

## **HPR-BASED BIODIVERSIFIED APPROACH TO FARMING:**

### **Reducing Insect Pests and Other Environmental Benefits**

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**CROP SCIENCE CLUSTER – INSTITUTE OF PLANT BREEDING**



## **OUTLINE**

1. Why this topic
2. Painter's Host Plant Resistance; HPR at IPB
3. No weeds policy at IPB
4. Ecological considerations (Tropical HPR) in debate with Dr. Jun Lit
5. Effects of other biotic and abiotic stresses,  
(my graduate work on Ultraviolet-B and flavonoids)
6. Biodiversity - sources of resistance, Eggplant
7. Hard data as insisted by Dr. Vic Gapud
8. Still no funding for basic research on PM in mixed culture in the Philippines (Fukuoka, Altieri...)

## OUTLINE

1. Why this topic
2. Painter's Host Plant Resistance vs HPR at IPB
3. No weeds policy at IPB (floor weaved)
4. Ecological considerations (Tropical HPR) in debate with Dr. Jun Lit
5. Biodiversity - Eggplant
6. The "halo-halo/sagul-sagul/aglala-uk" approach - bahay-kubo

9. The biodiversified approach-Philippine style:  
"halo-halo/sagul-sagul/aglala-uk" approach - bahay-kubo
10. "Gumamela, lemon grass, cosmos, saluyot"
11. "Don't feed the plant, feed the soil"  
Try Trichoderma suggested by Dr. Gie Cuevas
12. "Enhance the soil, biodiversify, let others grow and live  
(weeds) = Reduced pests, consumer friendly, increased  
income, farmer's safety,  
environmentally sound
13. There is HOPE - 'back to basics' farming  
(FUNDING for basic research on pests under halo-  
halo/bahaykubo farming)
14. BahayKubo folksong/Wolf Robe famous line

## WHY THIS TOPIC

Where do I begin.... To tell a story.....

the challenge to prove that mixed cropping (halo-  
halo sagul-sagul bahay-kubo farming)  
can help reduce/regulate insect pest population...  
can increase biodiversity... that weeds have roles  
to play... that soil can be improved... etc etc etc

The unfolding of events and experiences in field  
experiments and direct exchanges of ideas with  
farmers...

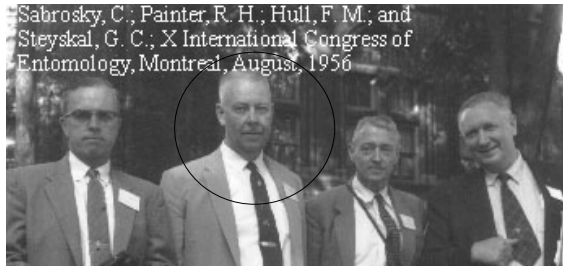
a participatory approach to scientific inquiry

## HOST PLANT RESISTANCE



Dr. Charles V. Riley - grapes resistant to *Phylloxera*, 1860s

Dr. Reginald H. Painter -  
Father of HPR, 1960's



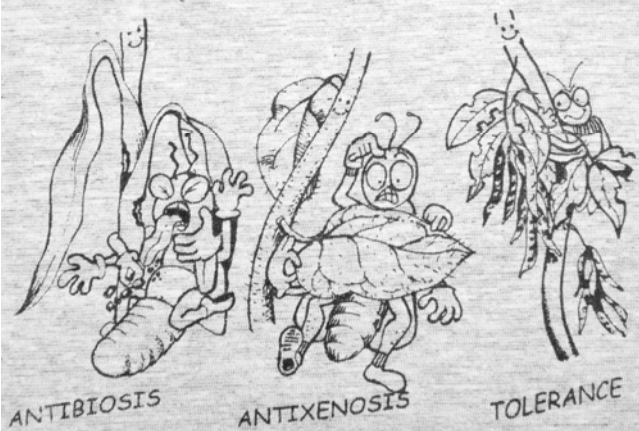
HPR - Plant defenses against herbivory.

Resistance of the plants to insect attack is the relative amount of heritable qualities possessed by the plant which influence the ultimate degree of damage done by the insect.

