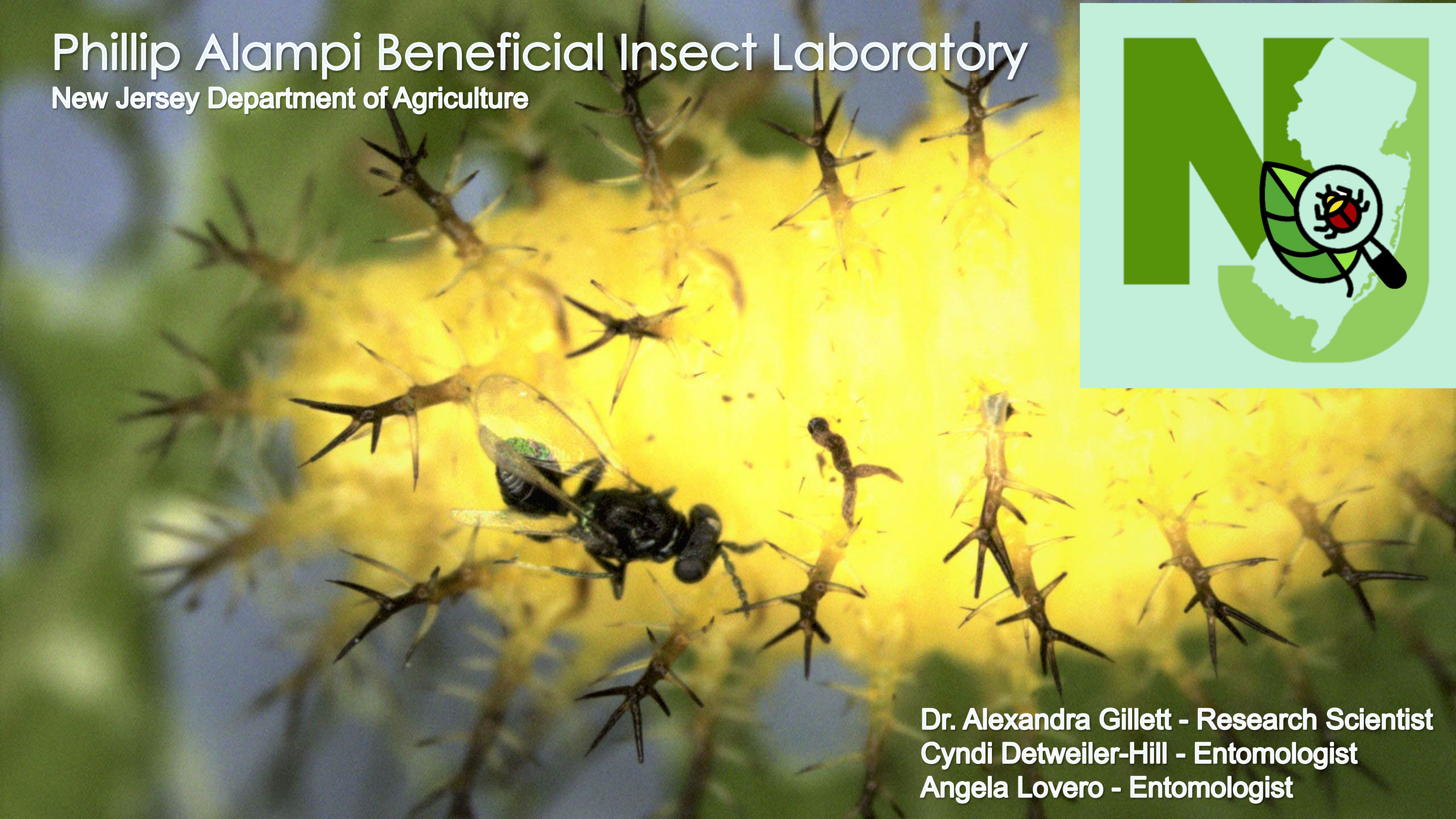
Phillip Alampi Beneficial Insect Laboratory

New Jersey Department of Agriculture



Dr. Alexandra Gillett - Research Scientist
Cyndi Detweiler-Hill - Entomologist
Angela Lovero - Entomologist

PABIL Mission Statement

- **Reduce** plant pest damage in forest and agricultural crops

- **Protect** natural and renewable resources and other open lands through the rearing and field release of beneficial insects, thereby reducing pesticide applications, insect resistance to pesticides, and reducing the amount of excess chemicals in the environment

- **Conserve** natural enemies of pests and to conserve and protect our natural resources

- **Develop** and improve insect mass rearing techniques so that current biological control programs can be implemented and expanded

- **Test** new biological control techniques

Past and Present Programs

FOREST & ENVIRONMENTAL PESTS
Gypsy Moth
Pine Shoot Moth
European Pine Sawfly
Japanese Beetle
Hemlock Wolly Adelgid
Scale Insects

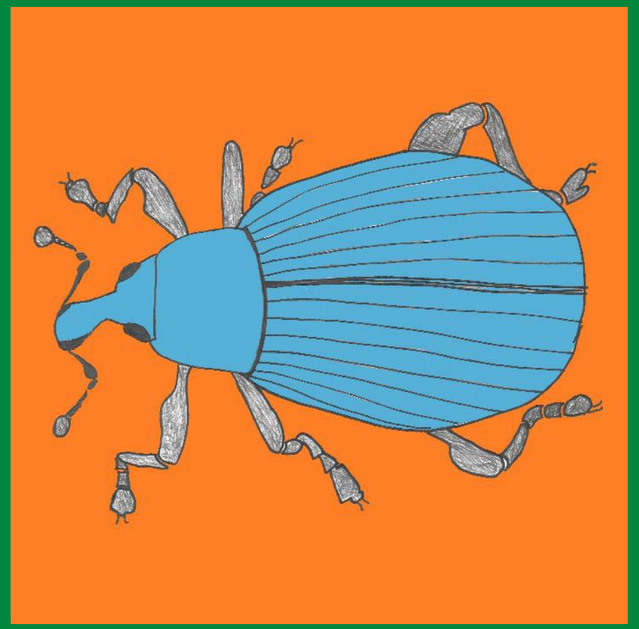
GRAIN & FORAGE PESTS
European Corn Borer
Alfalfa Weevil
Cereal Leaf Beetle
✓ **Mexican Bean Beetle**
Aphid Predators

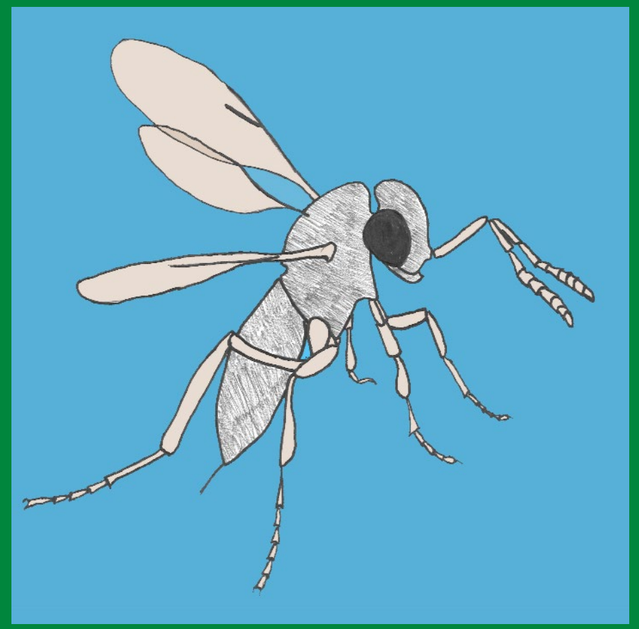
VEGETABLE & FRUIT PESTS
Colorado Potato Beetle
Asparagus Beetle
Tarnished Plant Bug
✓ **Brown marmorated stink bug**
Spotted lanternfly
Spotted-wing drosophila

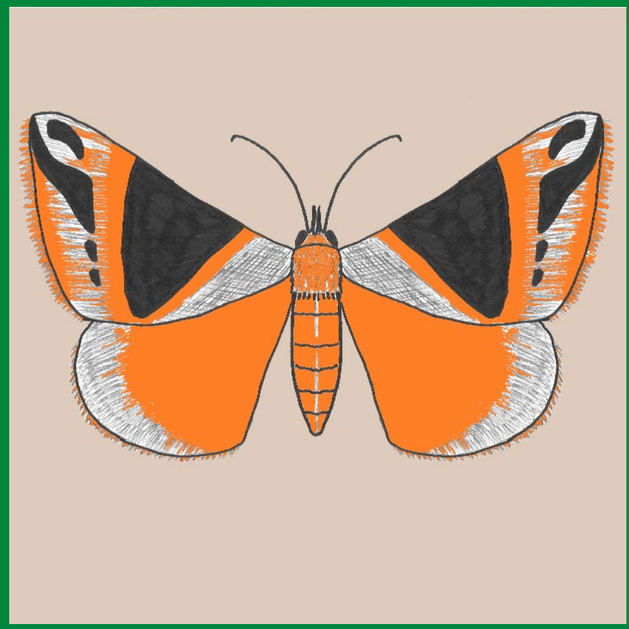
WEED CONTROL
Mile-A-Minute
Musk Thistle
✓ **Black swallowwort**
Purple Loosestrife
Japanese knotweed

Biological Control

- Classical – establish a new natural enemy
- Augmentative – increase existing natural enemy populations
  - Inundative – targeted, high density
- Conservation – Making a suitable environment







Things to consider

- Host specificity
- Effectiveness on the targeted pest
- Chances of success
- Cost of control (initially high; lower over time)
- Effect on non-target organisms
  - Endangered species?
  - Will the beneficial become a pest?
  - Will it increase of decrease diversity?

Before we get it at PABIL…

- Search for predators/parasites of the targeted pest
- Research and evaluation in the host country
- Evaluation under quarantine in the USA
- Testing (hosts, diseases, native species, choice/no-choice tests, larval development)
- TAG- Technical Advisory Group
- EAS- Environmental Assessment
- Approval by USF&W
- FONSI- Finding of No Significant Impact by USDA/EPA
- Rearing, Release, and Evaluation
- Individual State Approval

CABI

USDA

U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

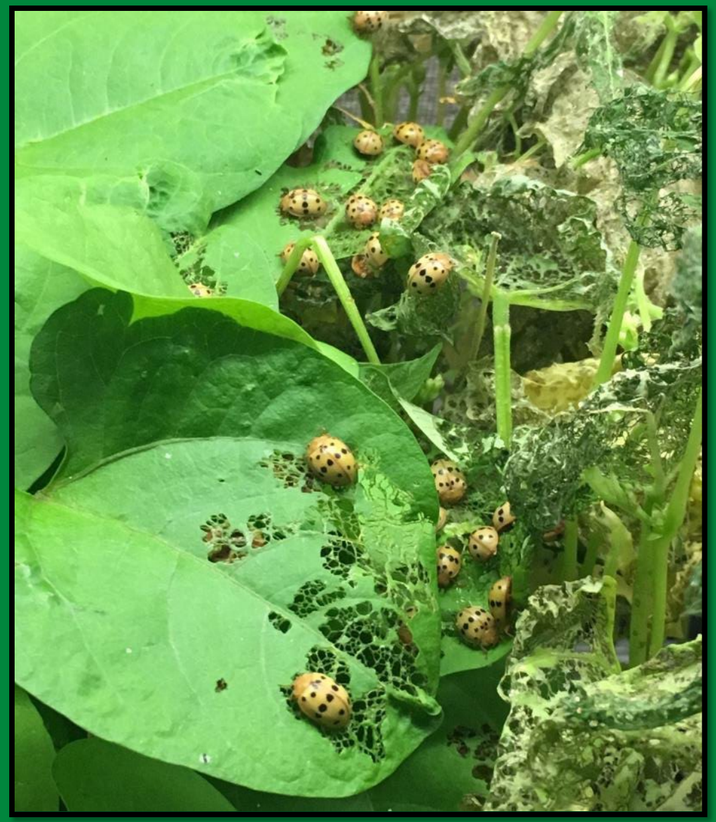
Ongoing Programs

- Black swallowwort - *Hypena opulenta (moth)*
- Mile-a-minute - *Rhinoncomimus latipes (weevil)*
- Japanese knotweed - *Aphalara itadori (psyllid)*
- Mexican bean beetle - *Pediobius foveolatus* (parasitoid wasp)
- Tarnished plant bug - *Peristenus relictus (*parasitoid wasp)
- Brown marmorated stinkbug - *Trissolcus japonicus* (parasitoid wasp)
- Spotted-wing drosophila – *Ganaspis brasiliensis* (parasitoid wasp)

