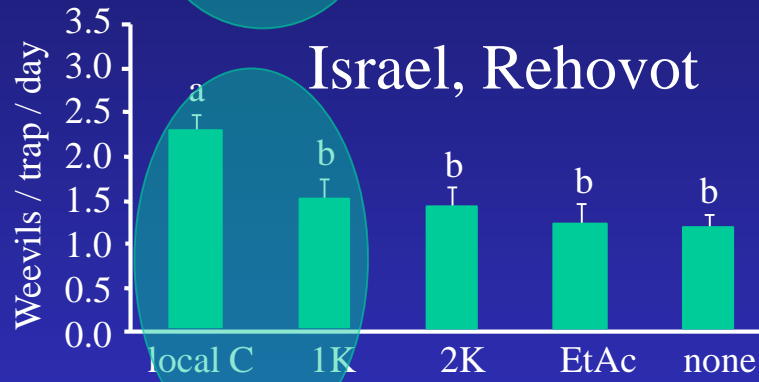
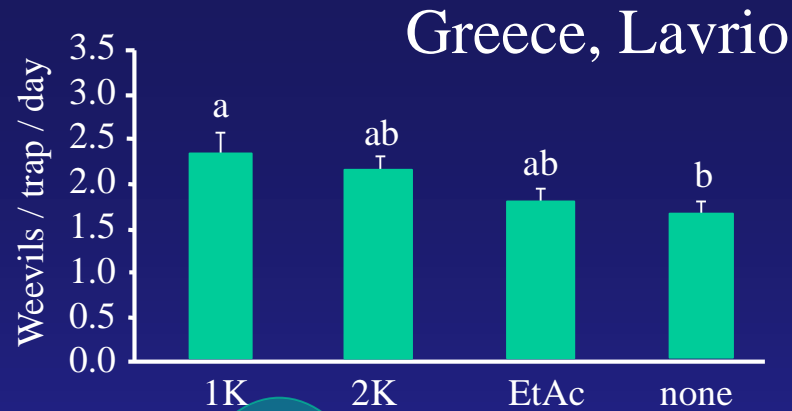
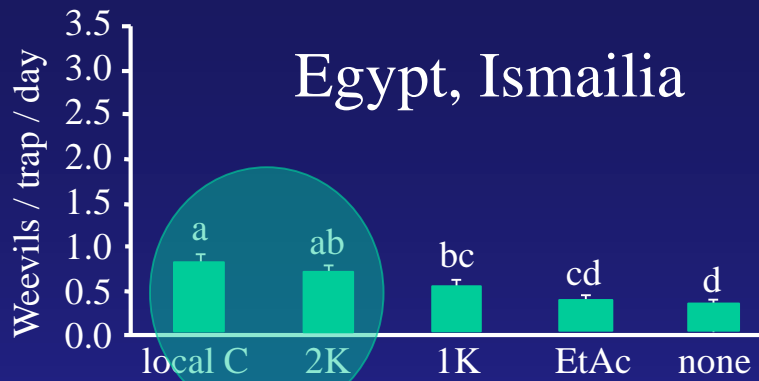
JR Faleiro



Synthetic co-attractants for RPW traps Europe & Middle East 2017



Sandra Vacas et al, 2017



Lures for red palm weevil trapping systems: aggregation pheromone and synthetic kairomone 2017 Sandra Vacas, Ourania Melita, Antonios Michaelakis, Panagiotis Milonas, Roxana Minuz, Paola Riolo, Mohamed Kamal Abbass, Paolo Lo Bue, Stefano Colazza, Ezio Peri, Victoria Soroker, Yaara Livne, Jaime Primo and Vicente Navarro-Llopis Pest management Science 73 (1) 223–231

Pheromone 3-5 mg/day optimal – no advantage to more.

