京都大学 KYOTO UNIVERSITY

MOONSHOT RESEARCH & DEVELOPMENT PROGRAM

Food and Agriculture Organization of the United Nations

International Plant Protection Convention

One of the eight projects
under the national program
Moonshot Goal 5 (Sustainable food supply)

IPM research to develop non-chemical pest controls

for Zero Pest Damage with physical methods and biological functions

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Project member institutes:
Kyoto University
NARO (National Agriculture and Food Research Organization)
Tohoku University
Osaka University
Tokyo University of Agriculture and Technology
Setsunan University
Jikei University
Tokyo University of Agriculture

Background

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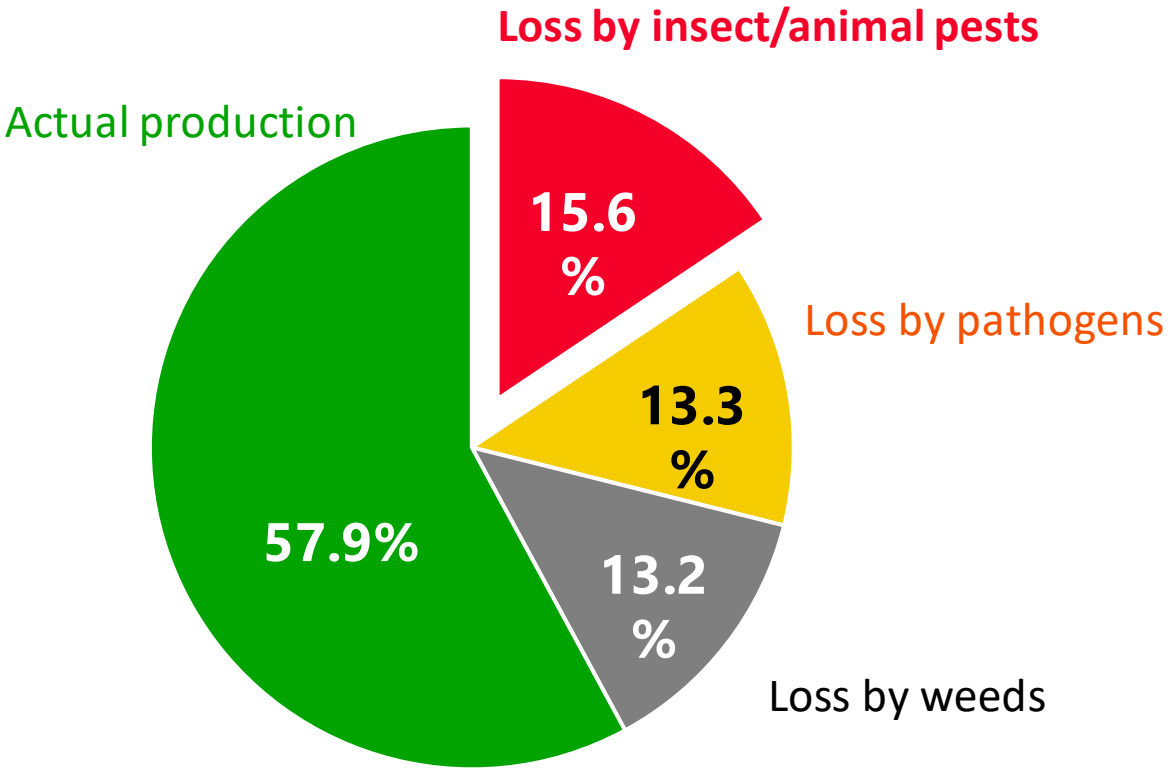
Pest damages cause crop loss



After Sharma et al. (2017) , Oerke et al. (1994)