Rearing the Mexican Bean Beetle & Parasitoid *Pediobius foveolatus*

Mexican bean beetle – *Epilachna varivestis*

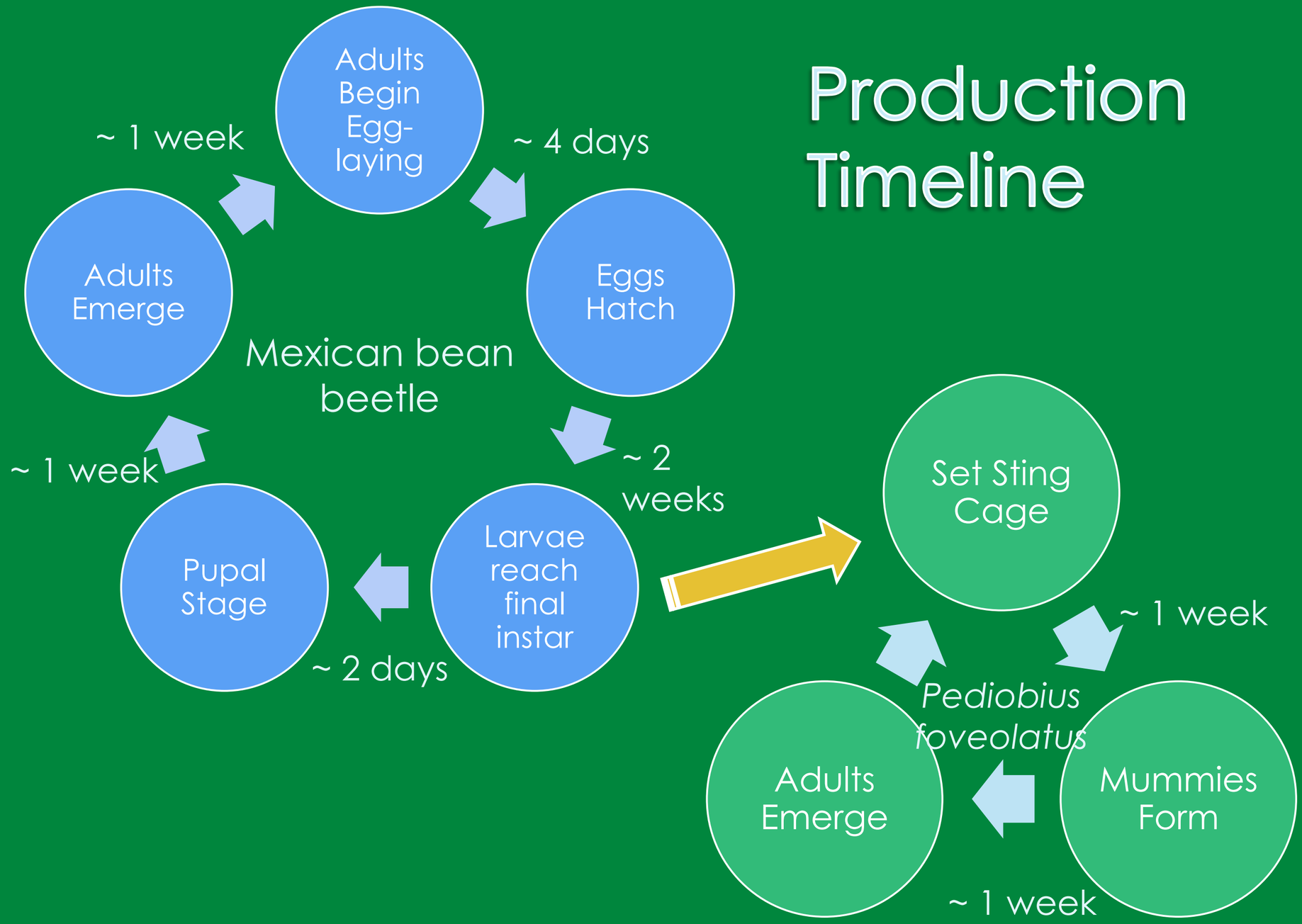
- Formerly an extremely serious pest of beans in New Jersey, esp. soybeans. Manifests in 2nd generation
- Larvae and adults both damage leaves



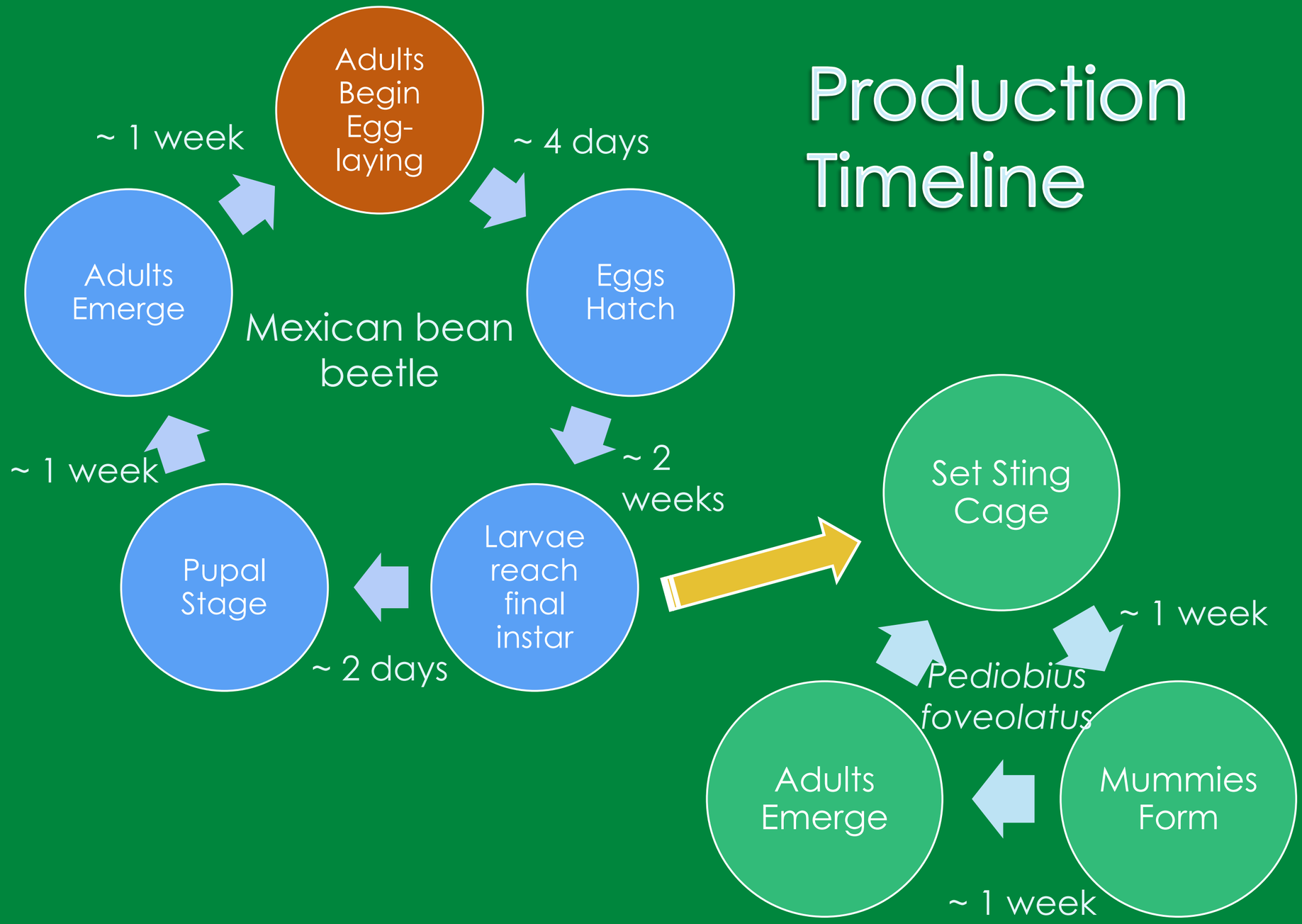
Pediobius foveolatus
Hymenoptera: Eulophidae

- Origin – India
- Do not over winter in New Jersey
- Raised and released every year (inundative)
- Attack only the larval stages
- 25 wasps emerge from each parasitized larva
- Follow the MBB into the soybean field
- Can disperse 16 miles
- Over 50 million released since 1980

