Forschungsinstitut
für Nutztierbiologie

Framework and Design of the FBN Breeding Program for Enhanced Efficiency in Black Soldier Fly (*Hermetia illucens*)

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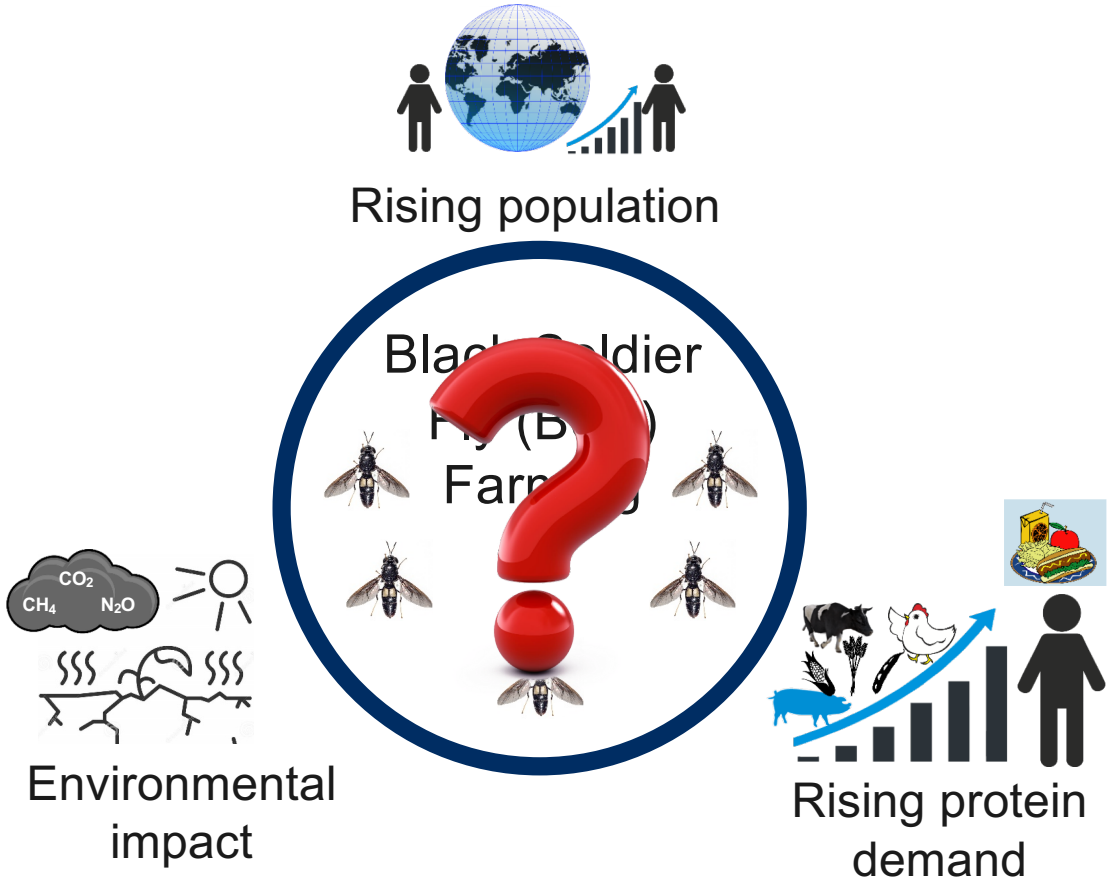
Why BSF Farming?



