IPM Intervention in Benin: Cowpea Farmers' Preferences for Biological versus Chemical Pest Control Strategies for Maruca vitrata

Michael Agyekum
with Cynthia Donovan and Frank Lupi

Feed the Future Legume Innovation Lab
Michigan State University
in collaboration with
International Institute of Tropical Agriculture (IITA) and
University of Illinois, Urbana Champaign (UIUC)

03/02/2016

Introduction

Cowpea is a key food staple in West Africa but insect pests, especially legume pod borer (*Maruca vitrata),* cause 50-80% yield loss. Chemical pesticides are most common defense used.

The pest and damage

One of pesticides used by farmers in Benin

Existing pest control method in Benin involves broad spectrum chemicals classified by WHO (2009) as highly or moderately hazardous

Concerns with existing chemical
pest control methods

- Cost
- Pest resistance
- Health and environmental
  issues

Our research evaluates, from a farmer perspective, the following options:

Biocontrol agents (parasitoids)
Botanical biopesticides
Botanical biopesticides +virus

Objectives of the research

- To determine farmers' preferences for the biocontrol strategy (parasitoids + neem oil biopesticides + virus) compared to existing chemical methods

- To understand key factors that may influence farmers' decision to switch pest control strategies

- To analyze farmers' awareness of adverse health and environmental effects of existing chemical control methods

Random Utility Theory and Discrete Choice Experiment

- In a discrete choice problem, an individual i derives utility U from attributes Z of a chosen alternative j as follows:

$$U_{ij} = V(Z_j, X_i) + \varepsilon_{ij} \qquad\qquad (1)$$

where X is the decision maker's own characteristics (e.g. age, income), and ε is an error term

- Researchers observe the probability of individual i choosing alternative j because utility is not directly observable due to its stochastic component

- We designed and implemented a choice experiment, and resulting data estimated using logit model

Study Areas and Sampling Procedure

- Benin is stratified into 3 zones: South, Center, and North

- 12 study areas: 4 in each zone (map)

- 2 villages randomly selected from each study area

- Sample size: 505 households

- Face-to-face interviews with household member responsible for cowpea prodn decisions using tablets with ODK software
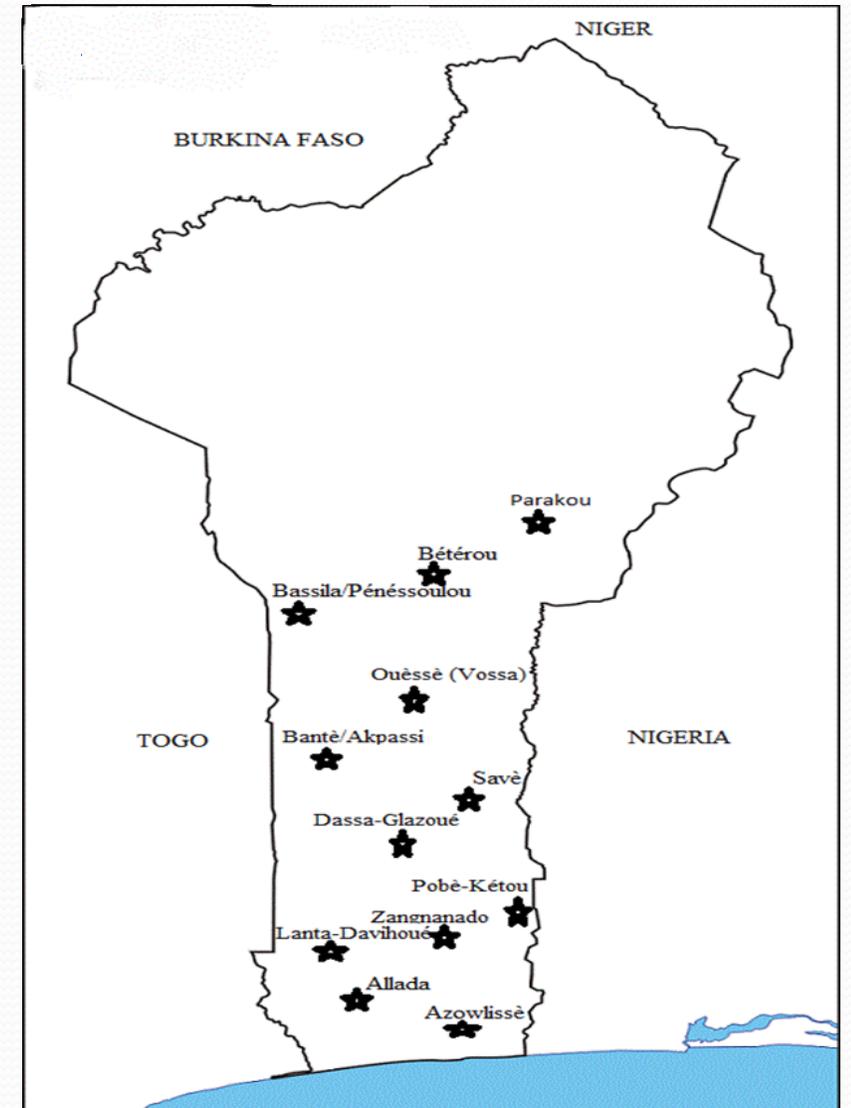
Map of Benin Showing Study Areas

Source: Biocontrol Unit, IITA-Benin, 2015

Table 1. Characteristics of smallholder cowpea production in Benin

Characteristics	
Cowpea farms:	
Land size for cowpea production (ha)	0.5
Cowpea grain yield (kg/ha)	320
Pest management:	
Application of chemical pesticides on cowpea crops (% yes)	88
Chemicals on other crops? (% yes)	14
How volume of pesticide use compare to previous years (% lower):	5
Share of grain yield value allocated to cowpea pest control (%)	6.3
Source: Survey Data, 2015.	