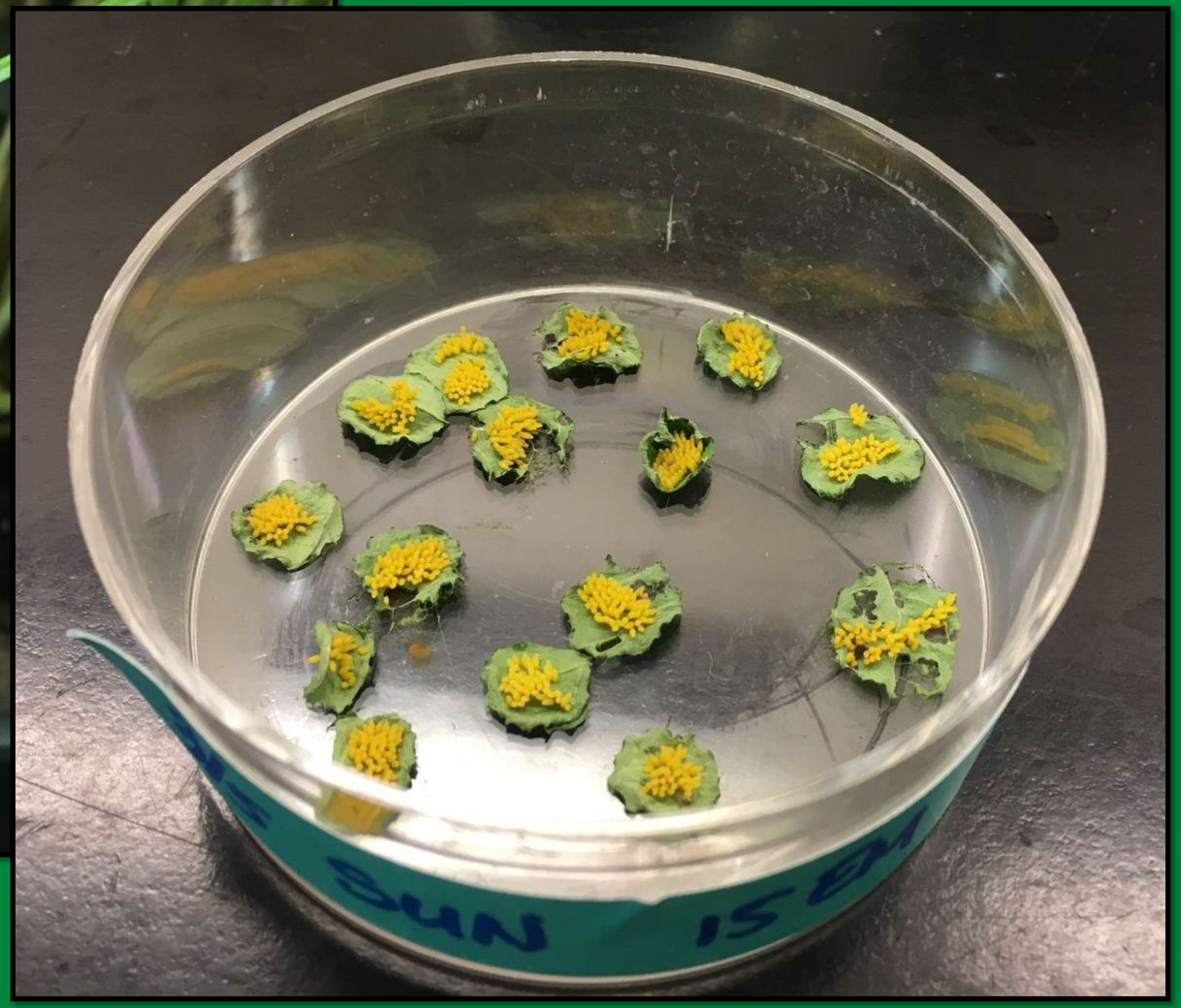
Production Timeline



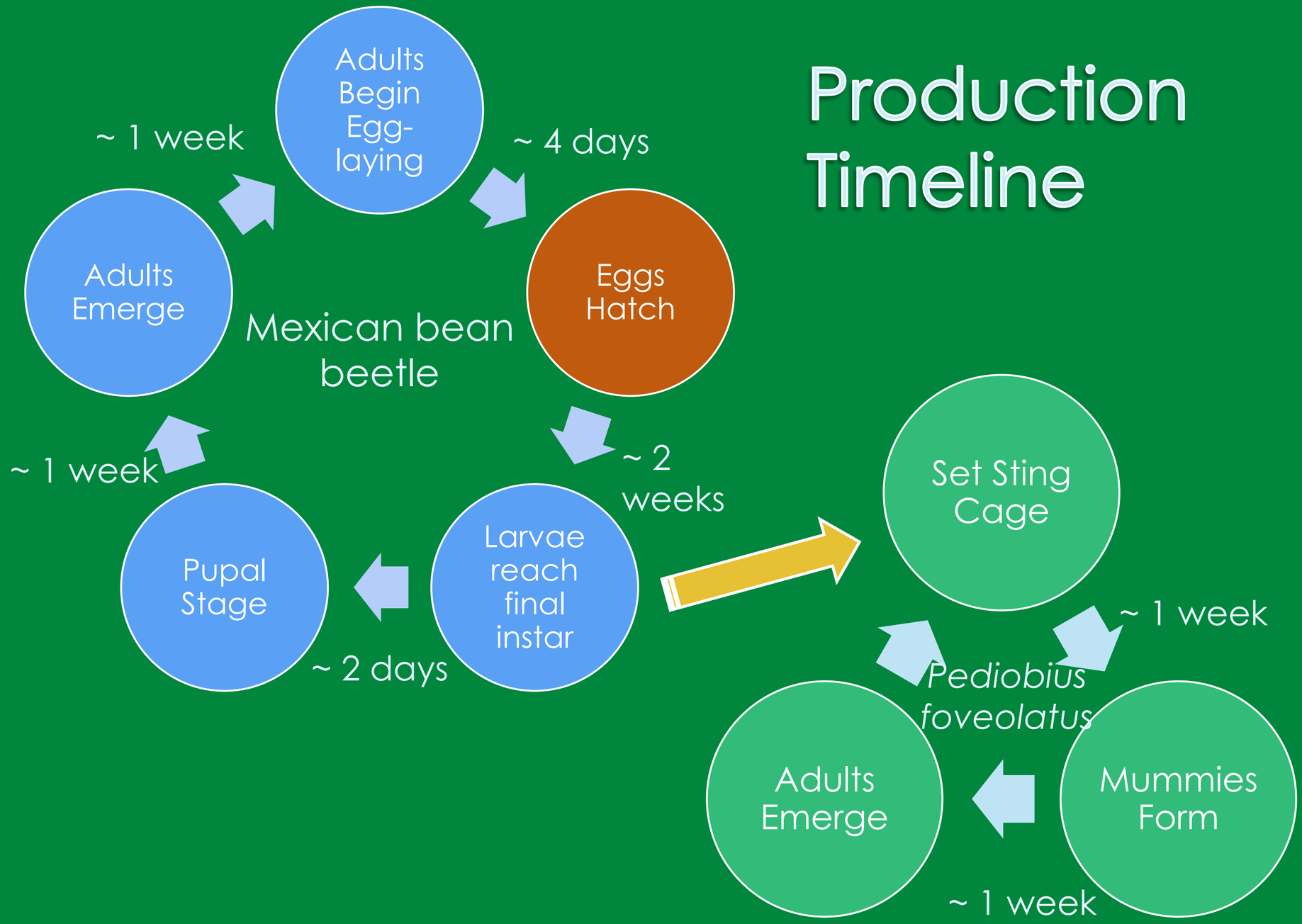
Production Timeline



Collecting Eggs



Production Timeline

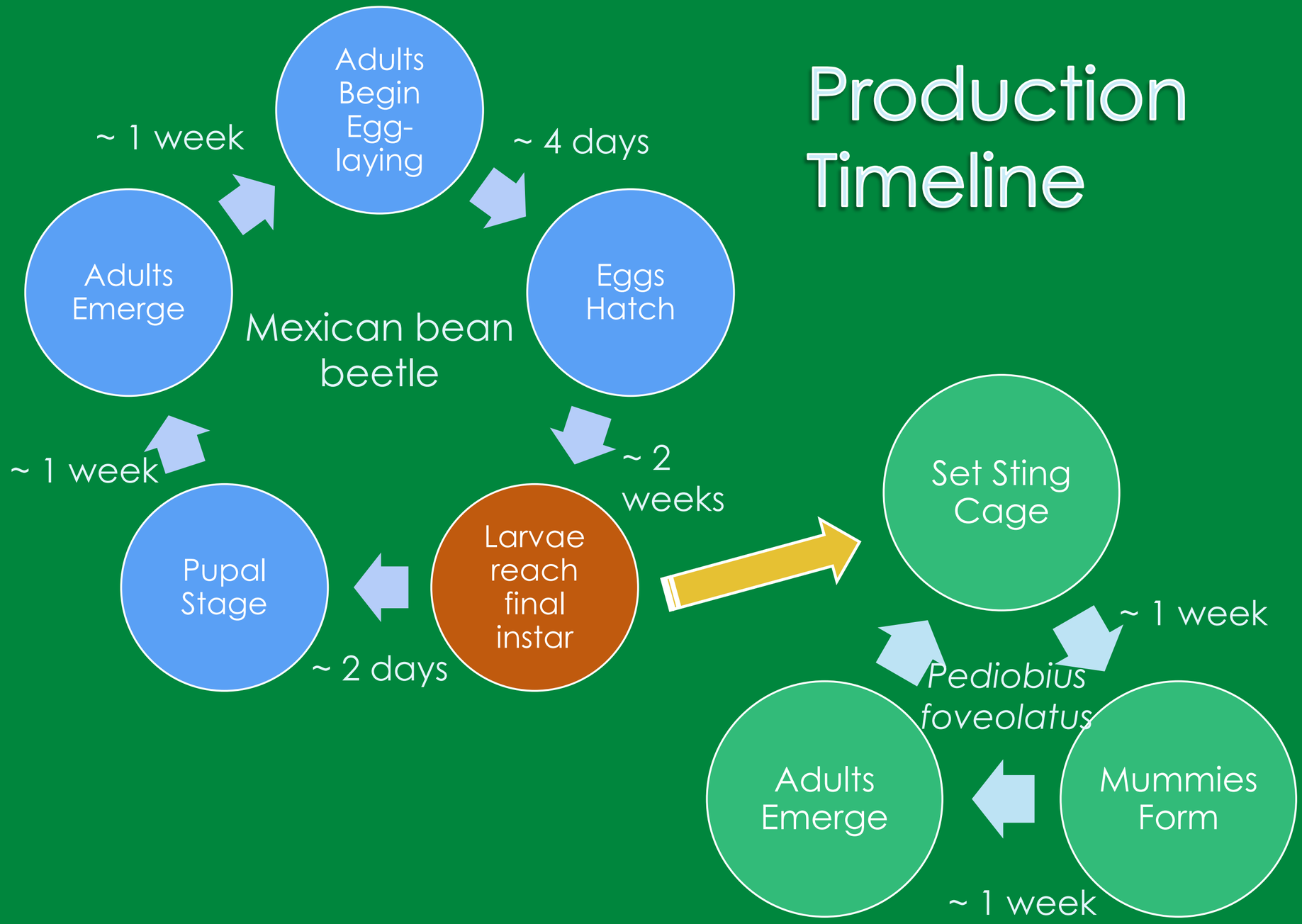


Eggs Hatch →Small Plant

Lots o’ Cages Everywhere

Munch Munch Munch…

Production Timeline



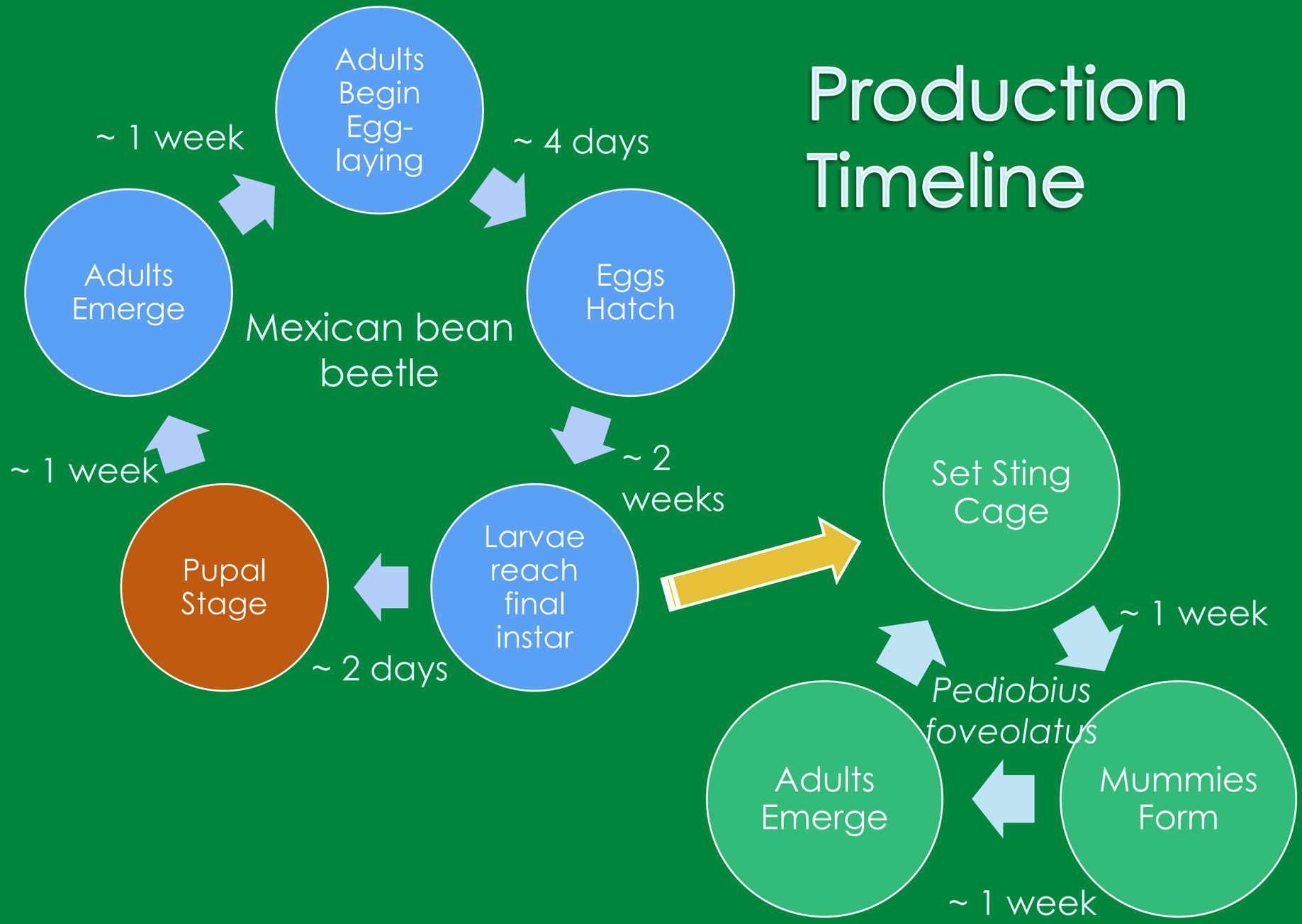
Larvae Reach Final Instar

A few lucky Larvae → Continue Normal Life-Cycle

Most Larvae → Doom!!

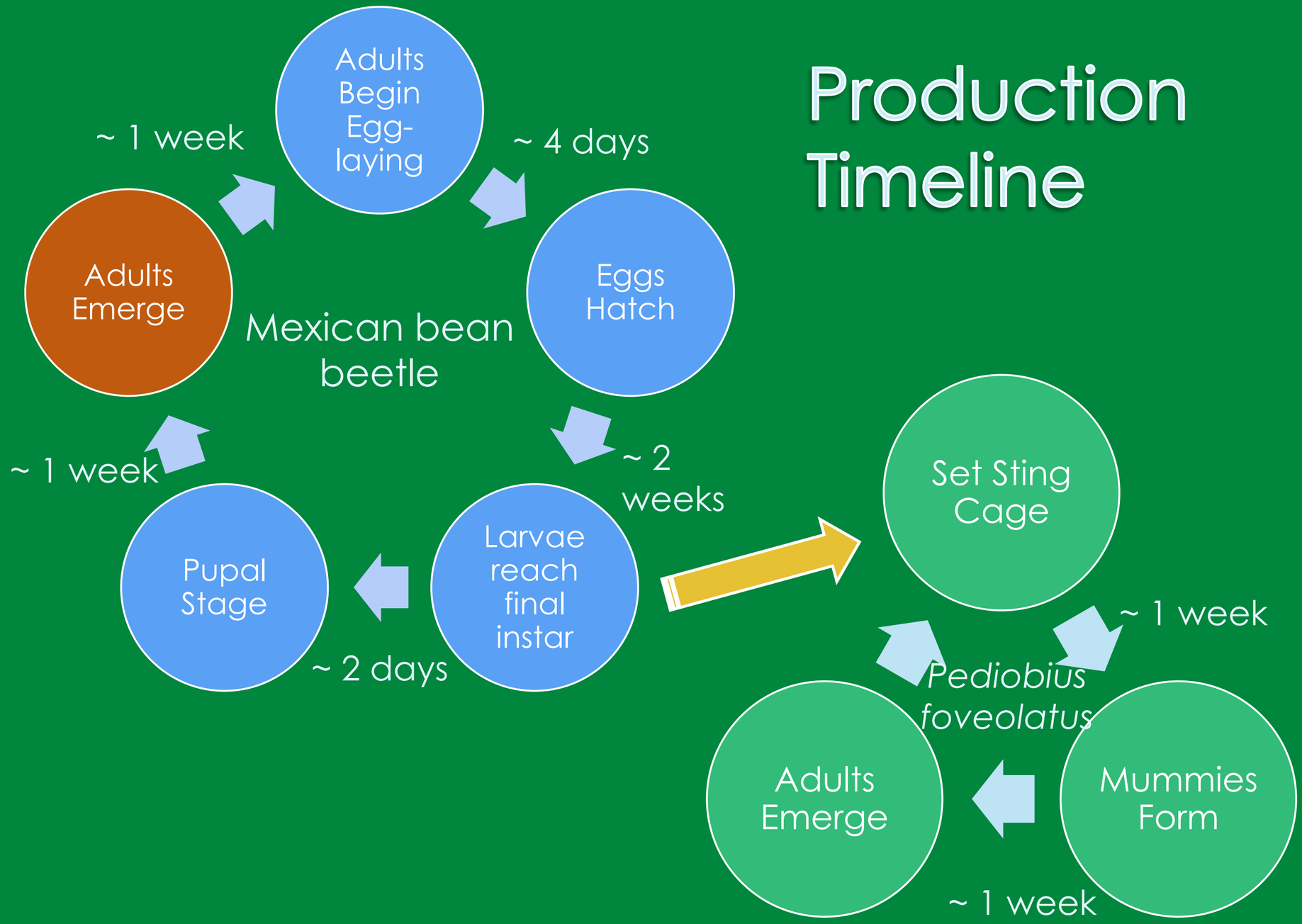
→ Off to *Pediobius* sting room!