Challenges in BSF Breeding

- Communal rearing & pedigree tracking:
  - ✓ Small size and difficulty in tracking individual performance
- Environmental noise
  - ✓ Variation in rearing conditions affects phenotypic data accuracy
- Short lifecycle
  - ✓ Limited time for data collection and selection

Implication: These challenges restrict genetic gains and need robust systems

https://www.valusect.eu/taxonomy/term/14

BSF in a rearing cage

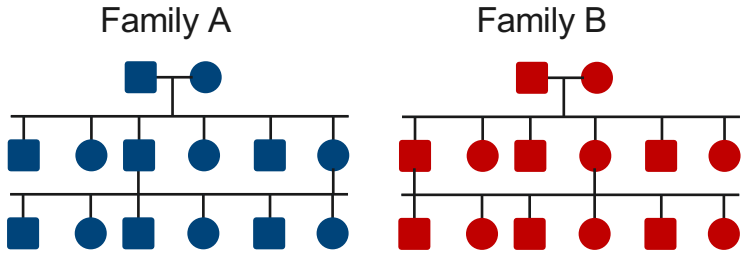
Selection Methods

Phenotypic Selection

- Pros: Simple, no need for pedigree tracking.
- Cons: Impacted by environmental noise, low precision.

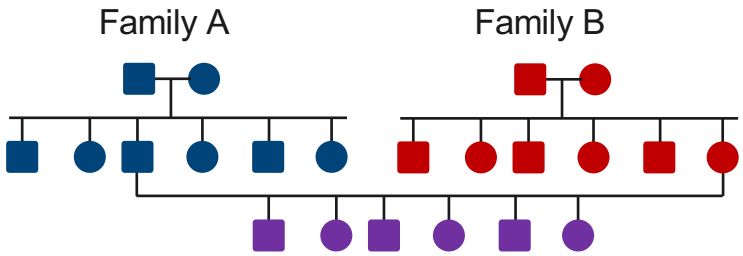
Within-Family Selection

- Pros: Enhance short-term gains.
- Cons: Depletes diversity, impractical for communal settings.



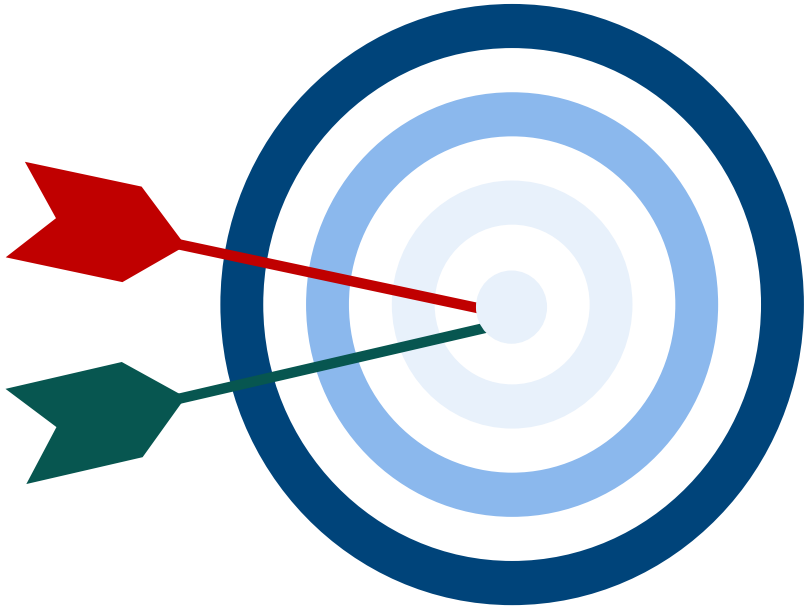
Among-Family Selection

- Pros: Reduces environmental noise, reliable for communal systems.
- Cons: Requires structured matings, risk of inbreeding if diversity unmanaged.