Table 2. Characteristics of smallholder cowpea production in Benin cont'd

Characteristics	
Chemical hazard awareness, and exposure to toxic pesticides:	
Do you think pesticides are harmful to people? (% yes)	93
Knows color label identifying most toxic pesticides (% yes)	11
Does household use gloves during spraying? (% yes)	25
Use face/nose mask to apply pesticides? (% yes)	24
Clothes/skin wet with pesticides after spraying? (% yes)	71
Any skin irritation incidents after spraying? (% yes)	73
Cases of eye irritation after spraying? (% yes)	57
Has anyone you know been sick due to pesticide poisoning? (% yes)	45
Awareness of beneficial insects:	
Farmer's awareness of beneficial insects (% yes)	9

Source: Survey Data, 2015.

Description of Choice Experiment

- Biocontrol program was introduced to farmers with prepared scripts

  - Biocontrol agents
  - Neem oil biopesticides
  - Virus combined with neem oil biopesticide

- Farmer's existing pest control method was identified

- Each farmer given a choice between existing and biocontrol options where biocontrol was known to be better for health but may have higher yield loss, higher cost for product and greater labor need for application.

- Example: Biocontrol costs 1000 FCFA more, has 10% higher yield loss and 3 extra days of labor. Which does the farmer choose?

Description of Choice Experiment cont'd

Table 3. Pest control attributes and levels used in the survey

Attributes	Levels
Cost of neem oil (FCFA)	1000, 3000, 5000
Labor for biopesticide application (days)	1, 3, 5
Yield Loss (%)	0, 10, 20

Note: Attribute values are relative to those experienced by farmers in their existing pest control method.

Exchange rate: FCFA 1000 = US$ 1.60

Source: Survey Data, 2015

Dep. variable is binary where biocontrol=1 and chemical=0

Results not shown here are gender, household size, land ownership, land size, existing yield, existing labor input, and existing costs of pesticides

Table 5. Estimation of farmers' preferences for the biocontrol strategy

(Dep. variable=biocontrol method)	Marginal effects
Yield loss (%)	-0.02***
	(0.002)
Labor (days)	-0.02**
	(0.01)
Cost (CFA 1,000)	-0.04***
	(0.01)
Faced severe pest damage in the past	-0.20***
	(0.06)
Young age group	0.10*
	(0.05)
No formal education group	-0.08
	(0.06)
Participated in pest mgt programs	0.14**
	(0.07)
Expenditure (CFA 10,000/hh member)	0.01
	(0.004)
Existing no. of spraying per season	0.05***
	(0.02)
Observations	567
Pseudo R^2	0.3

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Dep. variable is binary where biocontrol=1 and chemical=0

One other important factor explored is possible social influences on adoption

Table 6. Neighbors' influence on preferences for the biocontrol method

(Dep. variable=biocontrol method)	Marginal effects
50% of neighbors practising biocontrol	0.08^{**}
	(0.04)
75% of neighbors practising biocontrol	0.27^{***}
	(0.04)
Faced severe pest damage in the past	0.02
	(0.05)
Males	0.03
	(0.05)
Young age group	0.03
	(0.05)
No formal education group	-0.08
	(0.05)
Participated in pest mgt programs	-0.01
	(0.07)
Labor for existing control method (days)	0.04*
	(0.02)
Cost of existing control method (CFA 1,000)	-0.01
	(0.01)
Observations	322
Pseudo R^2	0.2

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Conclusion

- Cowpea farmers in Benin are aware of health hazards from chemical pesticides but continue to use out of necessity; no reliable pest control alternatives

- Survey results indicate that over 6% of the market value of harvested cowpea grains is allocated to purchasing chemicals for pest control. For resource-constrained farm households, this cash expenditure is nontrivial

- Cowpea farmers prefer pest control methods that are less costly, require lower labor input, and are associated with minimal yield loss due to pests attack

- Preferences for the biological pest control strategy are fairly uniform across Benin (less heterogeneity among farmers given that factors such as household size, gender, education, and income level do not affect pest control decisions)

- Social influences may be important in that increased community participation in the biocontrol program enhances other farmers' likelihood of adoption. This provides further support that promotion campaigns would improve adoption of the biocontrol program

- Relative to existing pest control methods, we presented 'worst-case' biocontrol scenarios to farmers in the decision experiment. Having used conservative values (for potential yield loss, labor input, and cost of biopesticides), we argue that the biocontrol strategy will be widely accepted

Next Steps

- Compare characteristics of cowpea farmers in Benin & other West African countries such as Burkina Faso, Nigeria, Niger, and Ghana

- Estimate potential impact of the biocontrol program on farm household income generated from cowpea production

Acknowledgment

This project is funded by Bill & Melinda Gates Foundation (BMGF)

Disclaimer:

Opinions expressed in this document are those of the authors and do not represent BMGF, MSU, IITA, and UIUC