Production Timeline



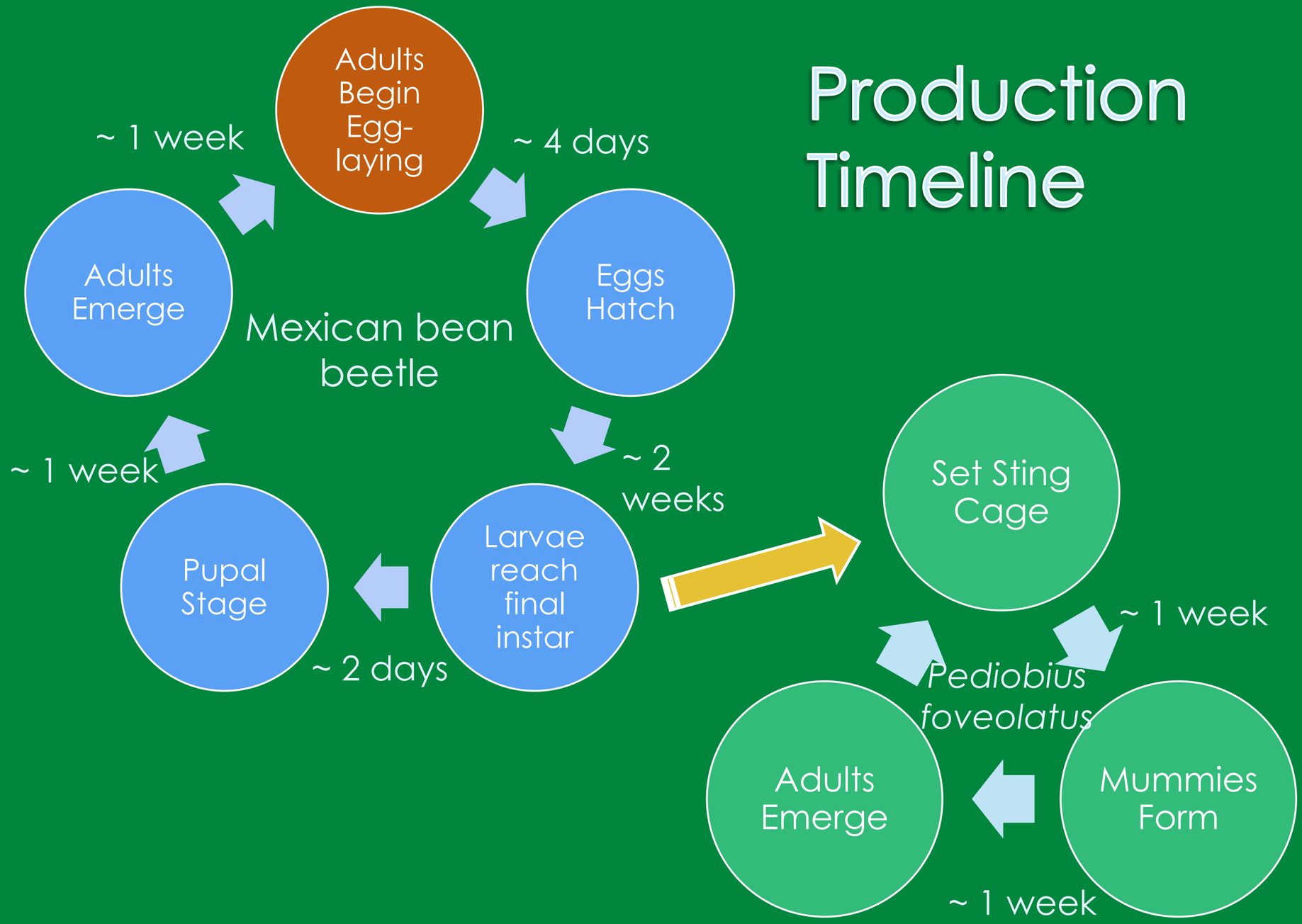
Pupation

Production Timeline



Adults Emerge

Production Timeline

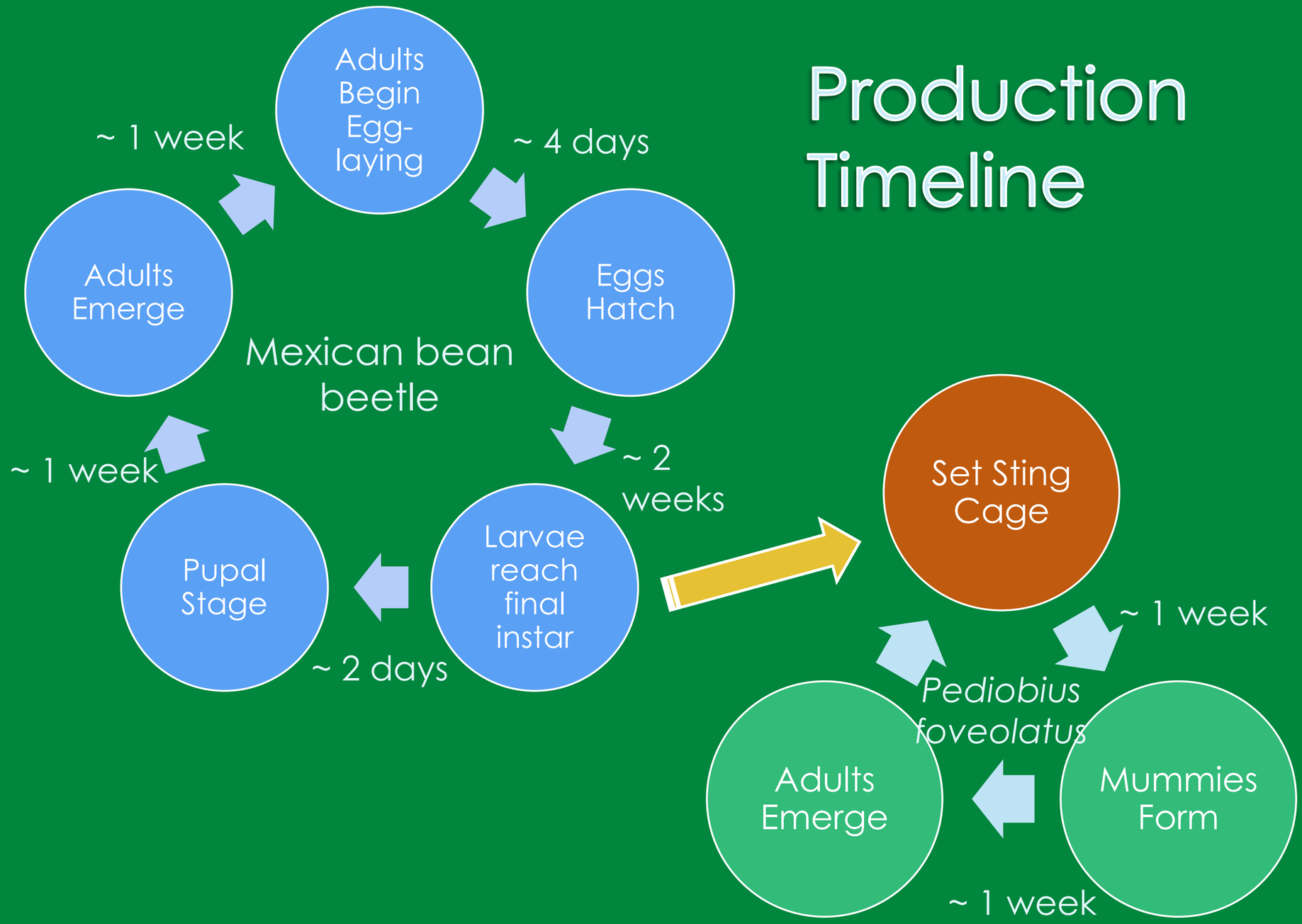


Larvae Reach Final Instar

A few lucky Larvae → Continue Normal Life-Cycle

Most Larvae → Doom!! → Off to *Pediobius* sting room!