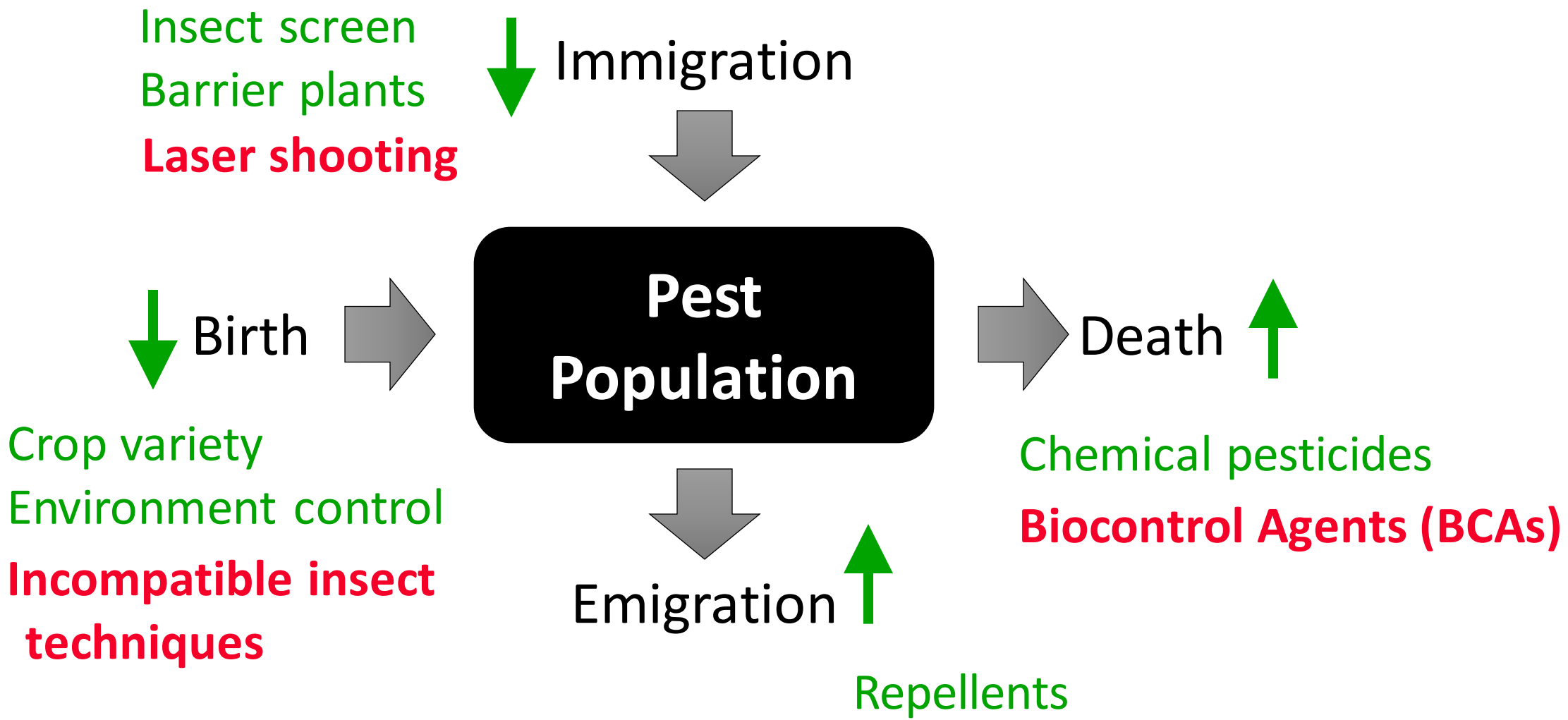
Insecticide resistance

More than 600 species

More than 300 insecticides

Sparks et al. (2020)

Scope – IPM tools



Relevance to the IPPC

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- **Strategic Objectives in Strategic Framework for IPPC 2020-2030:**
  - Enhance global food security and increase sustainable agricultural productivity.
  - Protect the environment from the impacts of plant pests.
- **The annual IPPC theme:**
  - 2022: Plant health and innovation for food security
- **The project will:**
  - address newly emerged arthropod pests (e.g., invasive species)
  - provide useful tools as pest distribution expands due to climate change
  - protect the environment with less chemical use
  - support food security and productivity

Approach – 3 steps to reduce insect pests

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Wide area: migratory pests

- Density reduction with symbionts (incompatible insect technique)

