



Forschungsinstitut
für Nutztierbiologie

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

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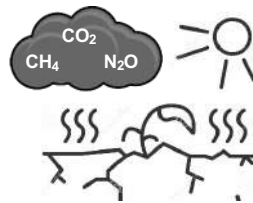
11. Februar 2025 · Dummerstorf



Why BSF Farming?



Rising population



Environmental
impact



Rising protein
demand



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



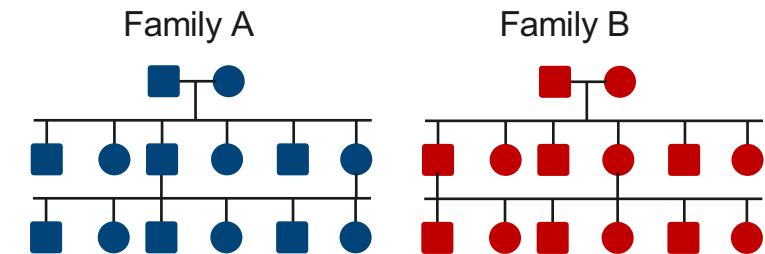
Phenotypic Selection

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



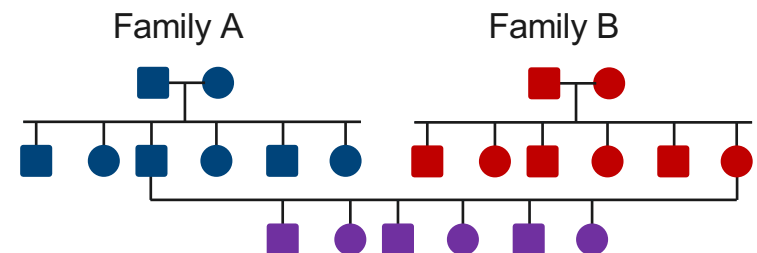
Within-Family Selection

- 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.





