



Agricultural Biodiversity and Plant Defense: The Potential of Varietal Mixtures for Insect Pest Management

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Objective

Literature review on the potential of varietal mixtures for insect pest management to decrease:

- ✓ yield losses
- ✓ genetic vulnerability

A. Introduction

A1. Crop monocultures-the challenge:

- ✓ a prevailing global change of the 20st Century
- ✓ advantage: uniformity in harvest maturity & mechanization of agricultural operations
- ✓ disadvantage: uniform susceptibility to insect pests and plant pathogens



Figure 1. Large monoculture in the United States. Source: Bee informed

A2. Integrated Pest Management:

Coordinated approach which integrates various pest management methods, such as arthropod-resistant cultivars, biological control agents and chemical pesticides, to keep pest damage below an economic threshold

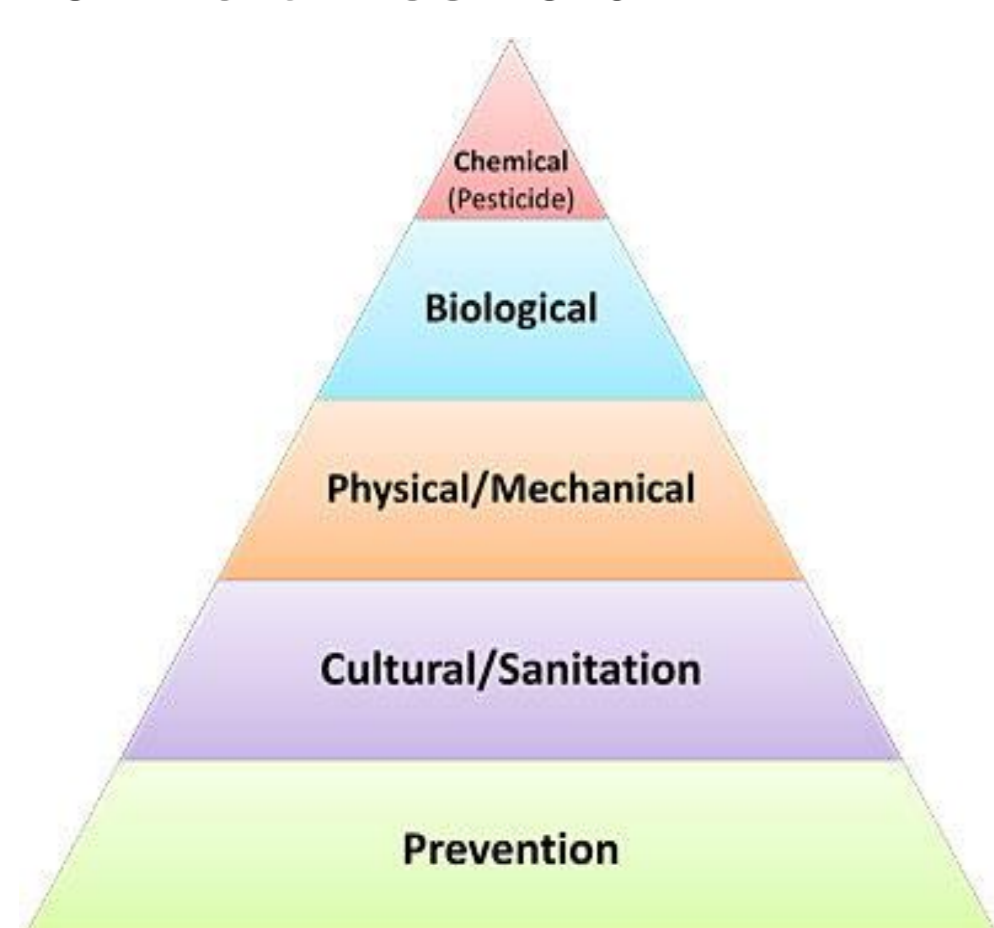


Figure 2. The underlying principle of IPM. Source: <http://www.agunlimited.com/consulting-ipm.html>