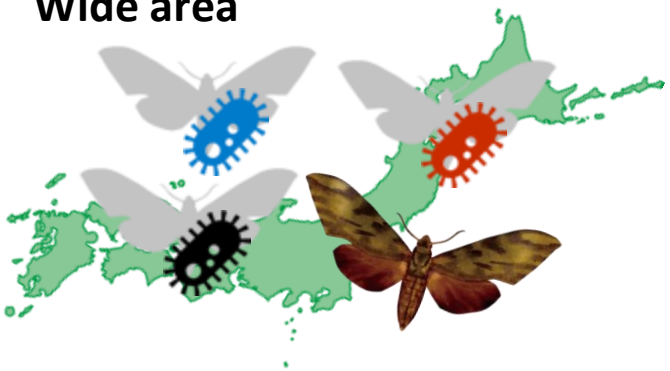
Around fields: flying pests

- Laser beam shooting

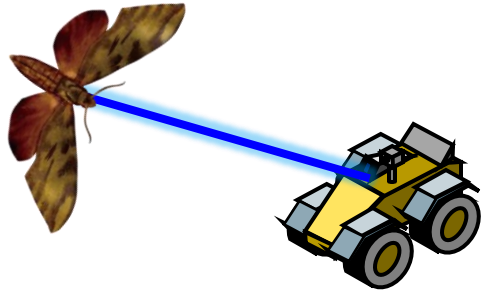
In fields: minute pests

- Surface irradiation of lasers & biological control agents (BCAs) enhanced

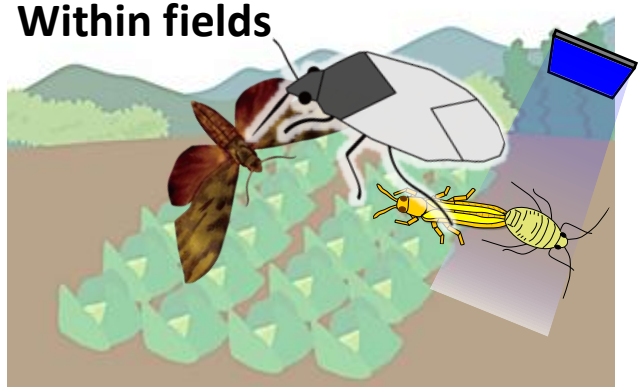
Wide area



Around fields



Within fields



Success and Challenges

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	Symbionts	Laser shooting	BCAs
Initial outcomes	**Artificial culture** of insect-symbionts in living host insects	**Successful prediction** of flying course of insects with AI	New **genome editing method** and RNA interference (RNAi) systems on BCAs
Challenges	- Culture system **without living host insects** - **Incompatible insect techniques** by symbionts	- Capturing **irregular flying patterns** of insects - Concerns of **safety and reliability**	**- Genome information-based breeding** and **elucidation of BCAs' function**

Laser beam shooting technique

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RNAi on BCAs

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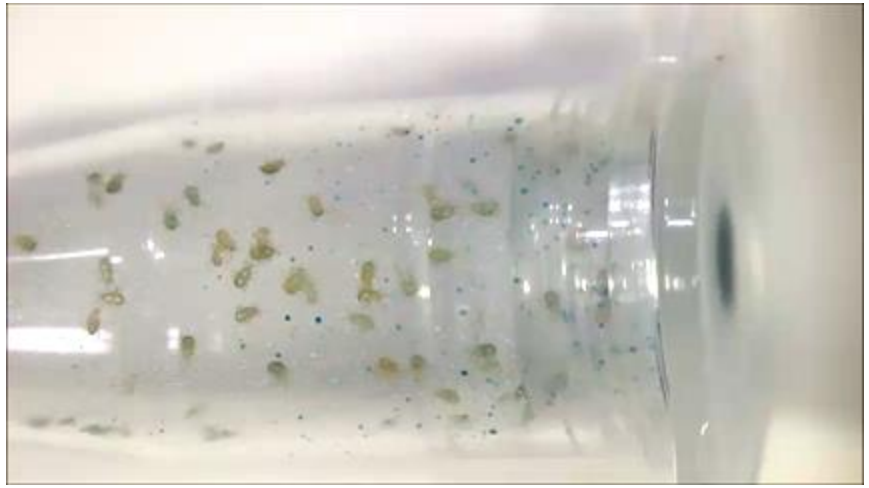
PLOS ONE