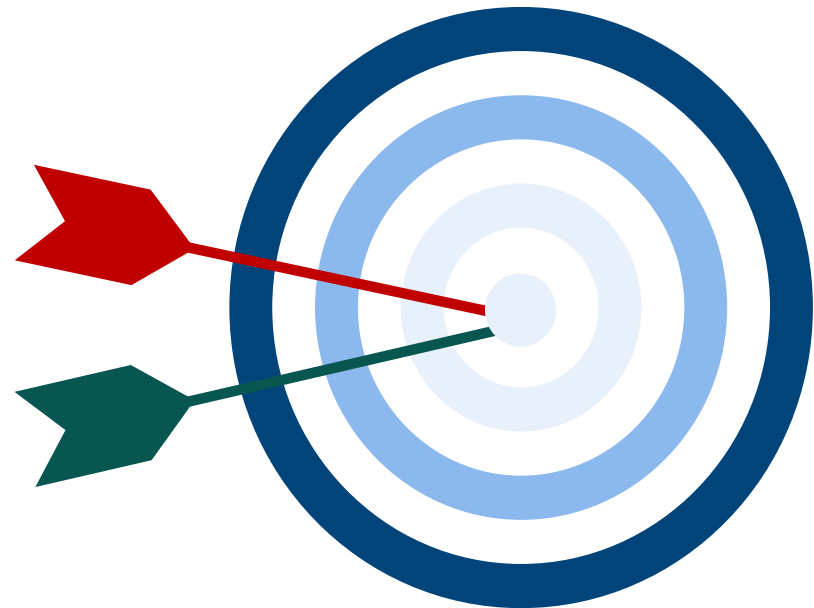
Objectives



Establish a structured BSF breeding program

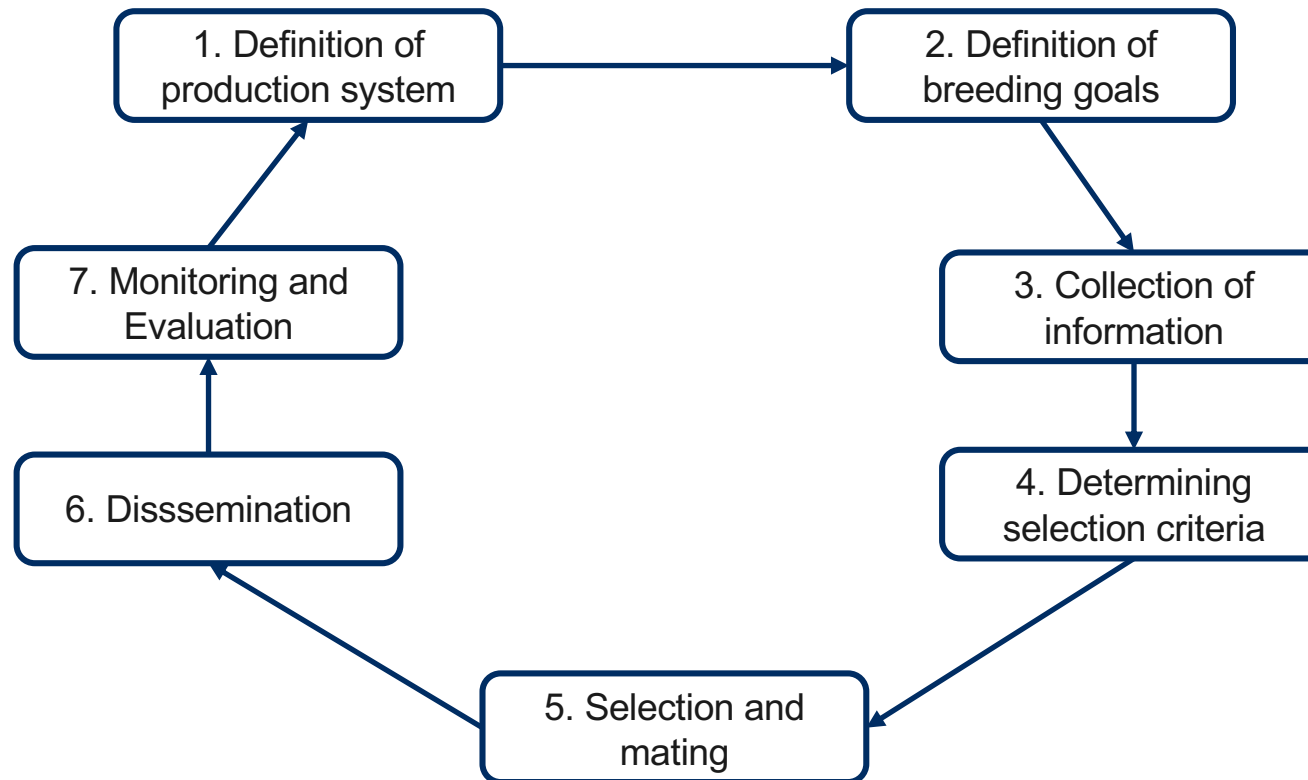


Enhance feed conversion, larval biomass yield and survivability





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



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.



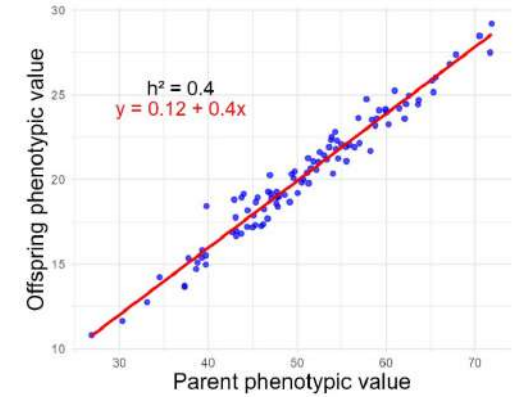
<https://www.plantandfood.com/en-nz/article/insects-key-weapon-against-food-wastage>