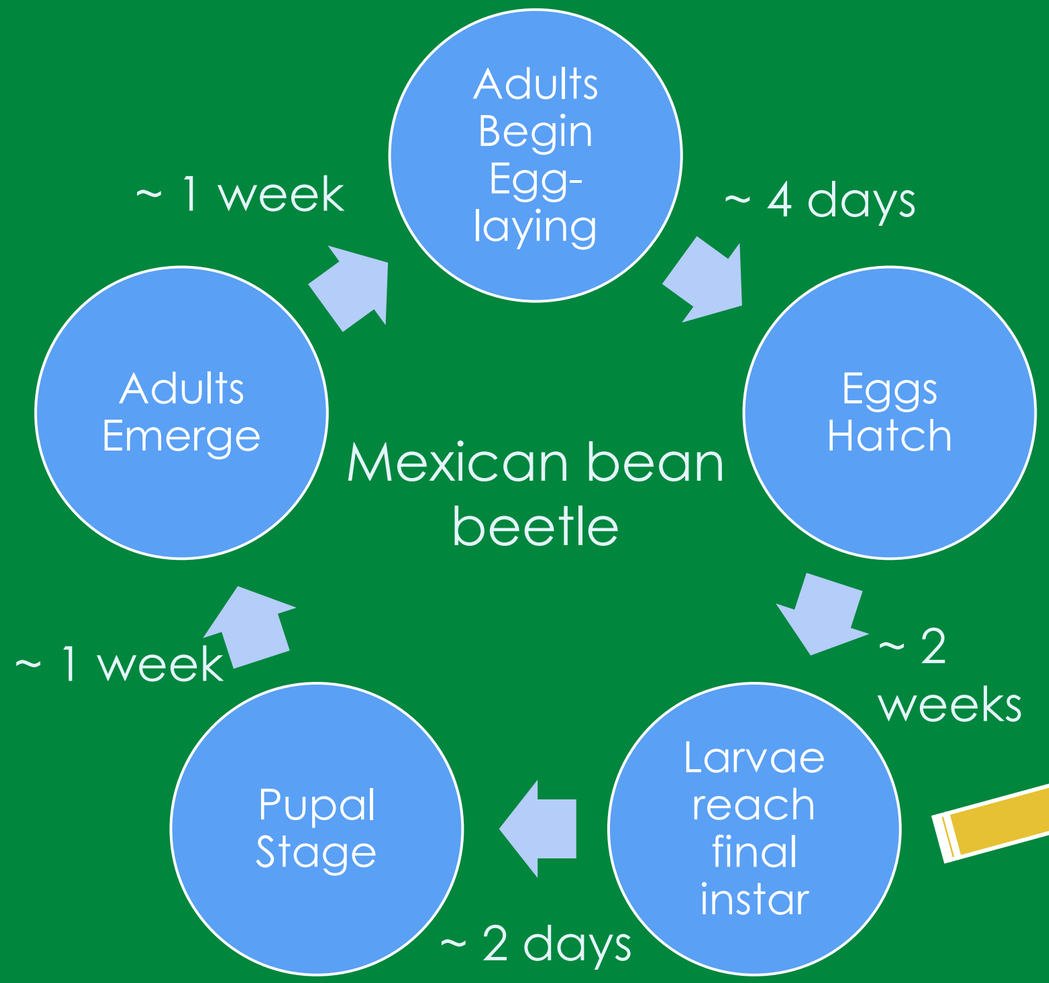
Production Timeline

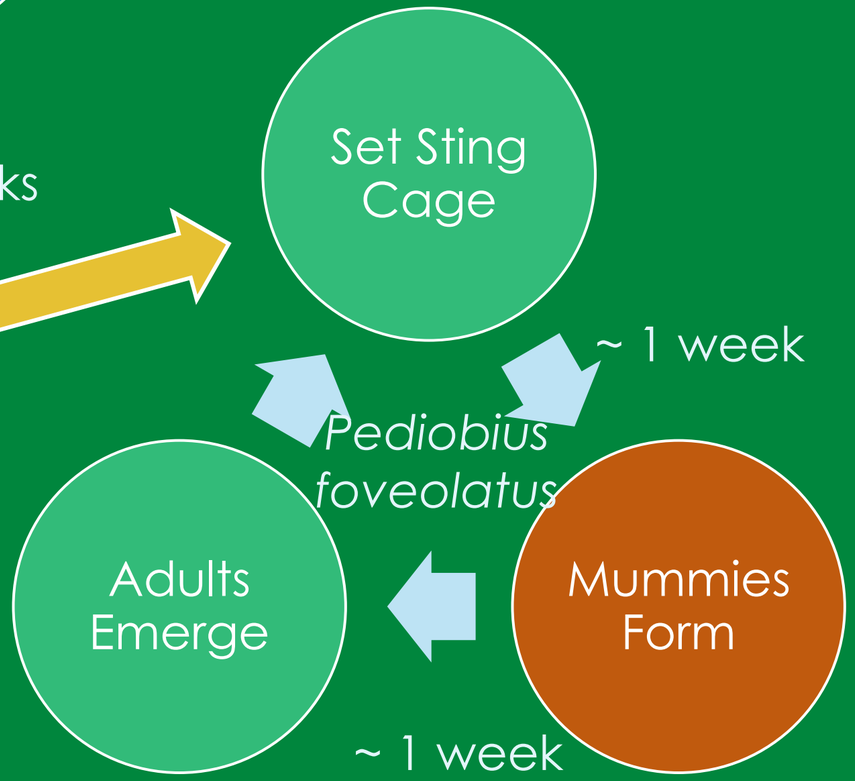


Setting a Sting Cage

- Bean Plants
- 300 MBB Larvae
- 150 Female *Pediobius foveolatus*

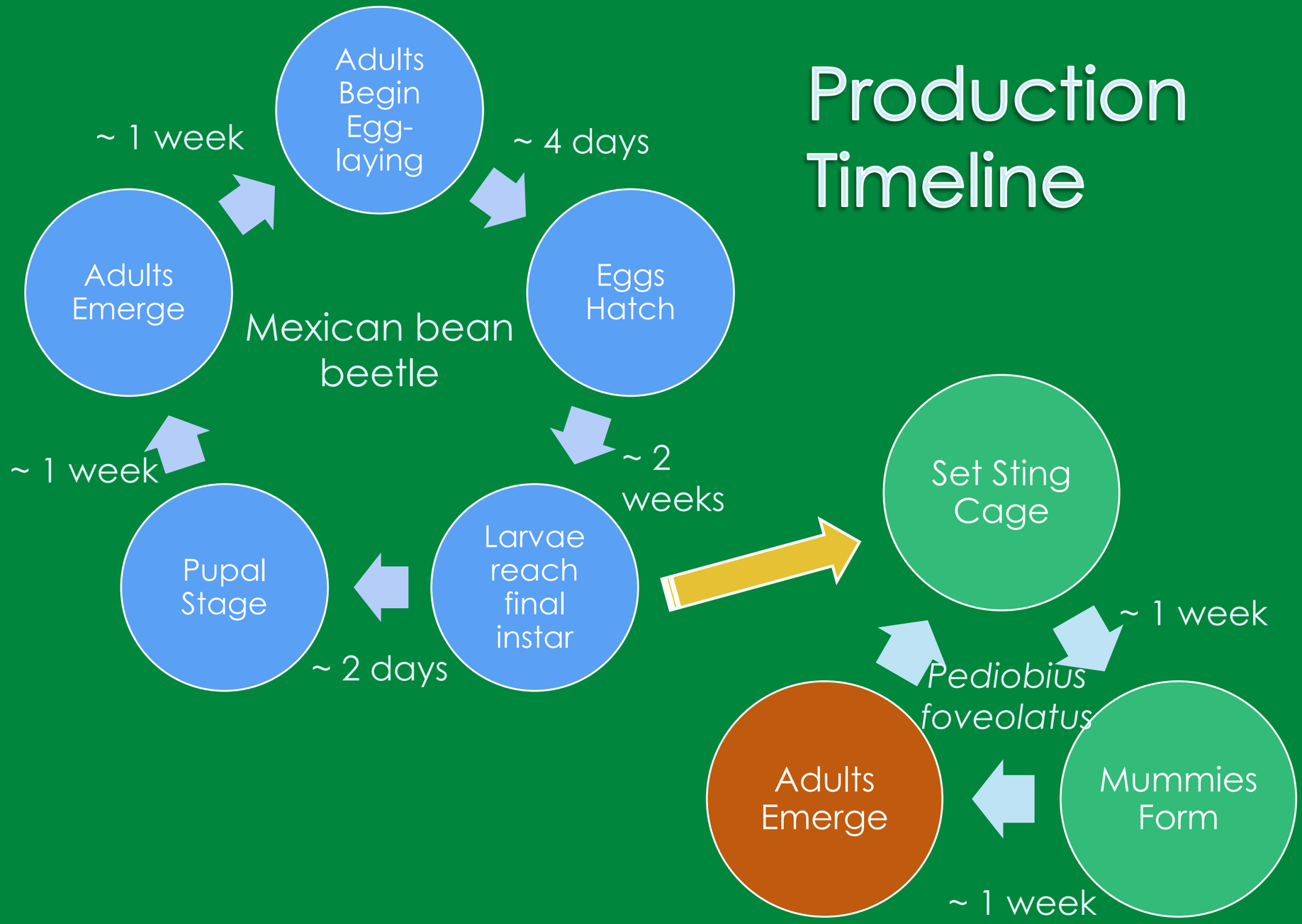
Production Timeline





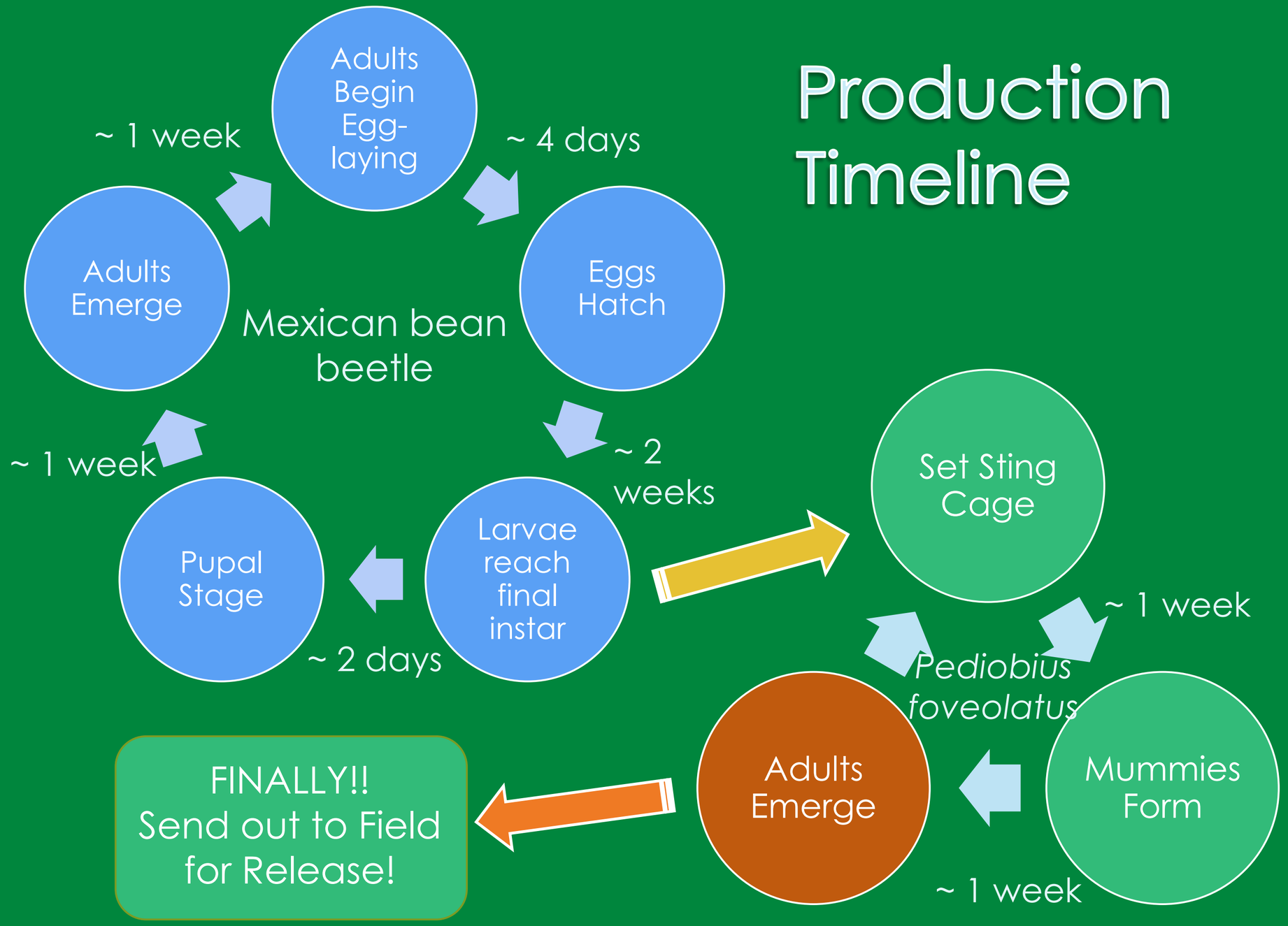
Mummies Form

Production Timeline



Adults Eclose

Production Timeline



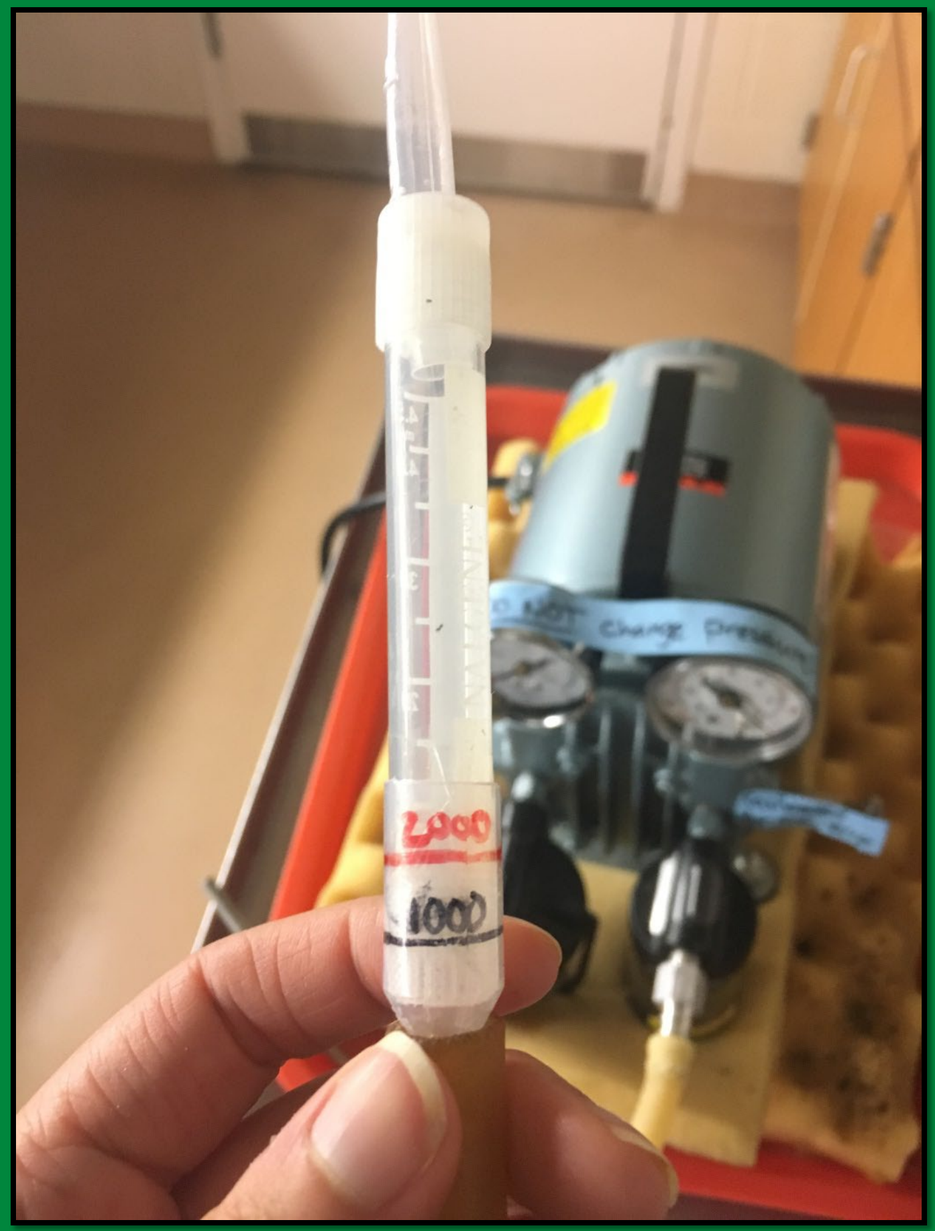
Collecting for Field Release

- Time savers:
  - Electric pumps
  - Calibrated tubes:

    Known volume of

    1,000 or 2,000

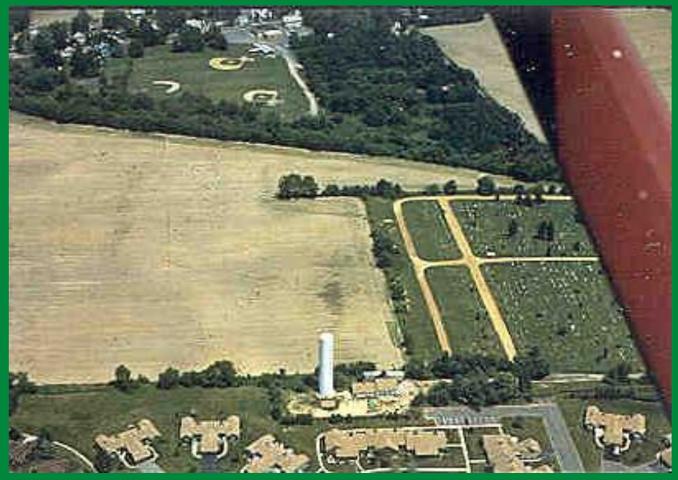
    Adults



Production Summary

- Process (MBB egg → *Pediobius* adults) takes about 6 weeks!
- NOT including time to grow the snap beans…
- Planning ahead!
  - Make sure production peaks when *Pediobius* are most in demand!
- Max production: about 30,000 Adults/week

Past Strategy- Nurse Plot (trap crop)

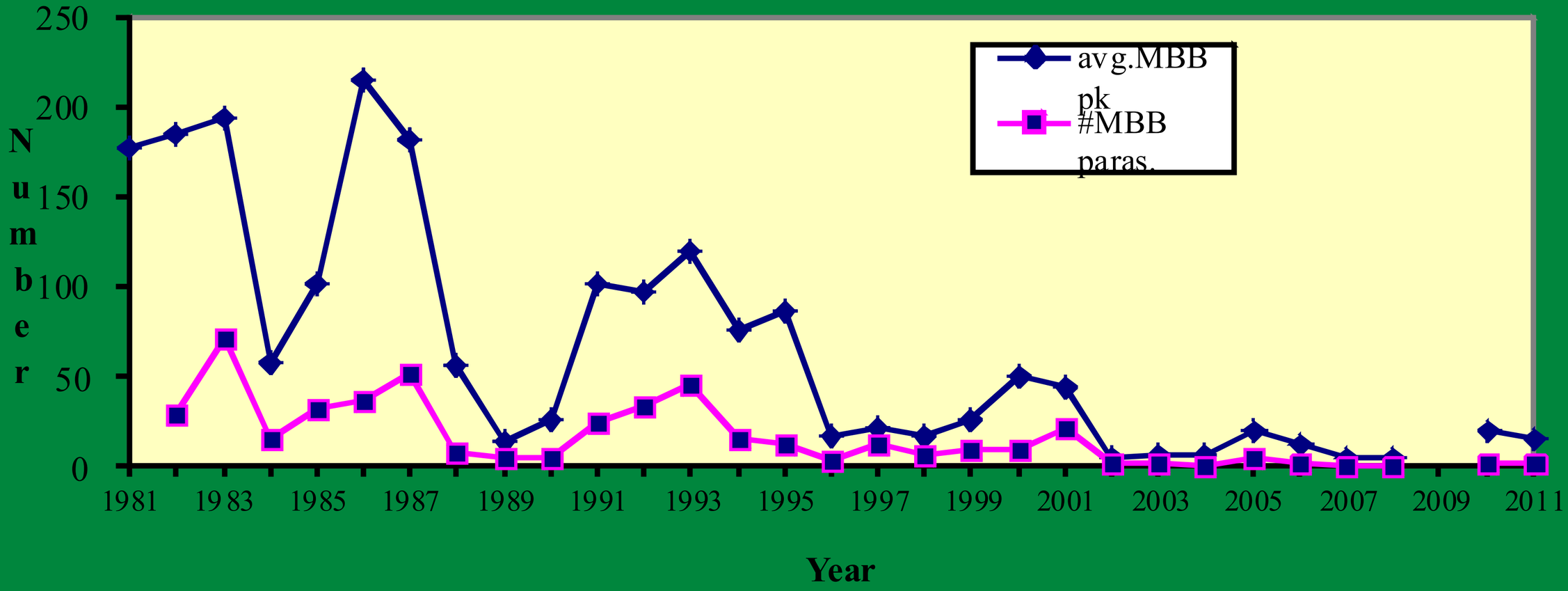


- 1/8 acre in size
- 15 lbs. of snap beans
- 5 lbs. of soybeans
- Planted before the grower plants
- Snap beans attract overwintering adult Mexican bean beetle from the hedgerows