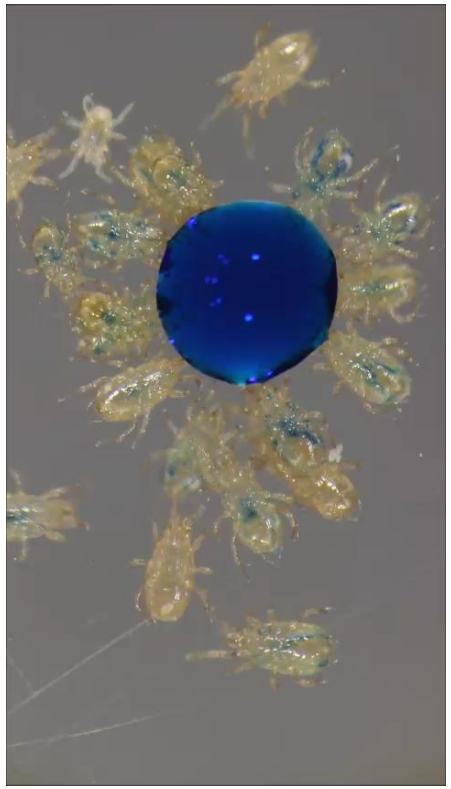
OPEN ACCESS PEER-REVIEWED

RESEARCH ARTICLE

Oral delivery of water-soluble compounds to the phytoseiid mite *Neoseiulus californicus* (Acari: Phytoseiidae)

Noureldin A. Ghazy, Takeshi Suzuki





(Ghazy and Suzuki 2019)

Contents lists available at ScienceDirect

Pesticide Biochemistry and Physiology

journal homepage: www.elsevier.com/locate/pest

Environmental RNAi-based reverse genetics in the predatory mite *Neoseiulus californicus*: Towards improved methods of biological control

Noureldin Abuelfadl Ghazy [a,b,c,*], Takeshi Suzuki [a,d,*]

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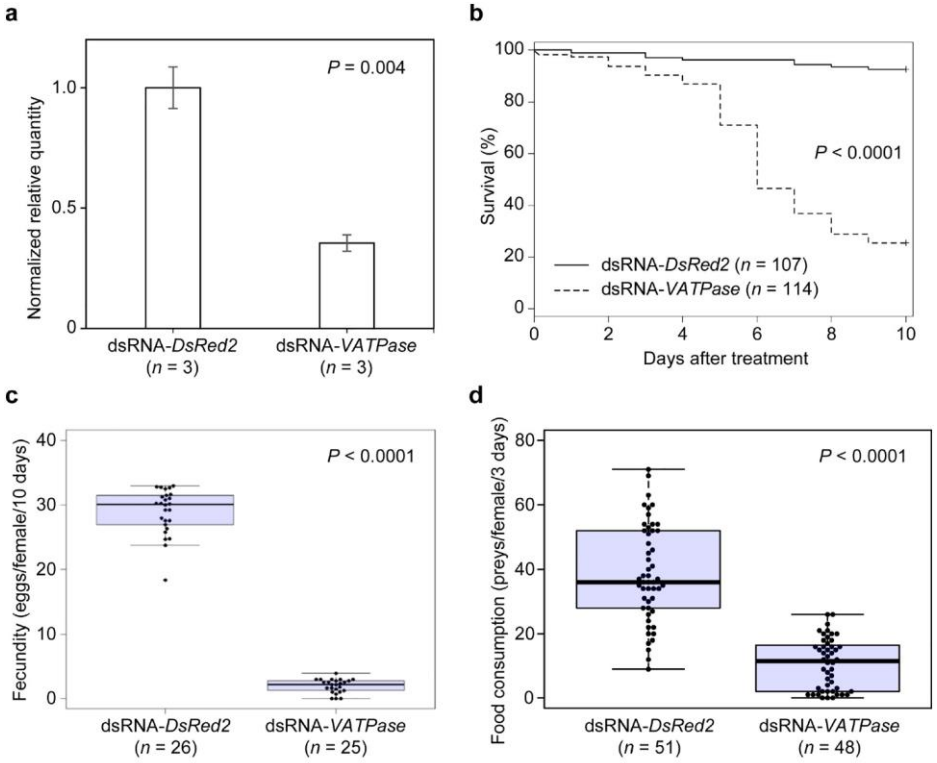
Control RNAi



Control RNAi

(Ghazy and Suzuki 2022)

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By 2050
Insect pests are controlled without chemicals