Selection Criteria and Mating Strategies



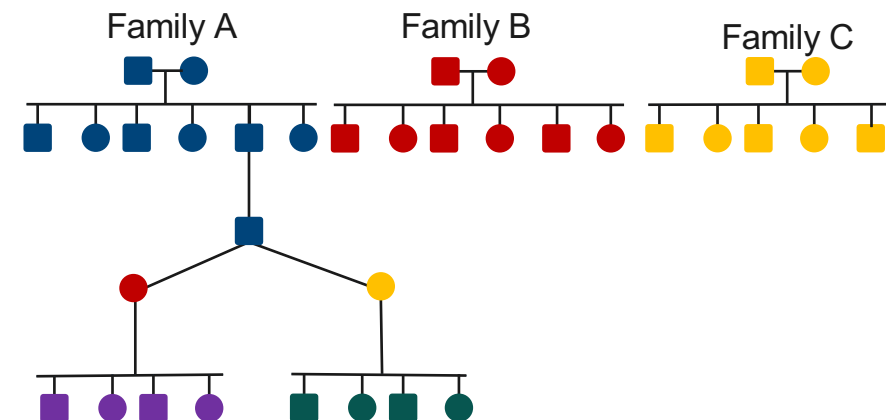
4. Selection Criteria

- 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

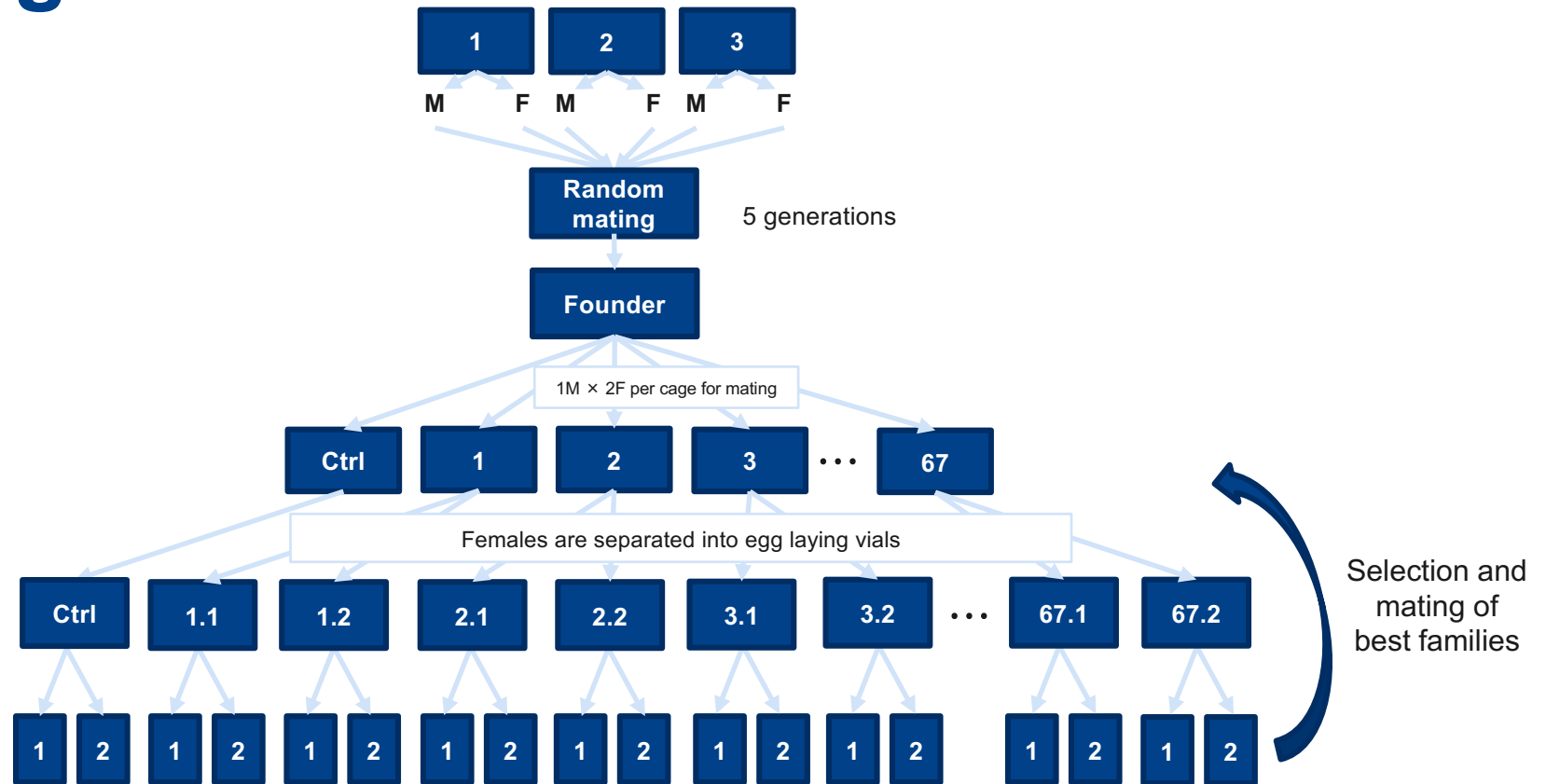
Assuming 3 strains

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



Selection and
mating of
best families



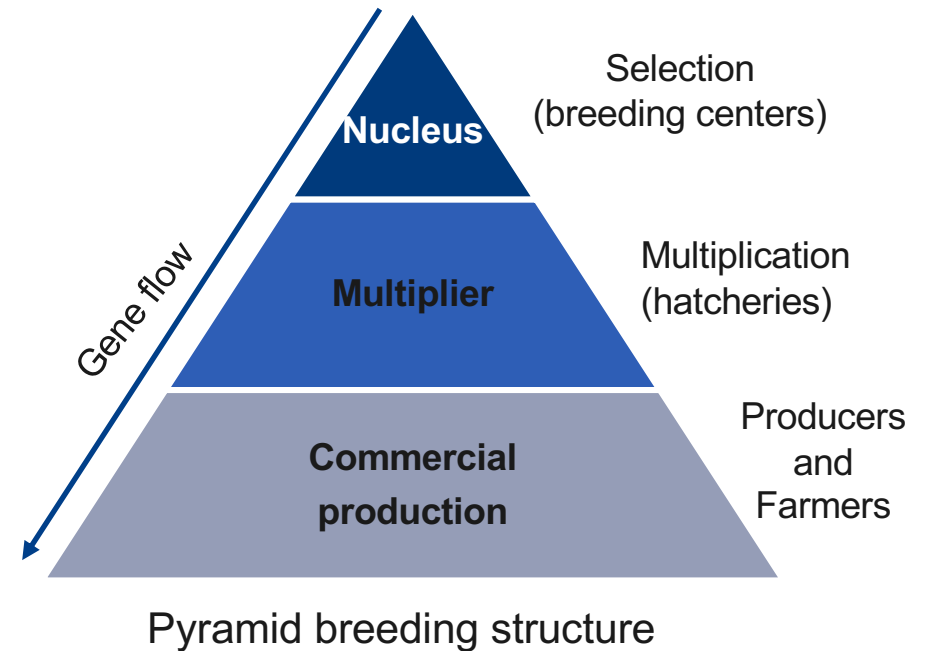
Dissemination and Monitoring