## HOST PLANT RESISTANCE



**INSTITUTE OF PLANT BREEDING  
ENTOMOLOGY LABORATORY**



AND NO INSECTICIDE SPRAYING



No weeds policy at IPB ('clean' culture)  
during resistance screening



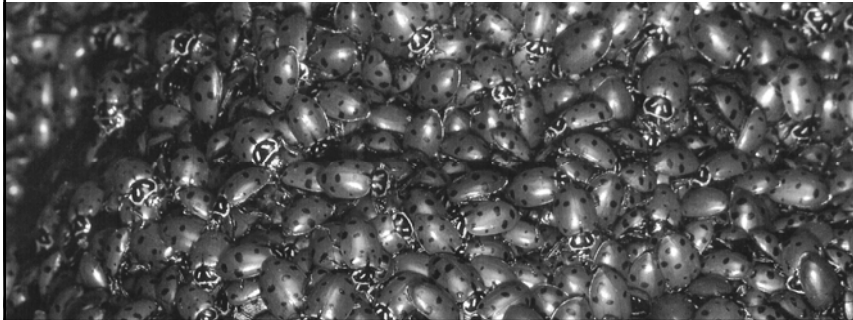
## FROM CONVENTIONAL TO ECOLOGICAL HPR

◉ MY EXPERIENCES AND FURTHER LEARNING  
SHAPED MY POINT OF VIEW ...

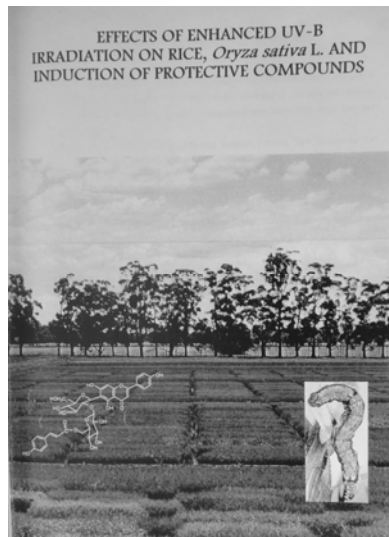
- ◉ Rethinking starts -
  - Man vs. Nature or
  - Man as part of Nature or
  - Man working with Nature ?

## ECOLOGICAL PRINCIPLES / CONSIDERATIONS

- Everything in the biosphere is interrelated, interconnected and interdependent.
- Most of the earth's resources are finite.
- There is no free lunch in nature.
- Biodiversity is nature's insurance against a continuously changing environment.
- Every environment has its own carrying capacity.
- Stewardship.



## IMPACT OF BIOTIC, ABIOTIC STRESSES ON PLANTS -



Effects of UV-B irradiated rice and specific flavonoids on the growth and development of three lepidopterous insect pests

THE IMPORTANT ROLE OF SECONDARY METABOLITES IN HOST PLANT RESISTANCE

MCLit1997 Effects of Enhanced UV-B Irradiation on Rice, *Oryza sativa* L. and Induction of Protective Compounds. PhD Dissertation Australian National University, Canberra.

## LOOKING AT THE TROPICS

-very different from the temperate regions

PARAMETERS	TROPICS	TEMPERATE
Cropping systems	variable	uniform
Farm size per farmer	small (2-3 ha)	large (usually >20 acres)
Farming community pattern	Not contiguous	Contiguous
Cropping pattern	variable (1-3)	Uniform
Availability of buffer zones	More buffer zones (i.e. small farms usually bordered by weeds and other crops)	Less buffer zones (only around the periphery of big farms)
Corn varieties	Diverse (Native/OPs)	Uniform (Hybrids/Bt-corn)
Choice of seed or variety	Variable	Mostly for feeds
Date of Planting	asynchronous	Synchronous
Labor-machinery needs	Labor-intensive	mechanized
Associated flora and fauna	Highly diverse	Much less diverse
Climate	Rainy and sunny (wet and dry, often not really distinct in many subregions)	Distinct seasonal variation (four seasons)

**LOOKING AT THE TROPICAL Asian Corn Borer**  
- very different from European Corn Borer

	Tropics <i>Ostrinia furnacalis</i> (Guenée)	Temperate <i>Ostrinia nubilalis</i> (Hubner)
Life cycle: egg-adult	shorter	longer
Life cycle break	virtually inexistent	pupae overwinter
Population <b>growth</b> break	during lag periods	winter and lag periods
Generation cycle/year	>8	>2
Generational succession	overlapping	first generation, second generation
Dispersal or migration flight distance record	unknown	¼ - ½ mi
Mating – flight pattern	unknown	adults fly a lot, mate outside field