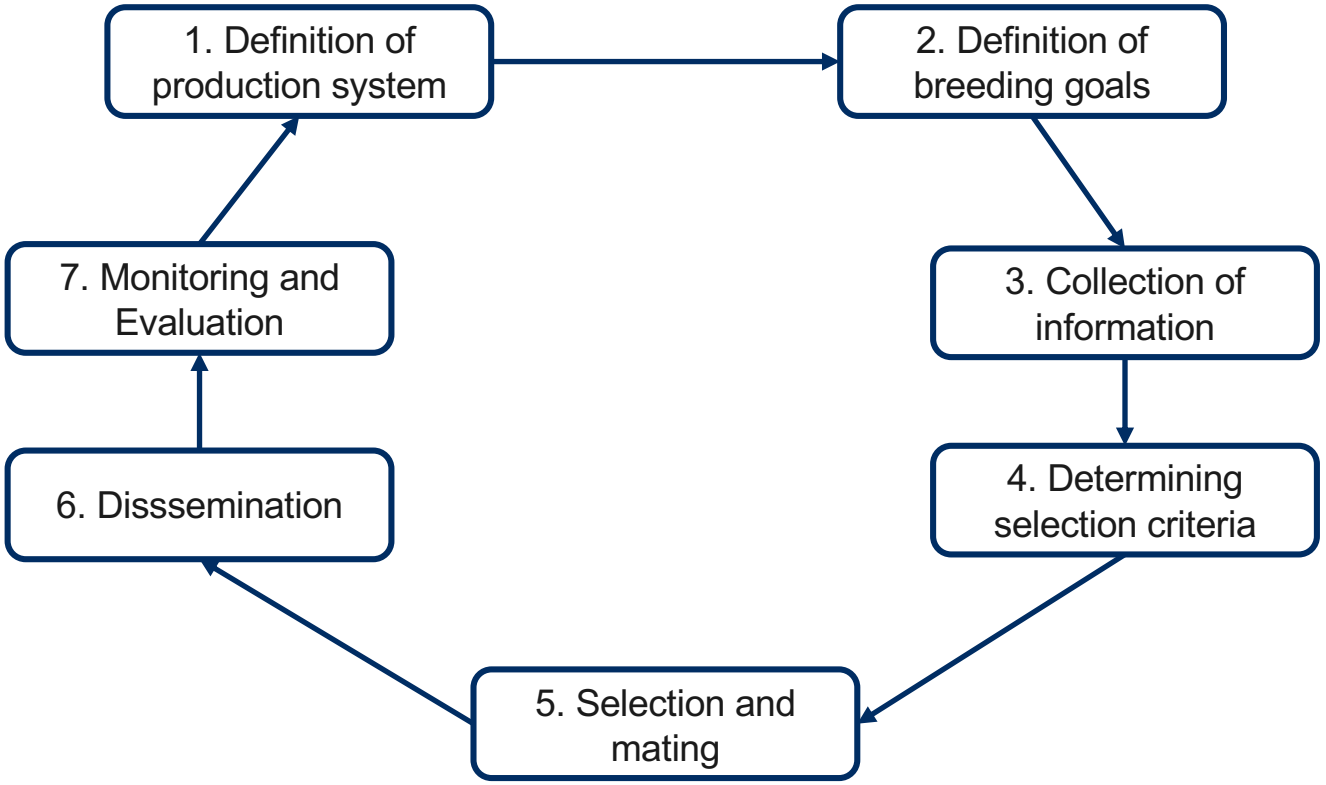


Objectives

- Establish a structured BSF breeding program
- Enhance feed conversion, larval biomass yield and survivability



Key Elements of a Breeding Program



ABG textbook from WUR

Breeding Program Design

1. Definition of production system

- Diverse base population from 3 strains; random mating for 5 generations
- Communal rearing under controlled conditions with the Gainesville diet

2. Definition of breeding goals

- Feed conversion ratio (FCR)
- Larval biomass yield
- Survivability

https://www.plantandfood.com/en-nz/article/insects-key-weapon-against-food-wastage

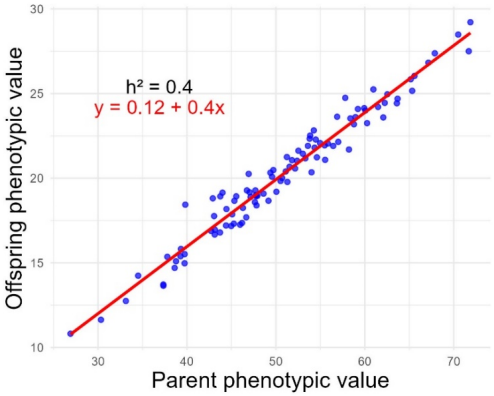
3. Collection of information

- **Phenotypes:** Traits of interest
- **Pedigree:** Family tracking for diversity and selection
- **Genotypes:** Molecular markers (if possible)
- **Environmental Data**: Rearing conditions to control variance.