Change in Methodology

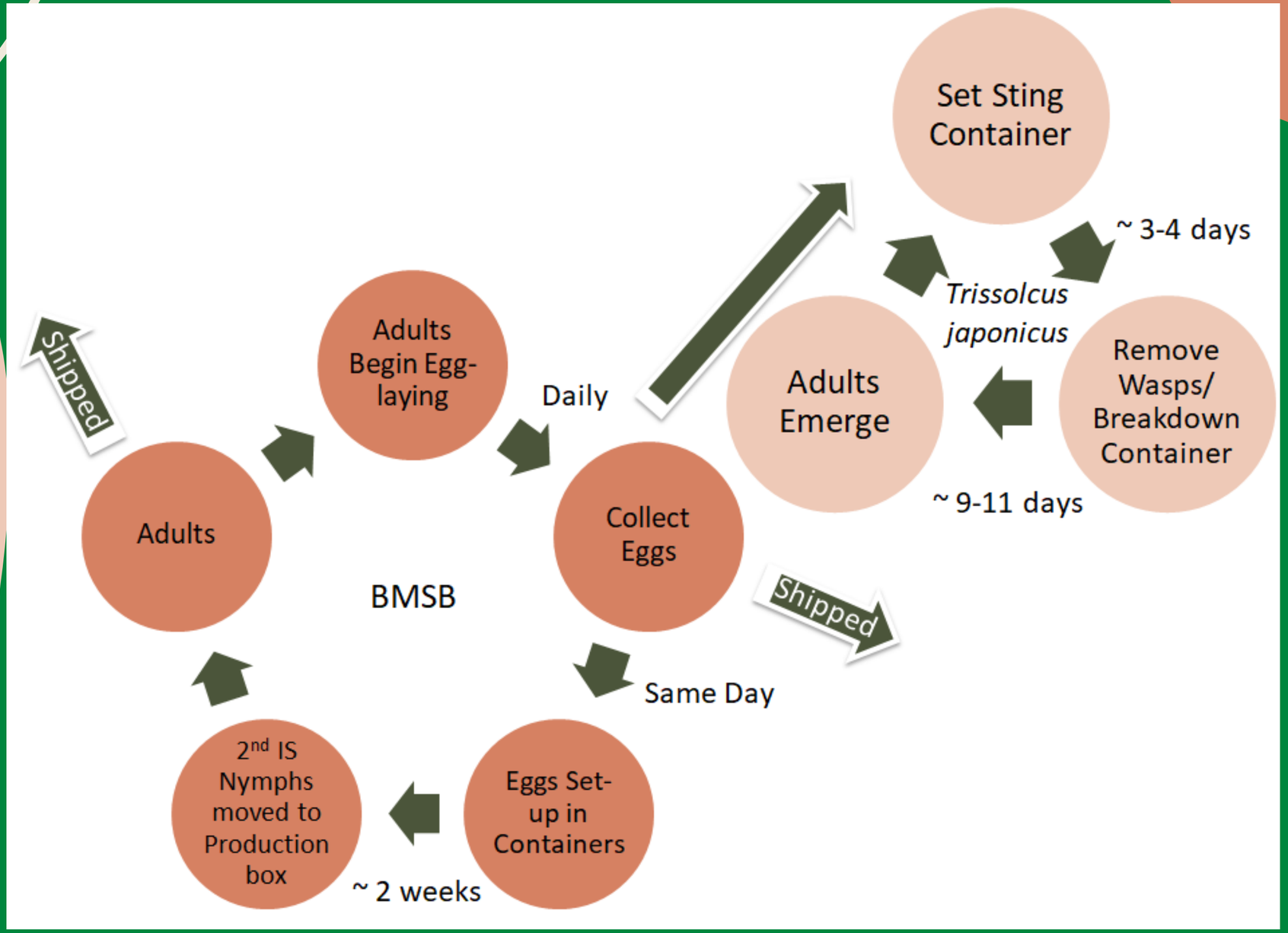
- Use of glyphosate began to kill the snap beans in the nurse plots so the plots were damaged
- Used historical data to determine where and when the MBB show up
- Scout 49 strategic locations 1X/week in Central and South Jersey where MBB populations have been found in the past
- Released a minimum of 4,000 wasps per site, more if MBB were found or if more wasps were available from the lab.
- Goal is to maintain pressure on the Mexican bean beetle

Figure 3. Mexican bean beetle Population and Parasitism 1981-2011



Rearing of Brown Marmorated Stink Bug (*Halyomorpha halys*) and *Trissolcus japonicus*