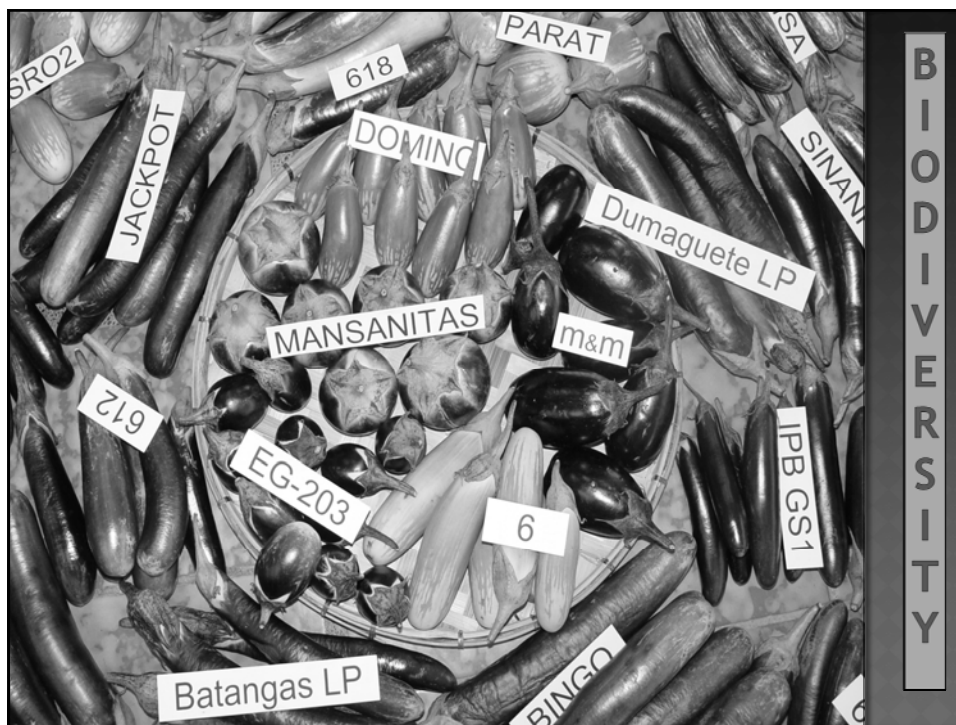
This will tell us that we really cannot apply a “one-size-fits-all” approach and merely adopt principles/concepts from other countries.

## BIODIVERSITY

- Everything in the biosphere is interrelated, interconnected and interdependent.
- Biodiversity is nature’s insurance against a continuously changing environment.

◎ 3 LEVELS OF BIODIVERSITY

Genetic  
Species  
Ecosystem or habitat







## PROJECTS ON EGGPLANT HPR

Host plant resistance of eggplant, *Solanum melongena* L. to the leafhopper, *Amrasca biguttula* (Ishida), and the eggplant borer, *Leucinodes orbonalis* Guenee: Resistance screening of farmer's and commercial varieties of eggplant against leafhopper. Jan 1998 -Sept 1999 (PhilRice - Munoz, Nueva Ecija)

IPM-CRSP-PhilRice-UPLB

Identification of eggplant varieties resistant against leafhopper, shoot/fruitborer, thrips, phomopsis blight and bacterial wilt. Oct 1999 -Nov 2004 (IPB, UPLB College, Laguna)

DA-BAR

Combined resistance of eggplant to the cotton leafhopper and the eggplant shoot and fruit borer. Oct 1999 -Dec 2004

IPM-CRSP - PhilRice (Pangasinan, Nueva Ecija, Laguna)

Evaluation of the performance of selected cultivars with resistance to the eggplant shoot/fruit borer, leafhopper and bacterial wilt in farmers' fields". July 2005 - Dec 31, 2006

PhilRice- IPM-CRSP (Balete, Batangas)