Selection Criteria and Mating Strategies

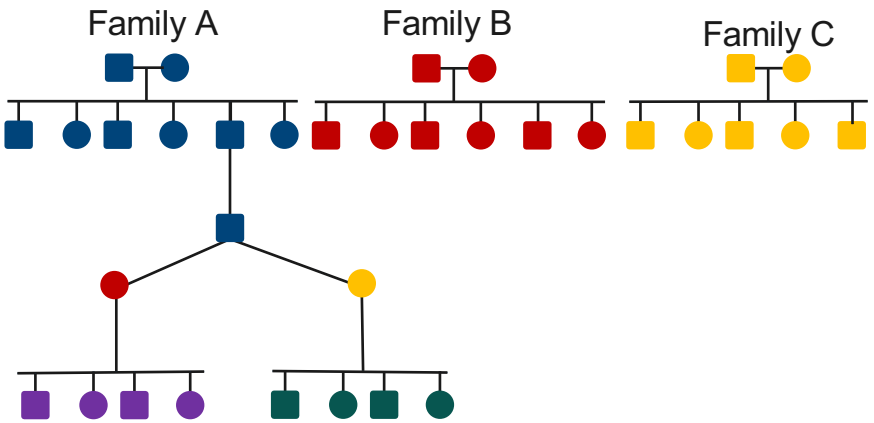
4. Selection Criteria

- Genetic parameter estimates, e.g., heritability and genetic correlations.
- Breeding value estimation
- Selection index for a balanced long-term genetic gain