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.





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.

Call to action

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



BSF larvae

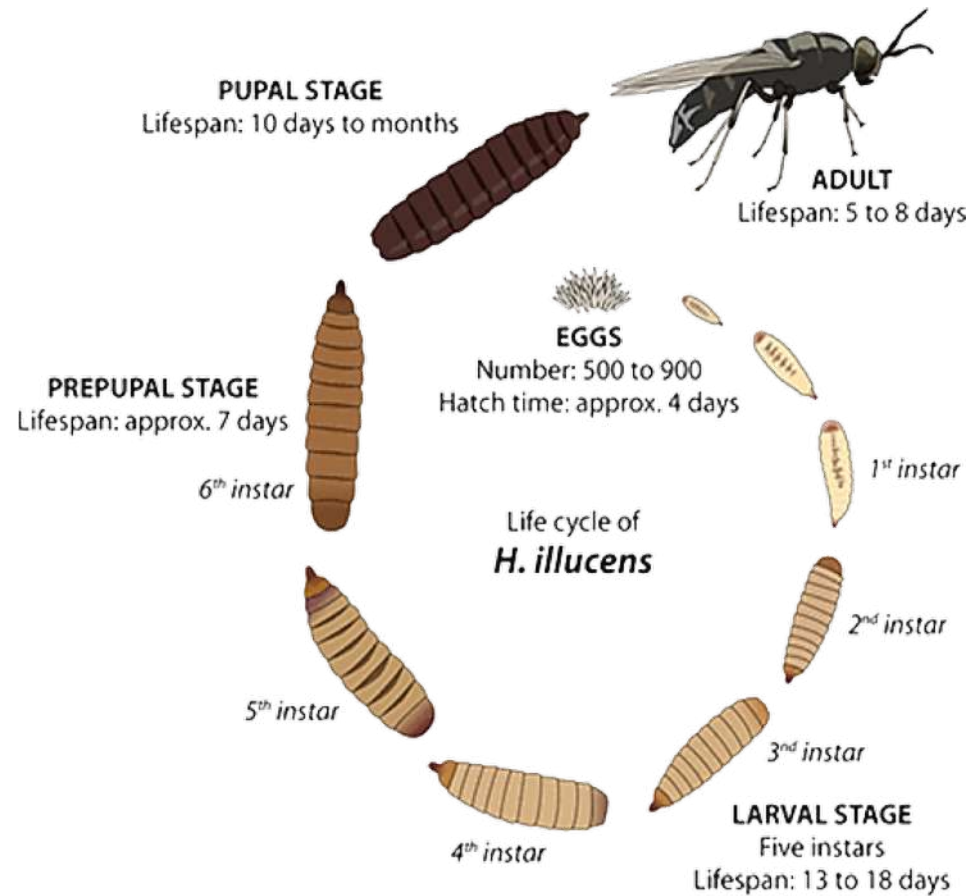
Thank you very much for your attention



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Life Cycle of BSF



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