**HARD DATA - IF YOU WANT TO PROBE SOMETHING  
SHOW REAL NUMBERS  
(DR GAPUD'S CHALLENGE)**

**STILL NO FUNDING FOR BASIC RESEARCH**

**(FEW REFERENCES FROM FUKUOKA, ALTIERI, ETC...)**

**To gather evidence and come up with hard data.....**

**Continued to conduct observations and small experiments.....  
Incorporated in the HPR trial or make small expt beside the  
experimental plots**

**The unwanted weeds...**

## DIVERSIFIED VS. MONOCULTURE FARMING

- ◉ Simplified virtual monocultural ecosystems in which our crops, commercial forest trees & our livestock are grown create dense aggregations of predictably available resources
  - encourage proliferation of specialists & some generalist insects
  - natural enemies generally require more diverse habitat or food resources; they are discouraged from agro-monocultures

- Gullan & Cranston (2000)

**Several explanations neither can solely satisfactorily explain the abundance of natural enemies and generally fewer pests in polyculture**

**Natural Enemies Hypothesis or simply  
Enemies Hypothesis  
Resource Concentration Hypothesis  
Plant Apparency Hypothesis  
Etc.**

**NE Hypothesis – NE are expected to be more abundant in polycultures, and therefore more effectively suppress herbivore pest population densities than monoculture (Root 1973)**

**Resource Concentration/Plant Apparency Hypotheses – many herbivores are more likely to find and remain on hosts that are growing in dense or nearby pure stands and which are providing concentrated resources and monotonous physical conditions (Root 1973).**

**Neither the NE hypothesis, RC or trap cropping has been shown consistently how an arthropod can behave in a mixed cropping system (Capinera 2008)**

**Hypotheses not mutually exclusive, there is some support for each one (Gullan & Cranston 2010).**

**Habitat management is a form of conservation biocontrol, it is a ecologically based approach aimed at favoring NE and enhancing biocon in agroecosystems. Goal – to create a suitable ecological infrastructure within the agricultrual landscape to provide resources such as food for adult NE, alternative prey or host, and shelter from adverse conditions (Landis et al 2000)**

**In no tillage plots, stuble and weeds likely provided shade, reduce wind speed, alternte food, higher humidity, lower temperature for natural enemies (Tonhasca 1993)**

#### **Weeds....**

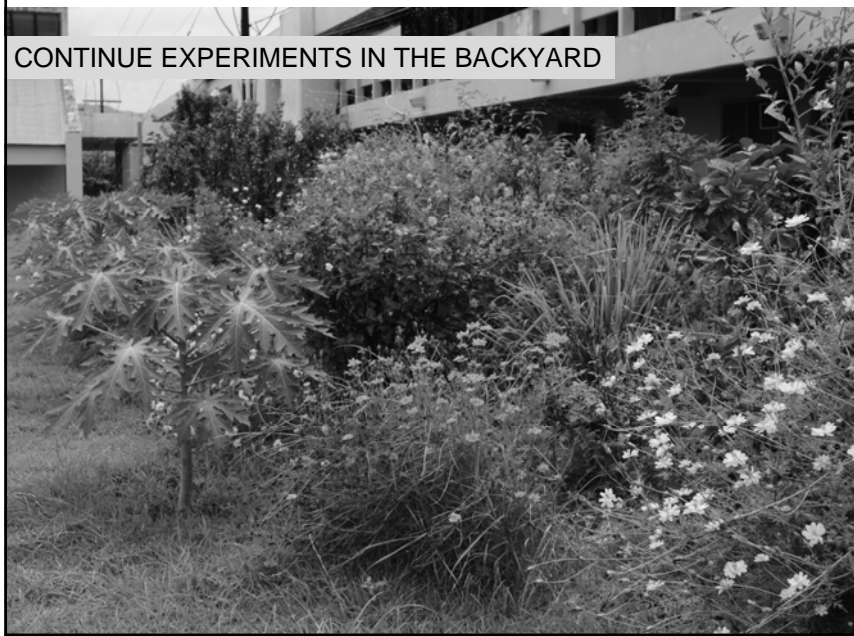
**Biodiversity is a salient feature in agriculture... vegetation management has to be used effectively as a primary IPM tactic in small scale sustainable agriculture. Selective or relaxed weeding ... Weeds serving useful purpose for food medicine, ceremonial materials, teas, soil improvers (Altieri 1993).**