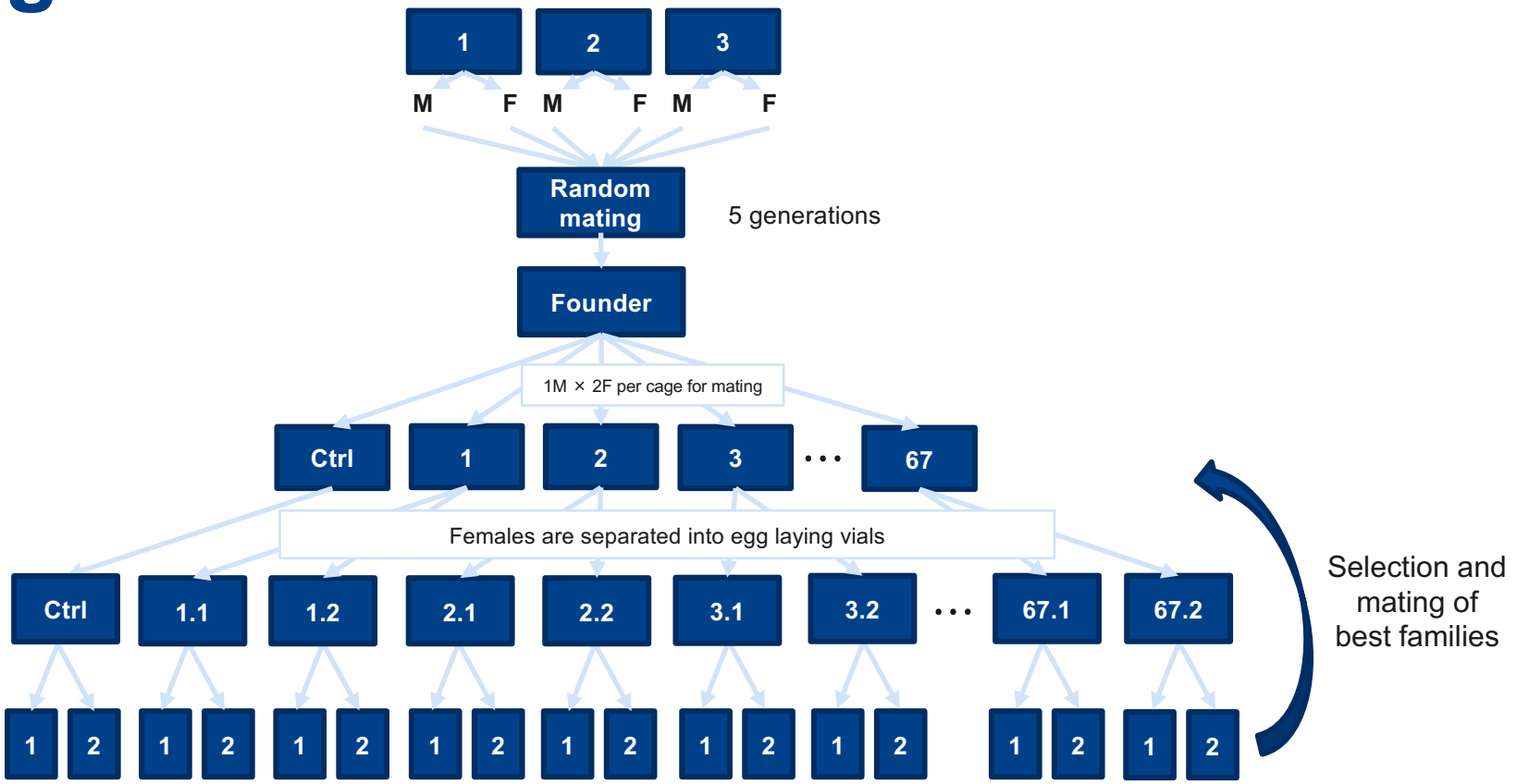
5. Selection and Mating Strategies

- Among-family selection to reduce environmental noise.
- Half-sib mating design for diversity and inbreeding control.
- Optimized pairing to maximize trait improvement.



Breeding Plan Overview

Assuming 3 strains



Founder population
(genetically diverse base)

Selection and Mating

Egg laying vials

Eggs divided into 2 to create subgroups
Performance testing
Data analysis
Genetic parameter estimation

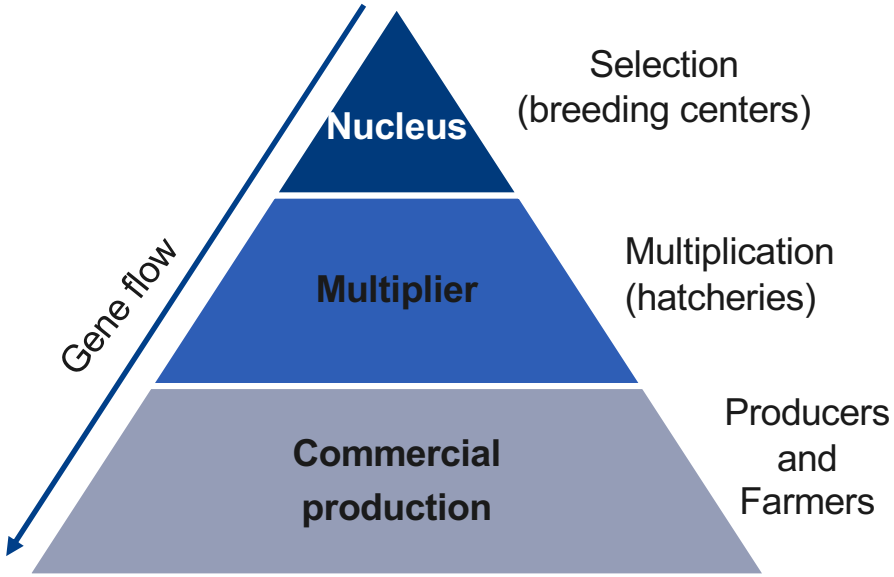
Dissemination and Monitoring

6. Dissemination of genetic improvement

- Pyramid structure: Gene flow from the nucleus to commercial levels.

