

Preventing post-harvest losses by a combination of a parasitoid and host plant resistance in dry beans

Silvia Dorn

Ine Schmale, Guido Velten, Anja Rott, Cesar Cardona

A collaborative effort between

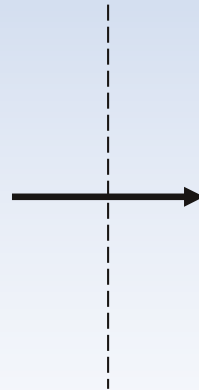
ETH Zurich, Switzerland and

CIAT (Centro Internacional de Agricultura Tropical), Colombia

to increase food safety and food security in developing countries

Counteracting post-harvest losses in the tropics

90% of dry beans produced in low-income countries, mainly by small farmers



field

harvest

post-harvest



poverty

hunger

malnutrition

Application-oriented research

Goal: to design, develop and prove innovative concepts
to counteract post-harvest losses
in dry beans

Measures: to facilitate subsequent implementation:
establishment of close collaboration
with the **international platform CIAT**;
publication of results in
international refereed journals
to stimulate further work throughout
the scientific community

➡ **step-wise research approach taken, experiences made**

Pest management options

- *classical insecticides* used by wholesalers
 - *controlled atmosphere* too sophisticated
 - *heat treatment* }
 - *barriers* }
 - (biopesticides, closed bins)** }
- success under
 certain conditions,
 yet still many
 unsolved problems**

Natural resources: novel tools adapted to on-farm use



Of fundamental importance: to understand the problem

- **Where does** the infestation by *Acanthoscelides obtectus* **originate from?**
- **Farmers** in Latin America and Africa: “Few weeks after storage the pest insect becomes apparent.”
- **Health status** of samples collected **at harvest:** 90% infested by *Acanthoscelides* larvae. Internal feeders. Invisible at harvest.

Schmale, Wäckers, Cardona, Dorn 2002.
Environ. Entomol. 31: 859-863

**Opportunity: control before they emerge
as adults**





Collaborative effort

- Partner CIAT (Centro Internacional de Agricultura Tropical) international platform, worldwide mandate for beans instrumental for development and implementation of technical improvements
- CIAT's initial attempt to limit post-harvest losses: investigation of wild Mexican bean lines; identification of **natural storage protein arcelin** that could be backcrossed into bean lines
- **Suppressed** one beetle (*Zabrotes subfasciatus*) **failed to directly kill** *Acanthoscelides obtectus*

Cardona & Kornegay 1999.
Book CRC Press

Joint effort ETH-CIAT to overcome this shortcoming by **introducing a parasitoid**



For on-farm storage: use non-toxic means of control

- Native parasitoid *Dinarmus basalis* collected in a local legume store
- On-farm in Colombia:
a single introduction of the parasitoid resulted in *Acanthoscelides* eradication or
> 90 % population reduction

Schmale, Wäckers, Cardona, Dorn 2006.
J. Stored Prod. Res. 42: 31-41

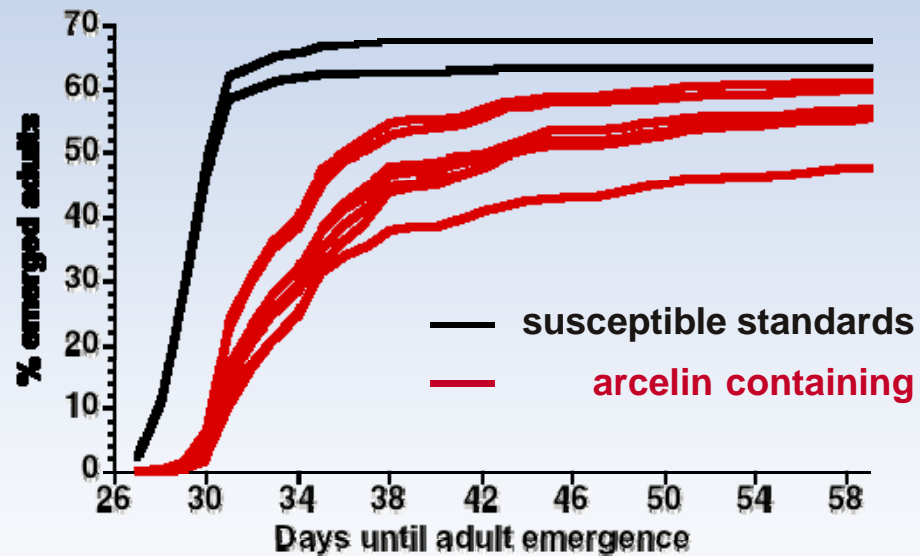
➔ considerable effect of the parasitoid alone,
but further improvement desirable

Here: locally available commercial cultivars (without arcelin)
Next: arcelin-containing beans



Enriched beans: exploit positive side effects

- Protein based **host plant resistance**:
“side effects” positive



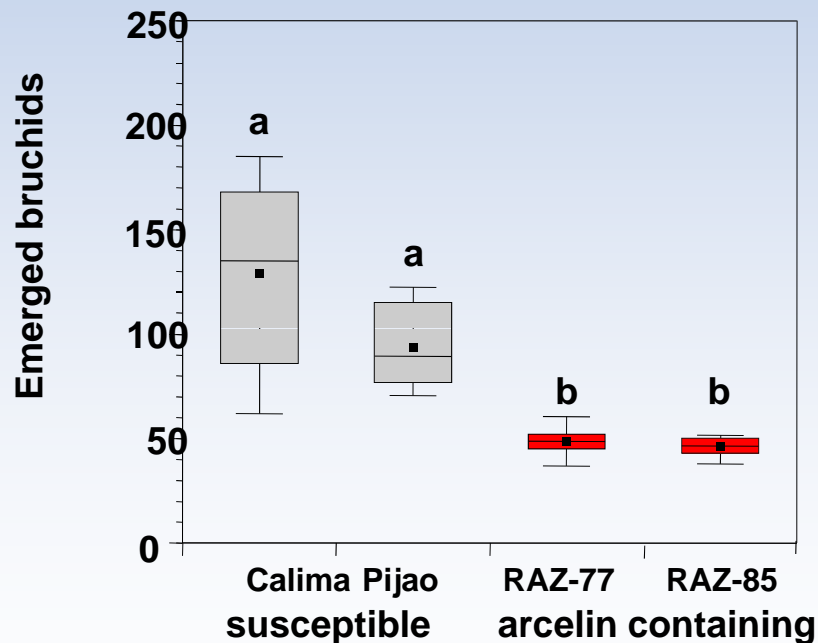
- **slower** beetle development, particularly in young larvae

Velten, Rott, Cardona, Dorn 2007.
J. Stored Prod. Res. 43: 550-557



Building an integrated system: exploit useful interactions, synergism

- **Slow** beetle development:
increased window in time for parasitoid attack
- Shift in mode of action towards **quick kill**



- **Further reduction** of beetle emergence by
combined use of **host plant resistance** and **parasitoid**

Velten, Rott, Cardona, Dorn 2007.
Biol. Control 43: 78-84

Achievements, conclusions

Counteracting post-harvest losses with new technologies

- **Natural-resource based: safe for user and consumer, neutral re. food processing**

Velten, Rott, Conde Petit, Cardona, Dorn 2008.
Biol. Control 47: 133-140

- **Single components useful *per se*, added benefit of integrated system**
- ➔ **Proof of concept system approach to improve farmers' livelihood, their nutrition, health and economics**



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all literature on
www.em.ipw.agrl.ethz.ch