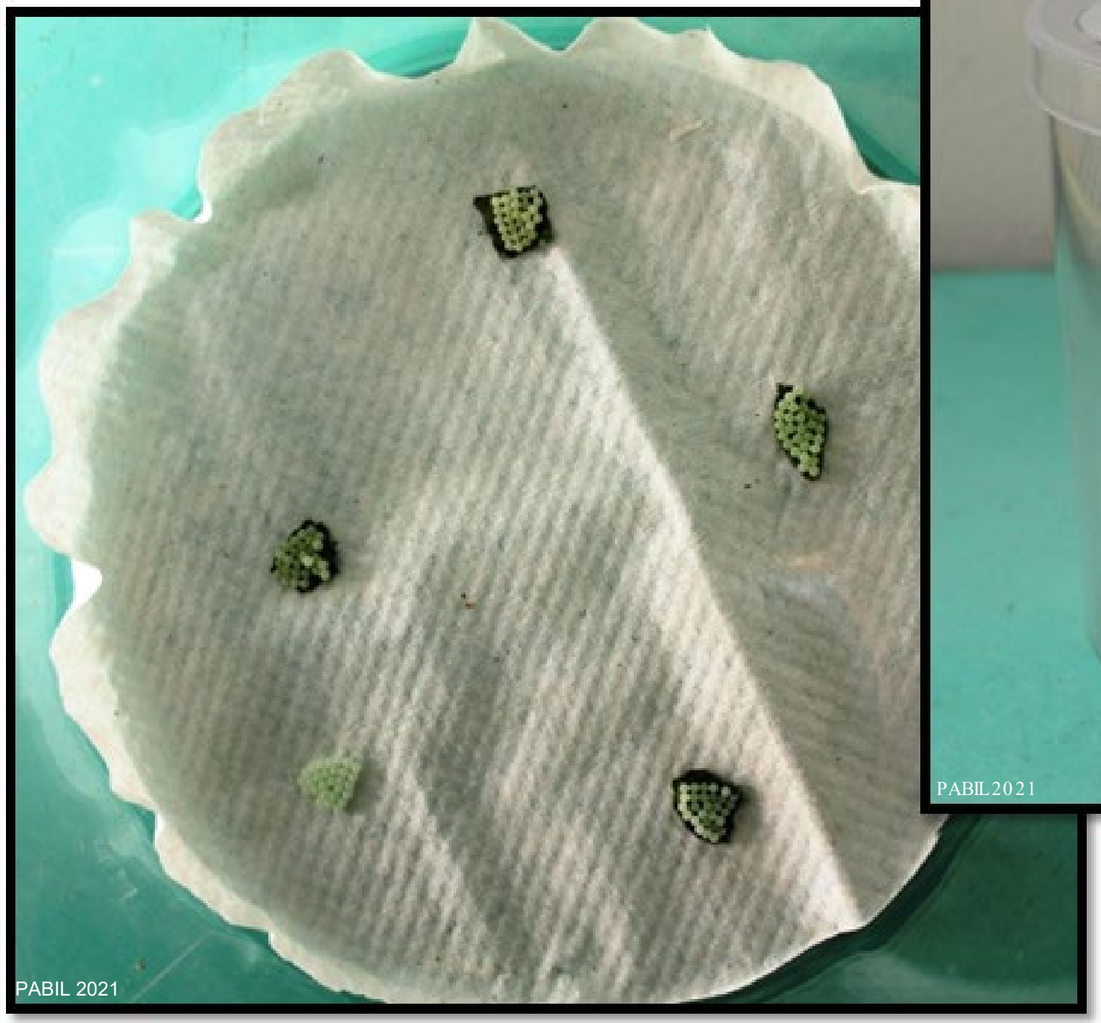
Production Timeline

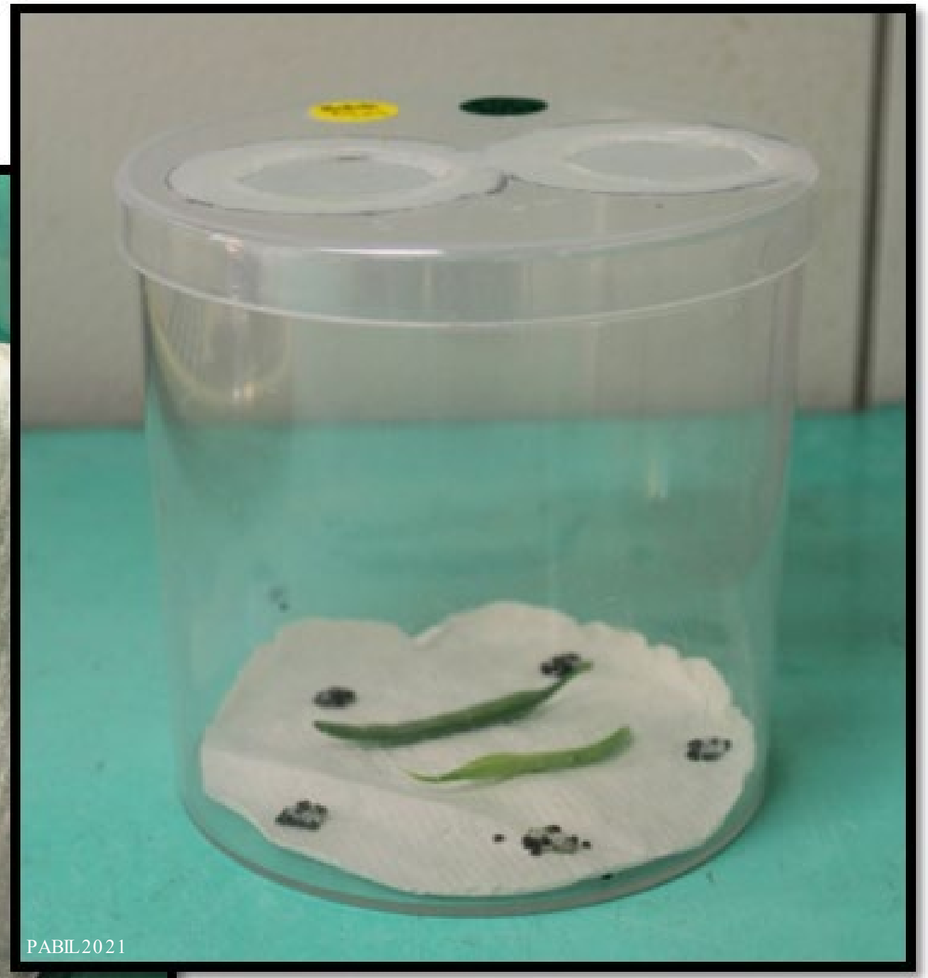


Collecting Eggs

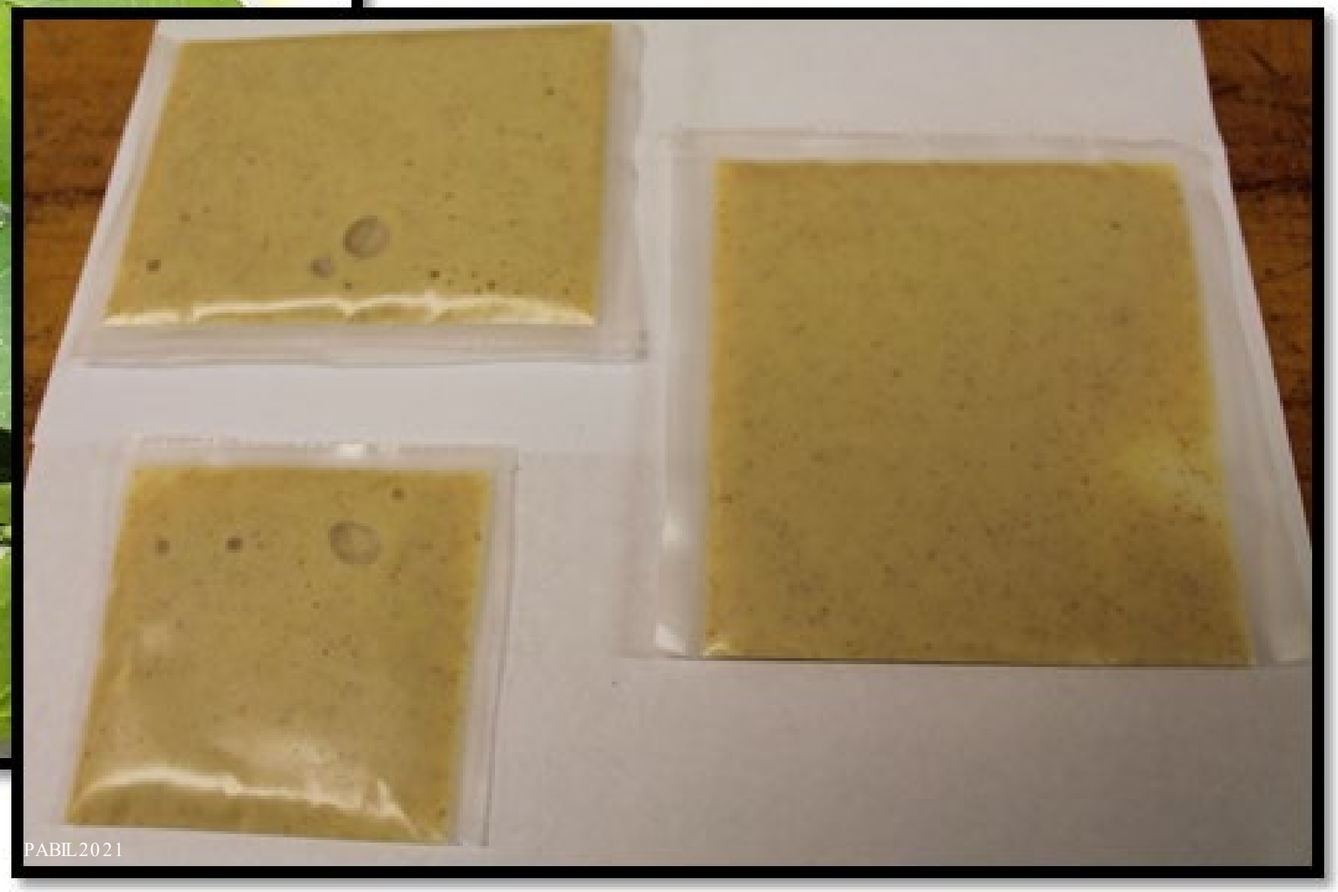
Collecting Eggs

Egg Set-Up

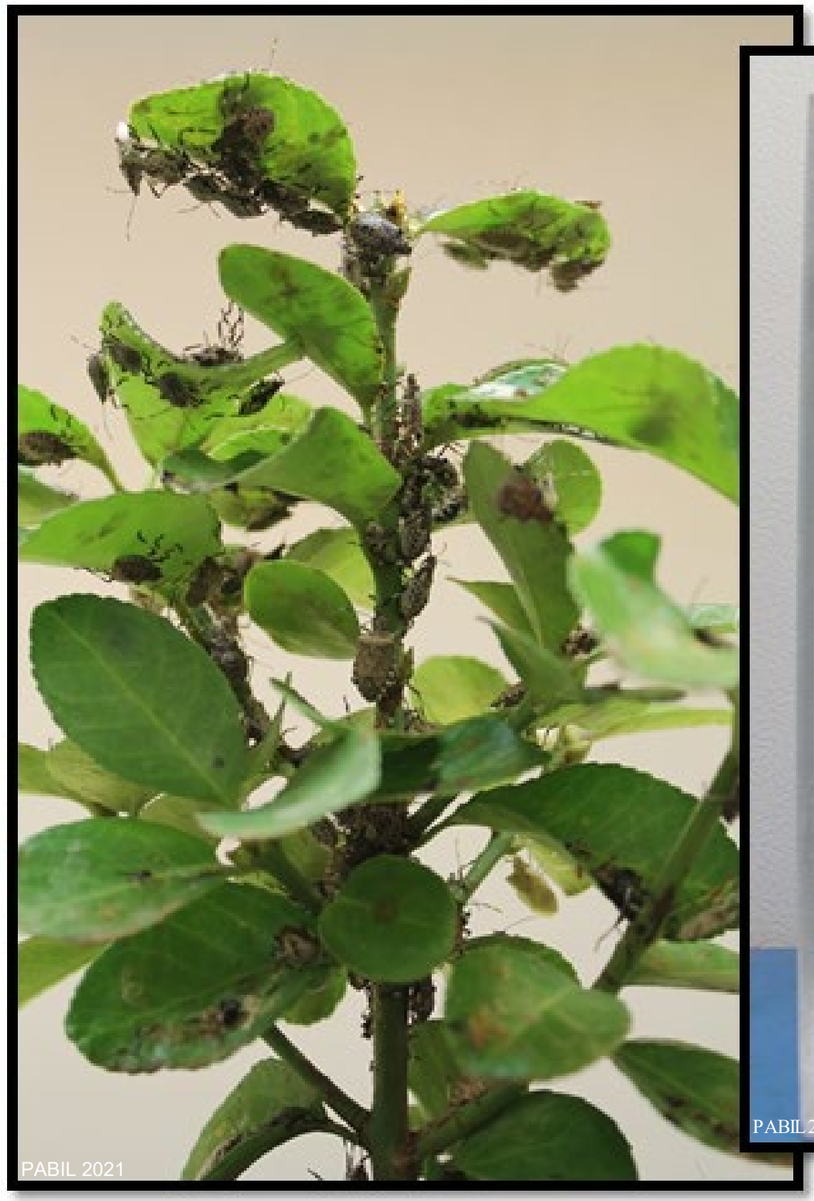




Feeding BMSB

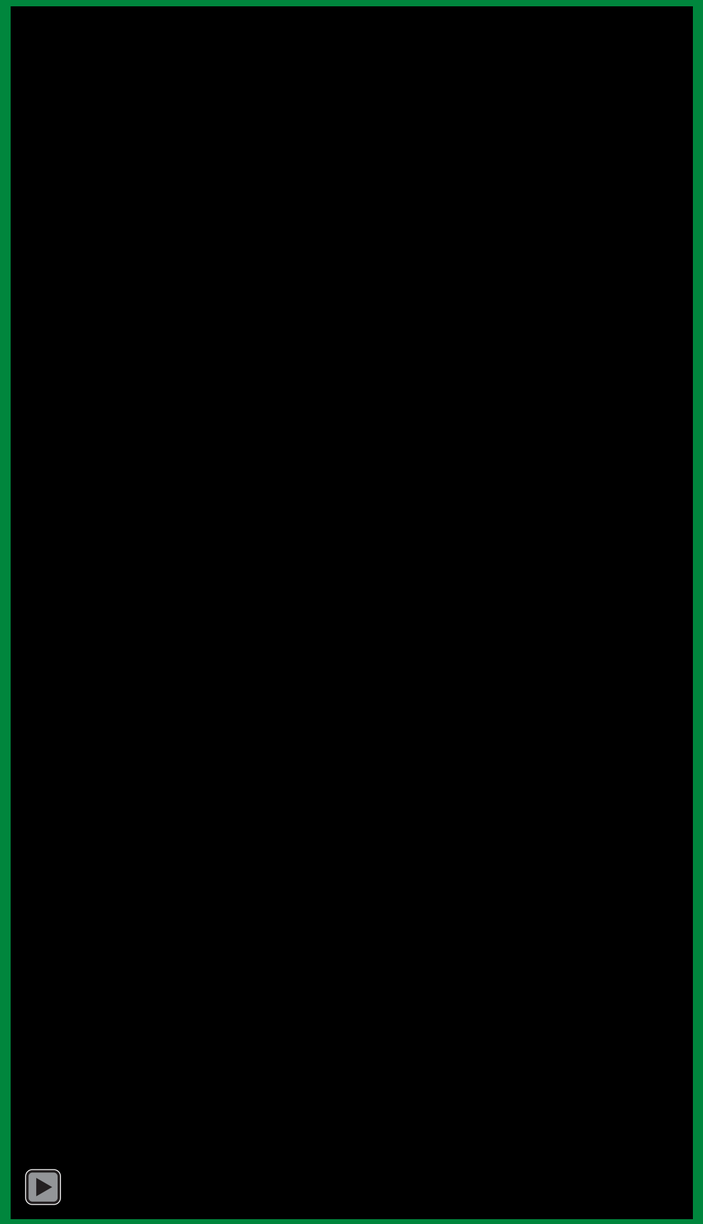


Production Box

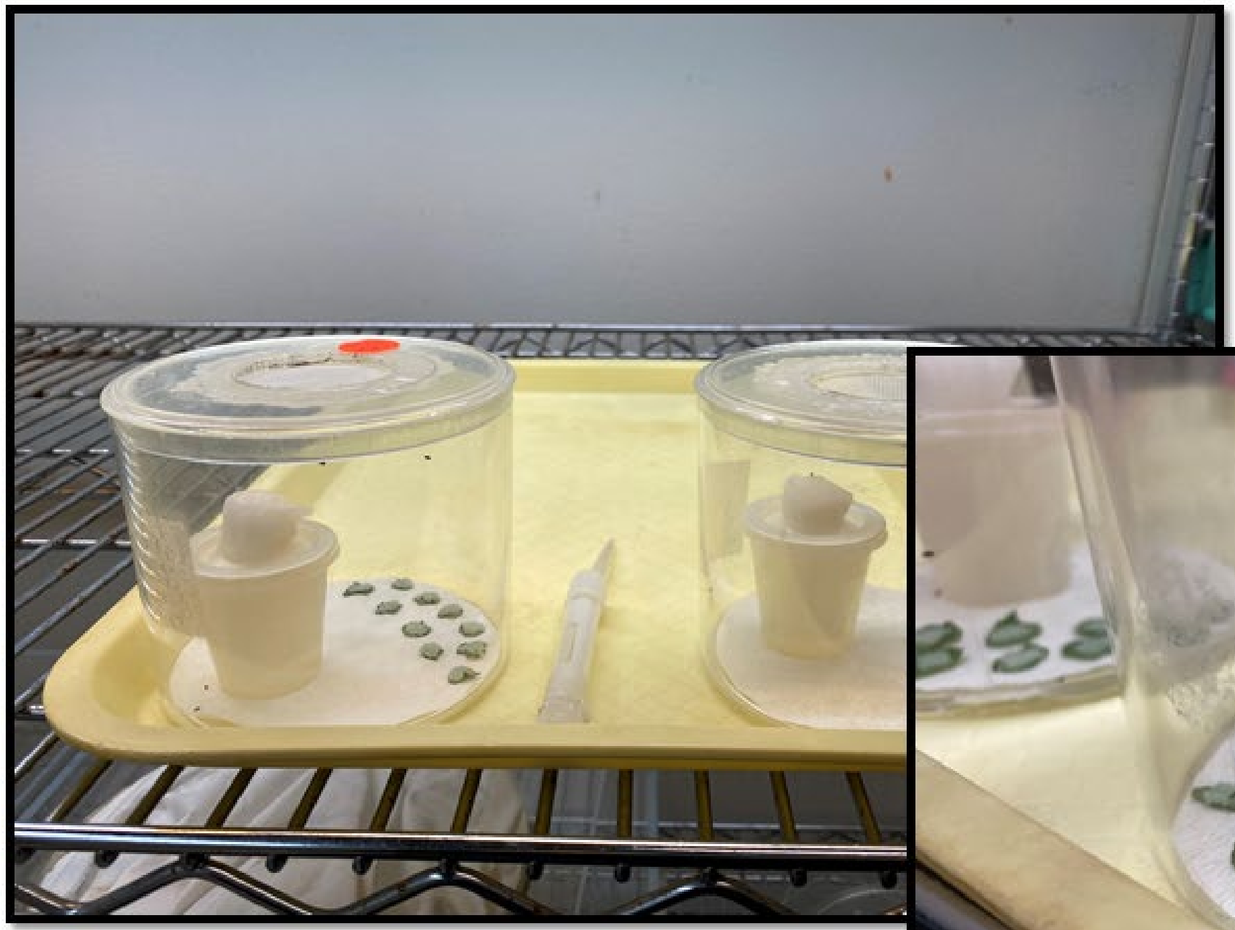


Egg Laying Box

Egg Laying Box



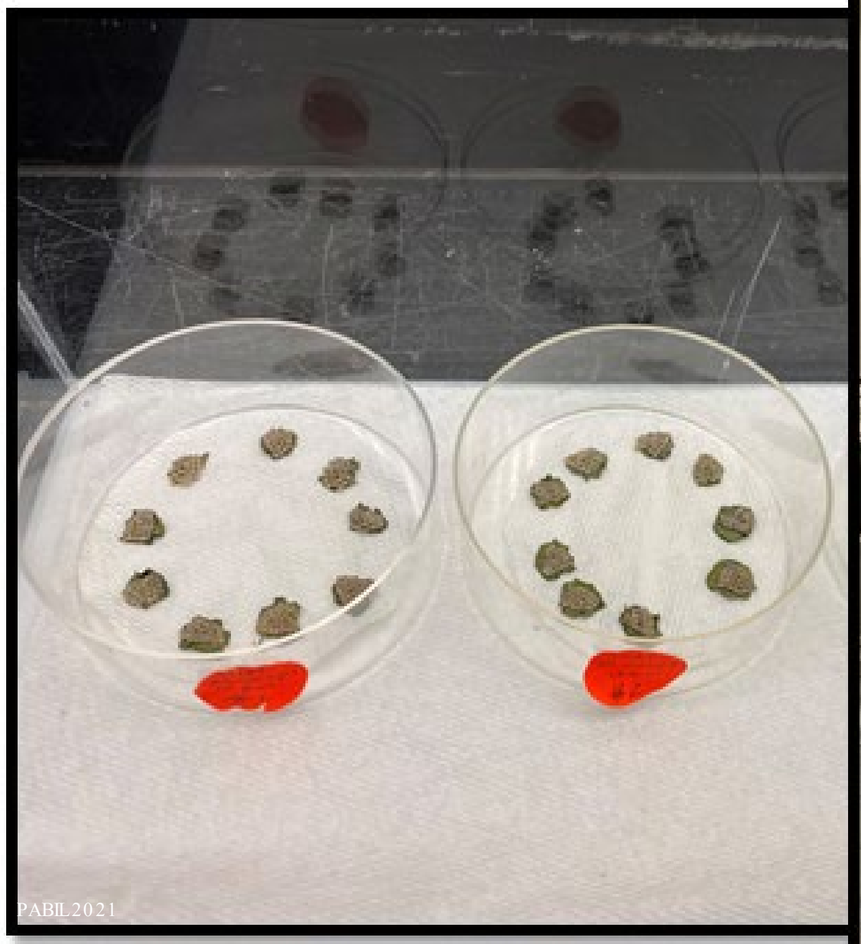
Setting a Sting Container

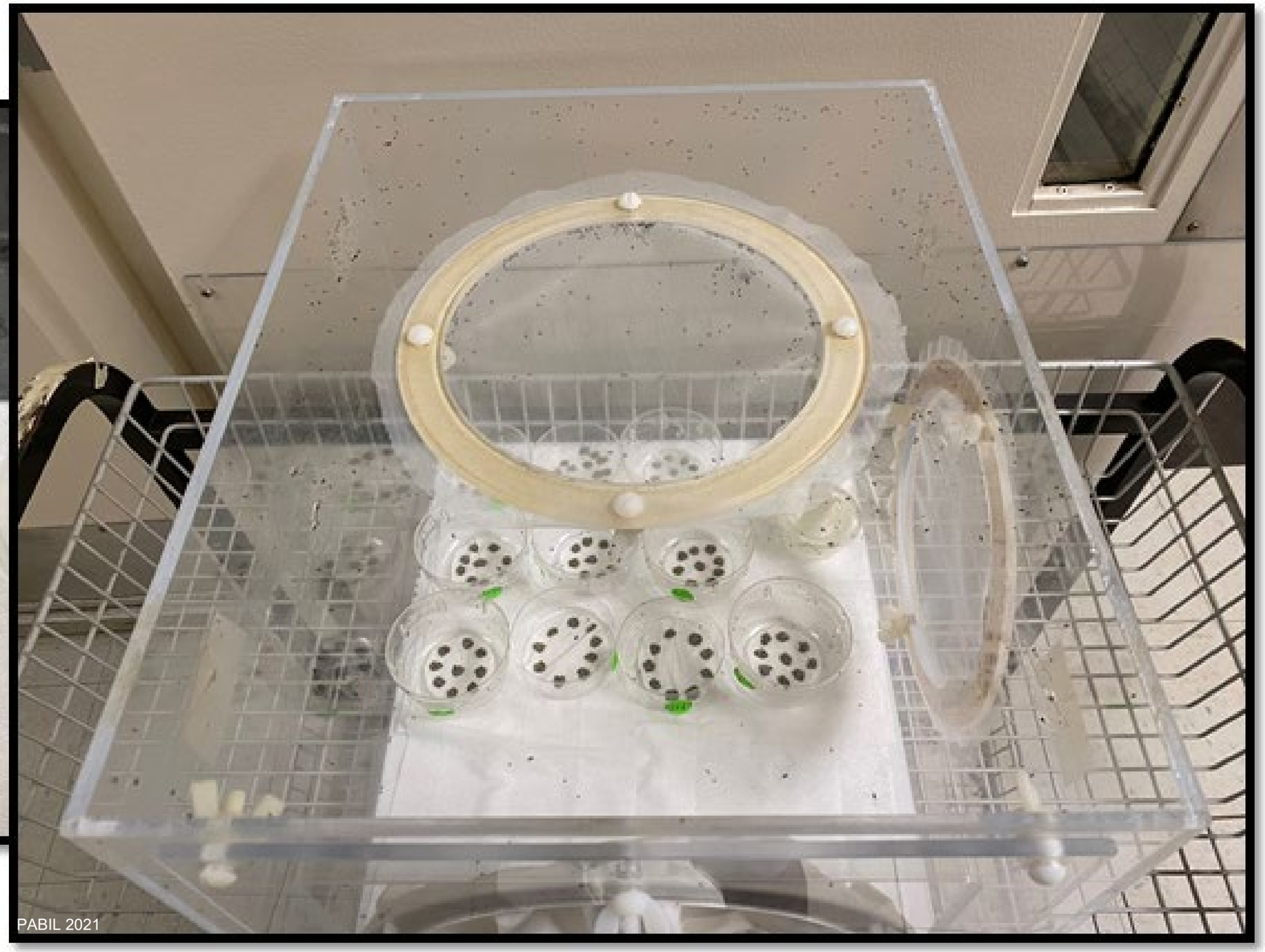


PABIL 2021

Stinging

Adults Emerge





Swallowworts

Black swallowwort & Pale swallowwort

VS

Hypena opulenta

The weeds

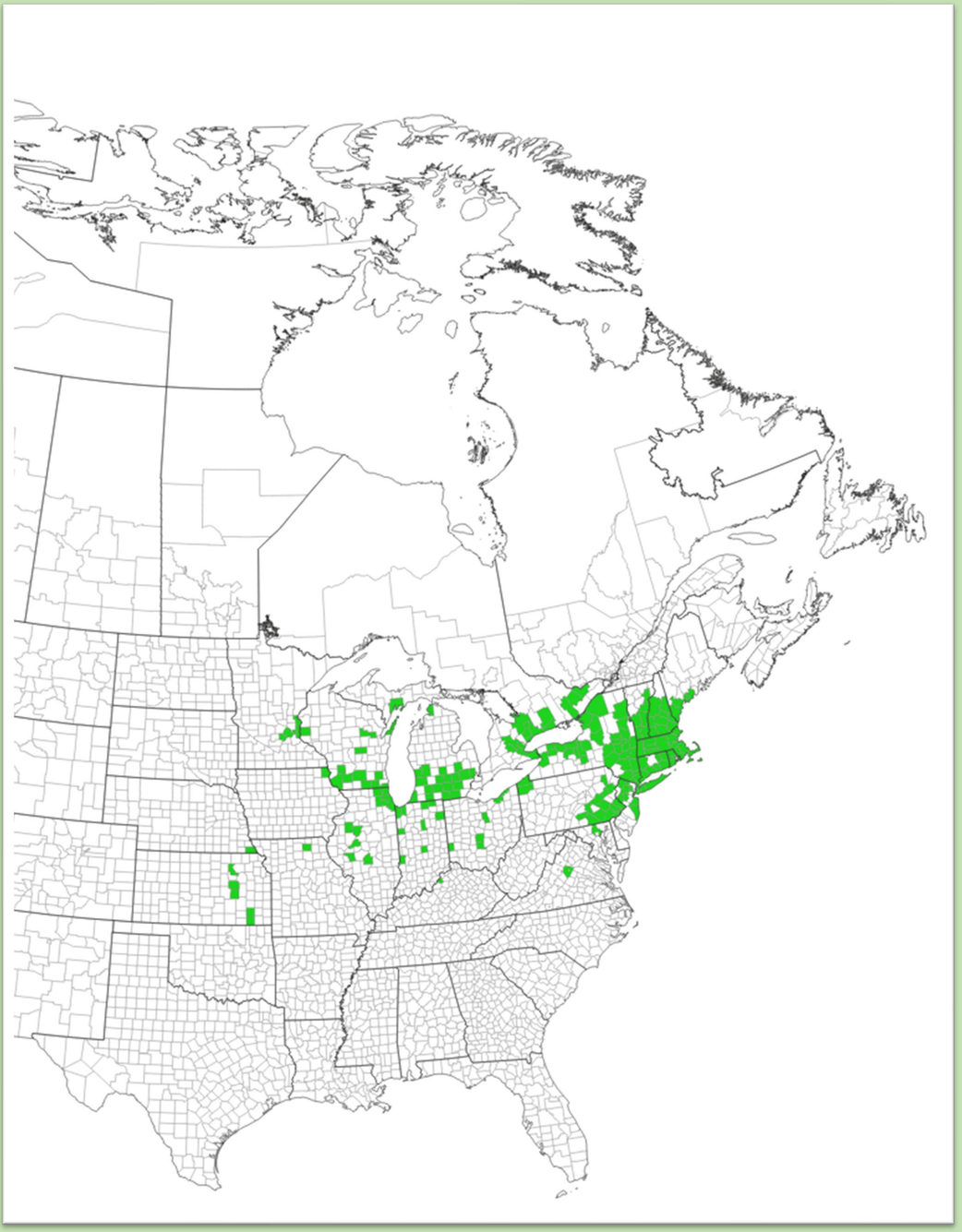
- Names
  - Black swallowwort = *Vincetoxicum nigrum* = *Cynanchum louiseae*
  - Pale swallowwort = *Vincetoxicum rossicum= Cynanchum rossicum*
  - “Dog-strangling vine”
- Dogbane family (with milkweeds)
- Native to Eastern Europe – invasive in Canada and USA

The problem

- First “escape” - MA mid-1800s
- Aggressive vine, crowds out natives, including root systems
- Monarch butterflies will lay eggs on them and not survive
- Toxic to livestock

How invasive?

- Wind-dispersed seed
- Root-crown divisions
- Extensive root system
- Self-fertilization



Range

- Black swallowwort
  - Ontario – Northeastern US – west to Missouri
- Pale swallowwort
  - most abundant - lower Great Lakes Basin
  - New York, Connecticut, Indiana, Massachusetts, Michigan, New Hampshire, New Jersey, and Pennsylvania, Ontario

Mechanical Management

- Small patches
  - by hand
  - MUST remove roots
- Large patches
  - ***Aggressive*** mowing
  - ONLY when seeds are immature, otherwise disperses seeds!
  - Intermittent mowing = denser regrowth!

Chemical Management

- See Michigan State and other state extension programs for more
- Must ***repeat several years*** to kill smaller plants and rootmasses