**Weeds that repel pests or weeds that attract natural enemies (Litsinger et al 1980)**

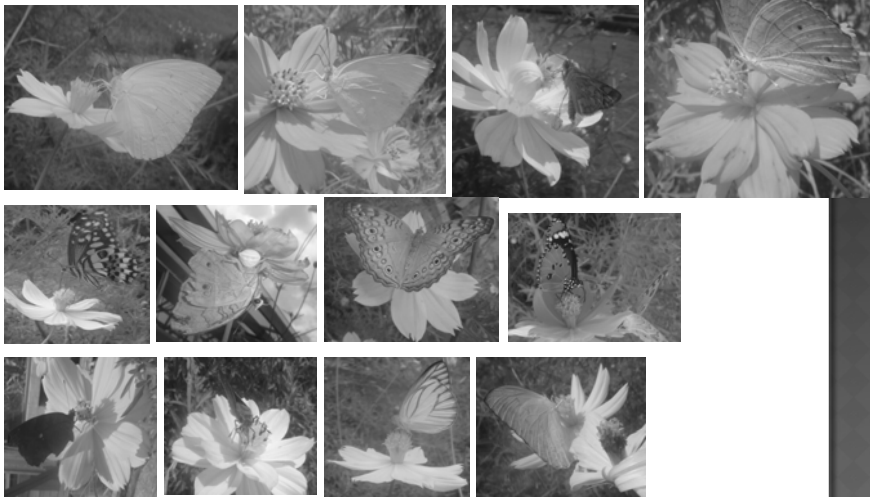
2YEARS AGO..

“GUMAMELA, LEMON GRASS, COSMOS, SALUYOT” AGAINST FLEA BEETLE

CONTINUE EXPERIMENTS IN THE BACKYARD



## INCREASED BIODIVERSITY



Generally for all arthropods -

## TOTAL BIODIVERSITY

- ◉ Increased arthropod diversity in a biodiversified crop environment however should consider not only the aboveground biota
- ◉ It should also put emphasis on below-ground flora (including microflora) and fauna

## “DON'T FEED THE PLANT, FEED THE SOIL”

- ◉ An environmental-friendly approach to soil management....
- ◉ Dr. Virginia C. Cuevas - Trichoderma
- ◉ Dr. Jocelyn T. Zarate - Biofertilizers
- ◉ Involvement to confirm the biopesticidal or similar effects of applying Trichoderma, a compost activator & endosymbiont

## TRY TRICHODERMA - WILL COMPLETE THE WHOLE



## “BIODIVERSIFIED FARMING

Nicknames = halo-halo

sagul-sagul

aglala-uk

chopsuey

pinakbet

bahay-kubo

An alternative to conventional pest management



## THE FORMULA

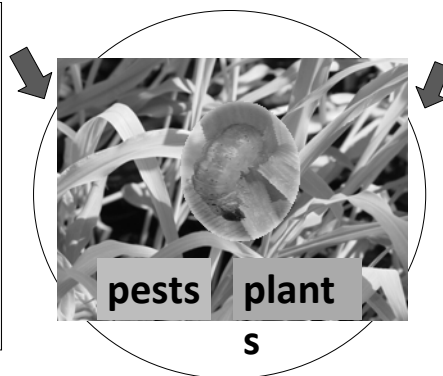
“Enhance the soil, biodiversify, let others grow and live (weeds, other plants, livestock) =  
Reduced pests, consumer friendly, increased income, farmer’s safety, environmentally sound, climate change-ready

- ◉ There is HOPE - ‘back to basics farming’
- ◉ Especially in this time of climate change

## CONCEPTUAL FRAMEWORK - MIXED FARMING

### BIOTIC FACTORS

- VEGETATION
  - .other crops
  - .weeds
- Non-targets
  - .Other organisms
- Farmers



### ABIOTIC FACTORS


- Climate/
- Weather
- Soil fertility
- Landscape
- Farming Practices

Integrated Crop Management  
**FARMING SYSTEMS**

Wolf Robe in  
June 1909

Only  
when the  
last tree  
has died  
and the last river  
been poisoned and  
the last fish been  
caught will we  
realise we cannot  
eat money.

*Cree Indian saying*



“BAHAY KUBO” ... kahit munti  
Ang halaman doon ay sari-sari  
Singkamas at talong

