Back to Africa: understanding the biology and biological control of the coffee berry borer

Juliana Jaramillo-Salazar

Outline

Coffee Berry Borer (CBB)

Classical Biological Control approach

Other approaches
- Conservation approach
- Understanding the pest
- Understanding integrated control

Learning from others, sharing information, collaborating

Conclusions

Why is CBB so difficult to control?

Concealed lifestyle

For conventional control, narrow application window

For biological control, implies few natural enemies

High reproductive & survival potential

Insecticide resistance

Low economic threshold which affects quality and quantity

Because pest & its system still poorly understood

Why back to Africa?

Highest numbers of specialized natural enemies in centre of origin – co-evolution

CBB less of a problem in Africa than in new distribution areas

Possibly natural enemies one important factor

We know some of them, but do we know ALL?

What are other factors?

The answers in Africa?

Photo: www.coffeesandteas.com

Outline

Coffee Berry Borer (CBB)

Classical Biological Control approach

Other approaches
- Conservation approach
- Understanding the pest
- Understanding integrated control

Learning from others

Conclusions

Classical Biological Control

Explorations for specialized natural enemies in area of origin & introduction into new areas

Establishment & high impact expected

In some cases approach has been phenomenally successful, e.g. cassava mealybug, water hyacinths, cottony cushion scale etc.

HOWEVER, concealed pests and beetles have in general comparatively lower success rates in classical biological control

Outcome of introductions in the Americas

Parasitoids became established in the field but control levels disappointing (ca. 5% for *P. nasuta* & *C. stephanoderis*)

It is worth looking for new natural enemies of CBB

Aphanogmus sp.

Karnyothrips flavipes

A 24 month study in western Kenya discovered a hyperparsitoid of *P. nasuta*

AND more important a potentially specialized predator of CBB, the thrips *Karnyothrips flavipes*

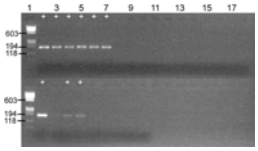
Real possibility that Africa harbours even more promising natural enemies of CBB

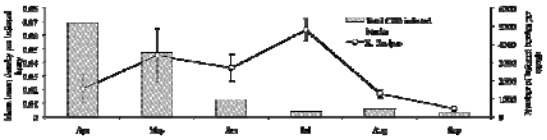
Worth pursuing, BUT would require to study the system over several fruiting periods rather than surveying it only once

Jaramillo & Vega 2009 Biocontrol, Science and Technology
Jaramillo et al., unpublished data

The new natural enemy

Karnyothrips flavipes





Outline

Coffee Berry Borer (CBB)

Classical Biological Control approach

Other approaches
- Understanding integrated control
Understanding the pest

Learning from others

Conclusions

Understanding integrated control

Biological Control

Parasitoids became established in the field but control levels disappointing

Cultural Control

Crop sanitation:

1. Invading CBB females do not find suitable berries to attack
2. Dry berries harbouring CBB removed - pest numbers reduced

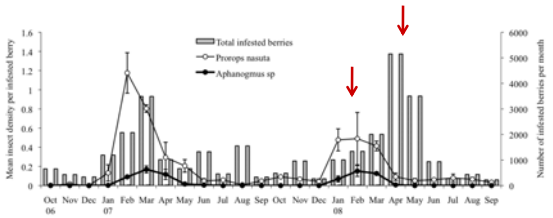
Understanding integrated control

	Trees	Ground
	333 specimens	10,409 specimens
P. nasuta	71.5%	82.2%
Aphanogmus sp.	1.2%	12.7%
"Sample 57"	24%	4.4%
P. coffea	0.3%	0.1%
C. stephanoderis	0.3%	<0.1%
		0.1%
		0.1%
	32,780 berries	**36,729 berries**

Jaramillo et al., 2009 Biological Control (in press)

Effect of crop sanitation on CBB infested

Dynamics of CBB, *P. nasuta*



Jaramillo et al., 2009 Biological Control (in press)

Learning from others: Use mass-emergence

Augmentorium

Kehrli *et al.*, 2005

Two complementary control techniques: direct pest reduction & conservation of natural enemies

Screened-enclosure in which all infested berries collected from the field are placed

Screen material prevents escape of CBB, but allows that of parasitoids

Minimizing negative effects of crop sanitation on natural enemies

Outline

Coffee Berry Borer (CBB)

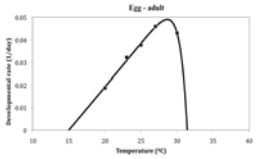
Classical Biological Control approach

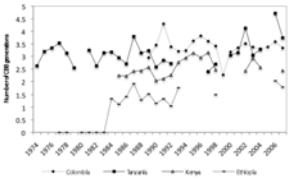
Other approaches
- Understanding integrated control
- Understanding the pest

Learning from others

Conclusions

Understanding the pest: Climate change & CBB





Basic biology of CBB

Small increases in temperature may lead to higher numbers of CBB generations/ year

Higher increases may lead to shifts in distribution range (latitude & altitude)

Introduction of shade trees in coffee plantations might alleviate negative effects of climate change on coffee production

Jaramillo et al., unpublished data

Conclusions

Prorops nasuta is the most important parasitoid of CBB in western Kenya

Infested 'fallen' coffee berries very important reservoir for natural enemies

Consequently crop sanitation may greatly affect impact of parasitoids on CBB

Mass-emergence devices a potential solution

Conclusions

'New' natural enemies of CBB can still be found in Africa

Climate change (global warming) may affect distribution & pest status of CBB

Fitness of CBB can increase with small rises in temperature; sun grown coffee possibly most affected

Acknowledgements

German Research Foundation – DFG

International Centre of Insect Physiology and Ecology – *icipe*

Taxonomist at the Systematic Entomology Laboratory (USDA, ARS)

Fernando E. Vega (USDA, ARS)

James D. Harwood & Eric Chapman (University of Kentucky)

Photos:
CENICAFE
Georg Georgen (IITA)
USDA, ARS
Juliana Jaramillo

THANK YOU

What to do?

Looking for new natural enemies in Africa & understanding the reasons for the lack of success of the existing ones

↓

Classical biological control should not be ruled out at this moment

Emphasis on integrated control & conservation

↓

Integration of several natural enemies and control strategies: the sum of the parts may be better than the "magic bullet"

Understanding CBB's biology and ecology in its area of origin

A meta-analysis of the CBB?
What do we know already?
What is the quality of the existing data?
What we do not know?
What should we know?