Conclusions

- ✓ **Varietal mixtures:** a potentially **viable additional strategy** within an insect pest management scheme
- ✓ Suitable **for pesticide-free, low-input systems**
- ✓ **More research** is needed on their added value for natural enemy attraction and insect pest repulsion

A3. Varietal mixtures:

- ✓ mixtures of different cultivars grown together
- ✓ low-cost strategy that can reduce damage caused by plant diseases
- ✓ shown to harbor smaller populations of insect pests
- ✓ widespread tactic among small-holder farmers in developing countries



Figure 3. Young farmer in front of diverse crop field in India. Source: Bioversity International/ C.Zanzanaini



Figure 4. Common bean varieties in Ecuador. Source: Bioversity International/J.Cornel

A4. Volatile Organic Compounds (VOCs) in plant defense against insect herbivores:

- ✓ are released by plants especially after herbivore attack
- ✓ attract the insects' natural enemies (insect predators and parasitoids)
- ✓ directly repel insect herbivores

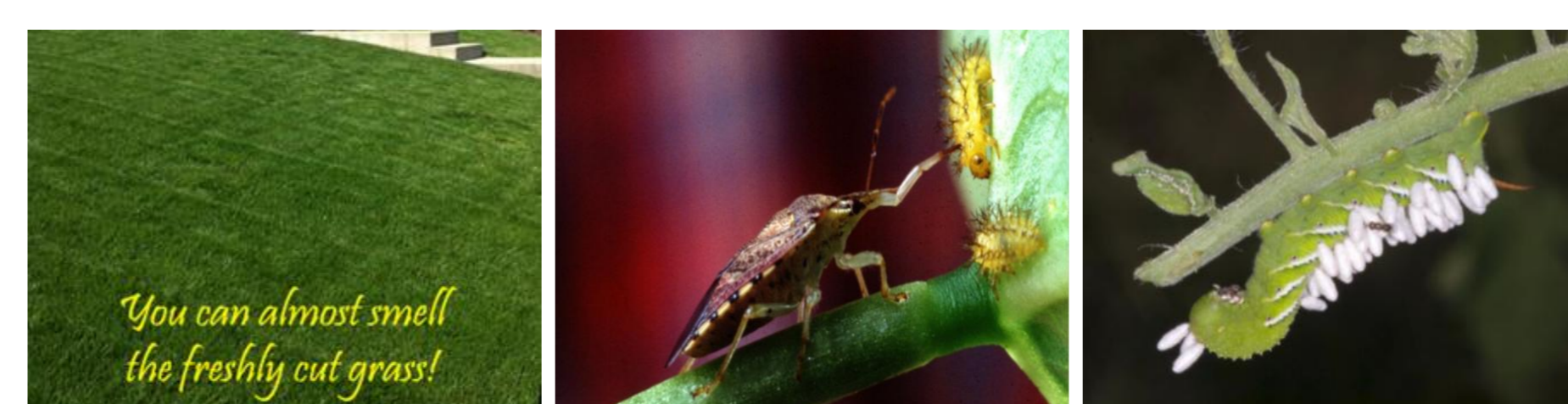


Figure 5. VOCs give grass its characteristic smell (left). Spined soldier bug attacking a Mexican bean beetle (center). Parasitoid larvae egressing from tobacco hornworm (right). Source: Hajek 2004.

B. Varietal Mixtures, VOCs and Insect Pest Management

B1. Hypothetically in a varietal mixture:

- ✓ Stronger attraction and higher diversity of natural enemies
- ✓ Enhanced pest suppression by natural enemies
- ✓ Stronger direct repulsion of pests by plants
- ✓ Increased crop productivity

B2. Promising but limited research evidence:

- ✓ Significant differences (qualitative and quantitative) were found in volatile emission between varieties in many crops e.g. cucumber, rice, cotton and apple.
- ✓ Mixture of barley varieties was preferred by predatory ladybird beetle over pure stands and showed increased aphid control
- ✓ Primary parasitoids were more diverse in mixtures of common perennial grass varieties which led to enhanced aphid control