Kairomone

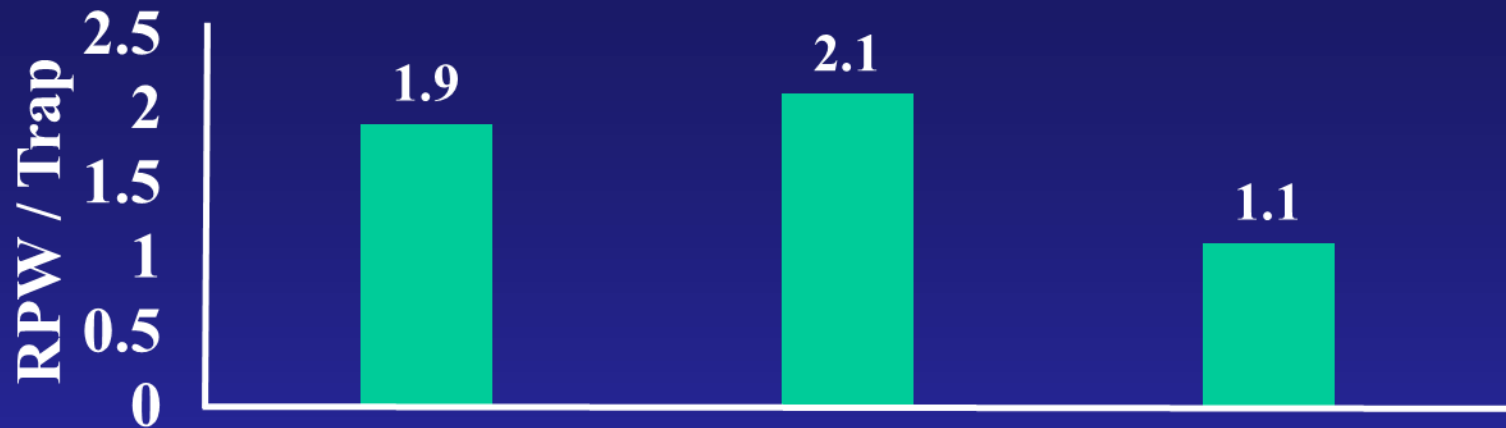
Ethyl acetate:ethanol 1:3 100 ml bottle with plastic cover to regulate release → 110-165 mg/day

Ethyl acetate 100 mL bottle → 316-623 mg/day

Picusan traps (water in base)



Test of serviceless trap in Saudi Arabia.
31 January - 20 February, 2016, Al Hassa, KSA
Dr. R. Faleiro, SC HLM, FAO Rome March 2017.

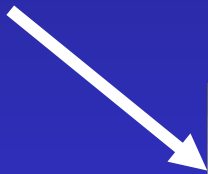


Electrap
Ferrolure+ &
ethyl acetate

Picusan
Ferrolure+ &
food

Standard
Saudi
ground trap

serviceless



Dr. Luigi Porcella
UAE First

Sansan Ag Eng,
Valencia

KSA Min Ag & Water

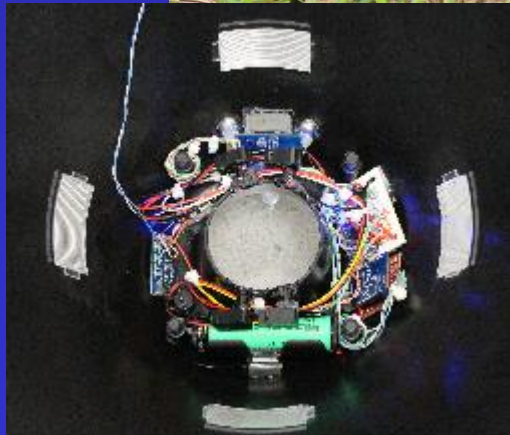
Serviceless trap



Electrap UAE
completely dry
no food or water

GPS SMART

SMART Serviceless Trap





Home sign-out

Signed-in as: pineappleFarmer

Farm: pacific shore farm

Zone: southeast



SMART
Serviceless traps

GPS data collection

data sent to cloud

data to

phone or computer

bait lasts months

solar powered

CONCLUSIONS

- Trapping lowers population at low trap density.
- Use of trapping is wide spread.
- Serviceless trap new tool.
- Trapping to be conducted with good phytosanitation.