7. Monitoring and evaluation

- Performance testing for key traits.
- Track genetic progress and inbreeding coefficients.
- Adaptive management to refine strategies.



Pyramid breeding structure

Current Progress and Next Steps

Current progress

- Development of cages for base population.
- Environmental controls installed (light, temperature, humidity).
- Evaluating mating performance and egg-laying.

Next steps

- Conduct a pilot breeding program.
- Assess labour requirements and phenotyping challenges.
- Apply for research funding to scale the program.

Conclusion

Key objectives

- Develop a sustainable BSF breeding program
- Improve traits like FCR, larval biomass yield and survivability

Challenges

- Tracking individual performance.
- Short lifecycle limits data collection.
- Balancing genetic progress with diversity.

BSF larvae

Call to action

- Secure funding for personnel, infrastructure, and automation.
- Build collaborations to scale innovations.

Thank you very much for your attention

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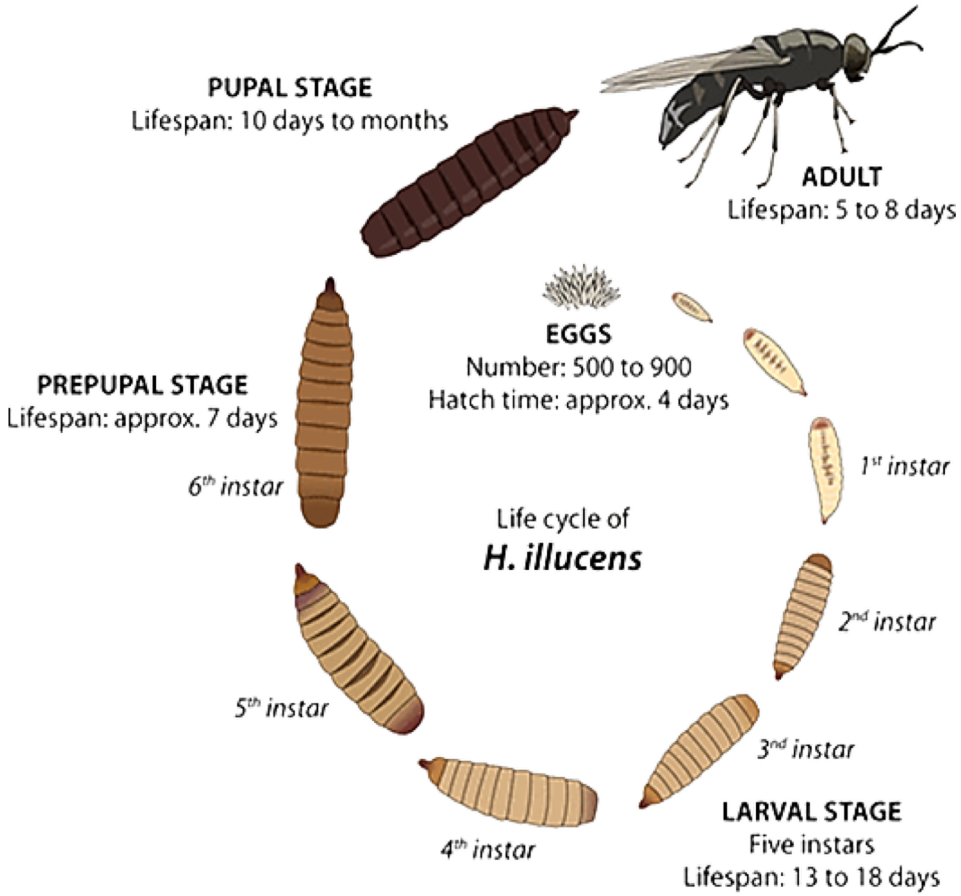
Life Cycle of BSF



- BSF life ≈ 45 days (5-6 weeks)
- BSF has five major stages

https://fabo.org/dca/black-soldier-fly-farming/hvp/43236-bsf-life-cycle