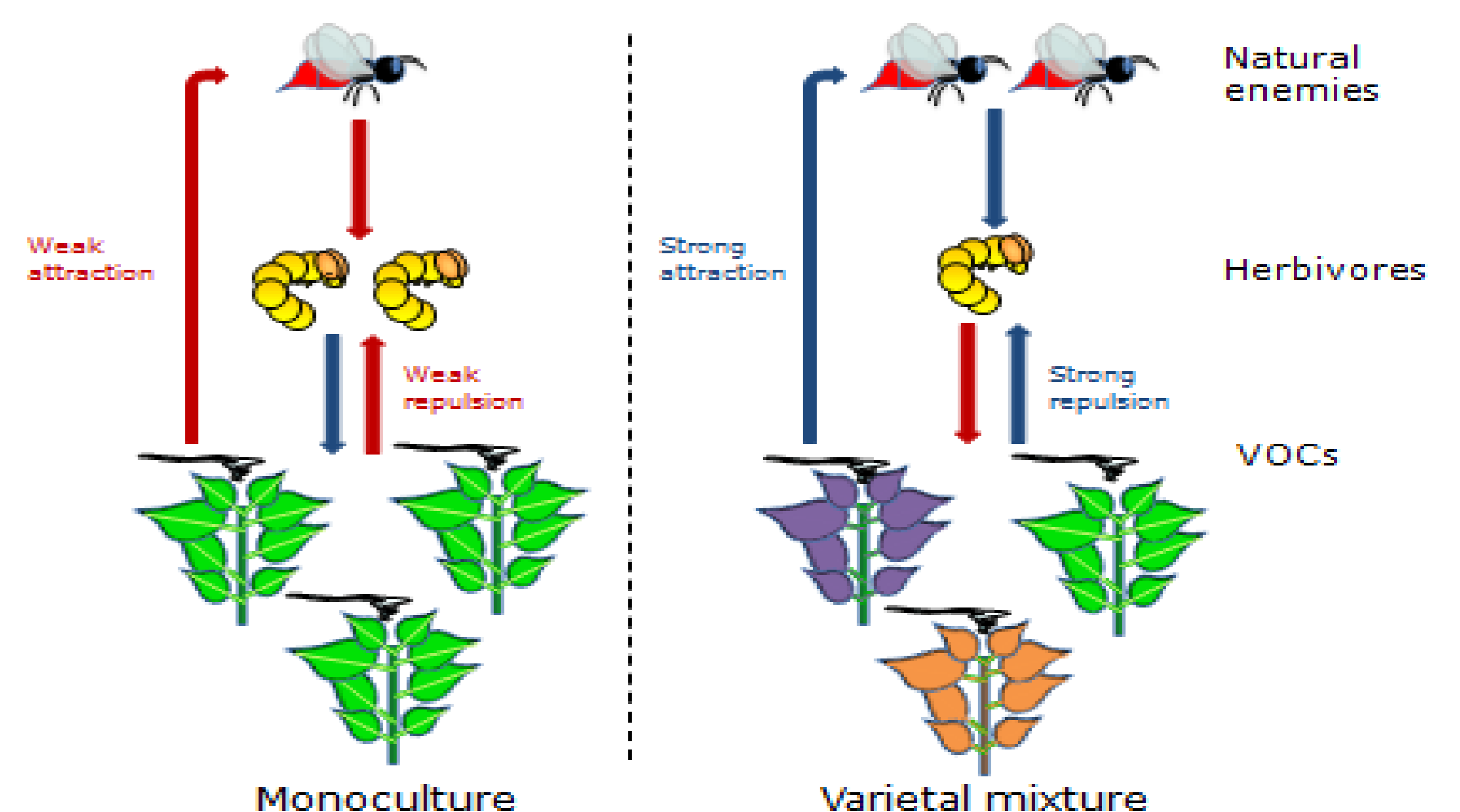


Figure 6. The hypothesized benefits of varietal mixtures for improving insect pest management. Picture adapted from Tooker & Frank (2012).

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