- Glyphosate as a foliar spray June (during flowering), repeat August.
- Triclopyr as a foliar spray once pods begin to develop
- Adjuvant to penetrate waxy leaves: vegetable oil based multi-purpose adjuvant on upland sites or a wetland-approved non-ionic surfactant in wetlands.

Classical Biological Control with *Hypena*

- *H. opulenta* approved for release in 2017
- Imported from swallowworts' native range
- Pros
  - Larvae defoliate plants
  - Promising climate match
- Cons
  - Intensive rearing effort
  - Only 1 or 2 generations per year
  - In NJ: Limited release sites

Classical Biological Control with *Hypena*

1. Propagate host plants
2. Get *Hypena*
3. Develop Rearing Strategy
4. Develop Field Survey and Release Methods

Greenhouse propagation

- Sourced from NJ & RI
- Primarily root divisions
- Occasional seed propagation

Bringing *Hypena* to NJ

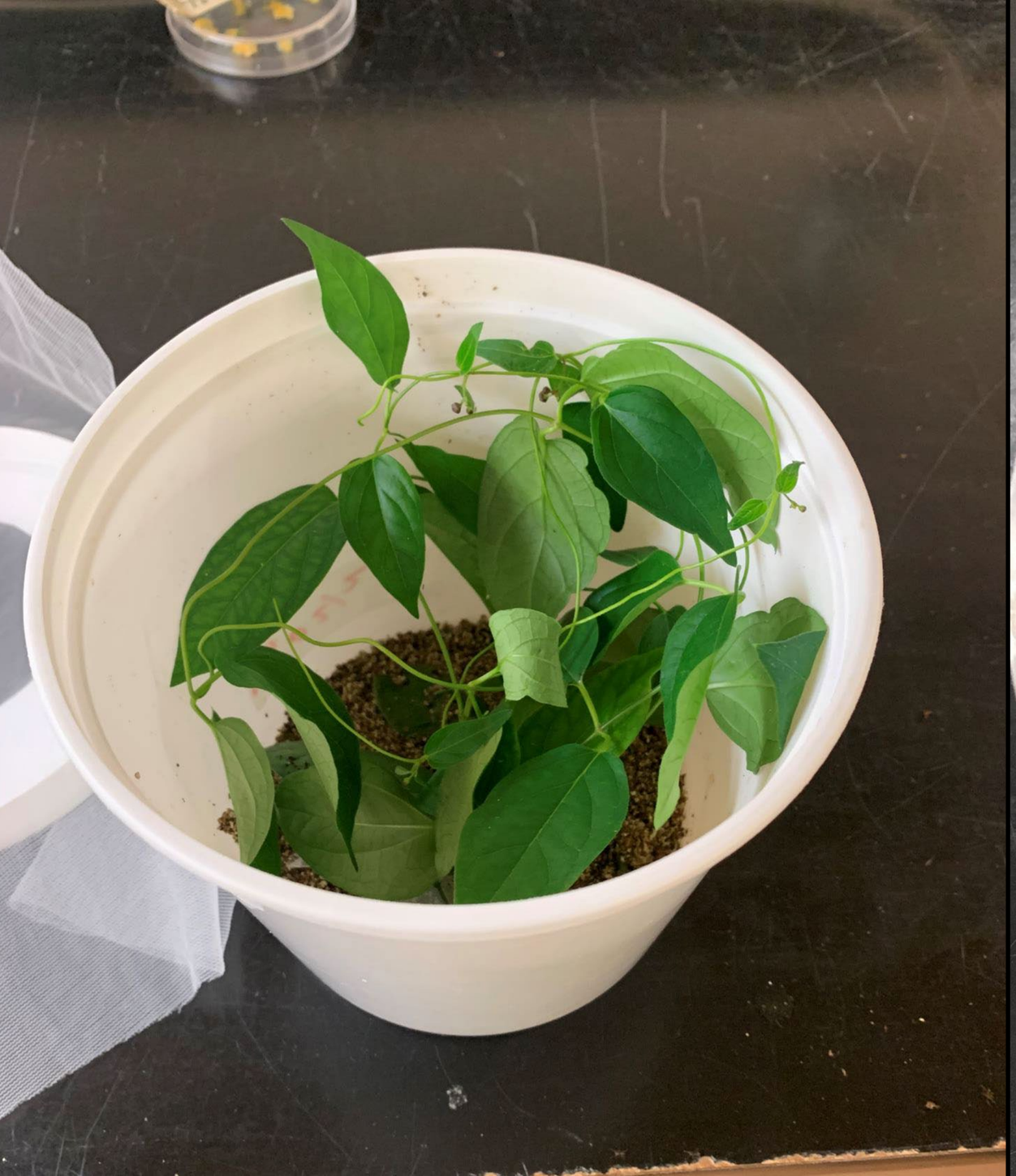
- Hand carry larvae – high mortality
- Ship pupae – better!

Developing Mass Rearing Techniques

- Considerations:
  - Temp / RH
  - Density
  - Pupation substrate
  - Sex determination

Defoliation

Pupae prefer to make cocoons in soil



Field Releases

- Locate Sites
  - Host plant
  - Permission
  - Accessibility
- Monitoring
- Release Methods

Field Releases

- Cage Releases
- Larvae vs Pupae


06/04/2019

Hope & Challenges

- Complete larval development observed summer 2021!
- Frequent mowing damage
- Flooding

Thinking about Mass Rearing…

- Balance – maximize insects per cage vs maximize fitness (quality vs quantity)
- Experimenting – how much of the colony to risk on a new method?
- Getting to know your species' needs and limits
- Example:
  New *Hypena* project

Acknowledgements

NJDA - Phillip Alampi Beneficial Insect Laboratory Staff
USDA APHIS Cooperative Agreements
NJ Soybean Board

Check us out on GETTING CURIOUS WITH JONATHAN VAN NESS on Netflix!

Questions?