INSECT-IMP

cost
EUROPEAN COOPERATION
IN SCIENCE & TECHNOLOGY

Nasekomo

Impact of Adult Body Size on Reproductive Performance in *Hermetia illucens* (Diptera: Stratiomyidae)

Yulia Riabtseva, Bartosz Grodzki, Marco Tejeda, Marc Bolard

Nasekomo

The black soldier fly (BSF, *Hermetia illucens*), known for its potential in transforming organic waste into valuable resources such as protein for animal feed, oil, and insect-based fertilizers.

There is still relatively little known about the adult biology of the BSF. The specific role of adult body size in determining reproductive performance remains largely unexplored.

.

Larger males *Hermetia comstocki* - **greater reproductive** success through lekking behaviour(Alcock, 1990).

Large males *H. illucens* displayed **higher** counts of **mating success**.

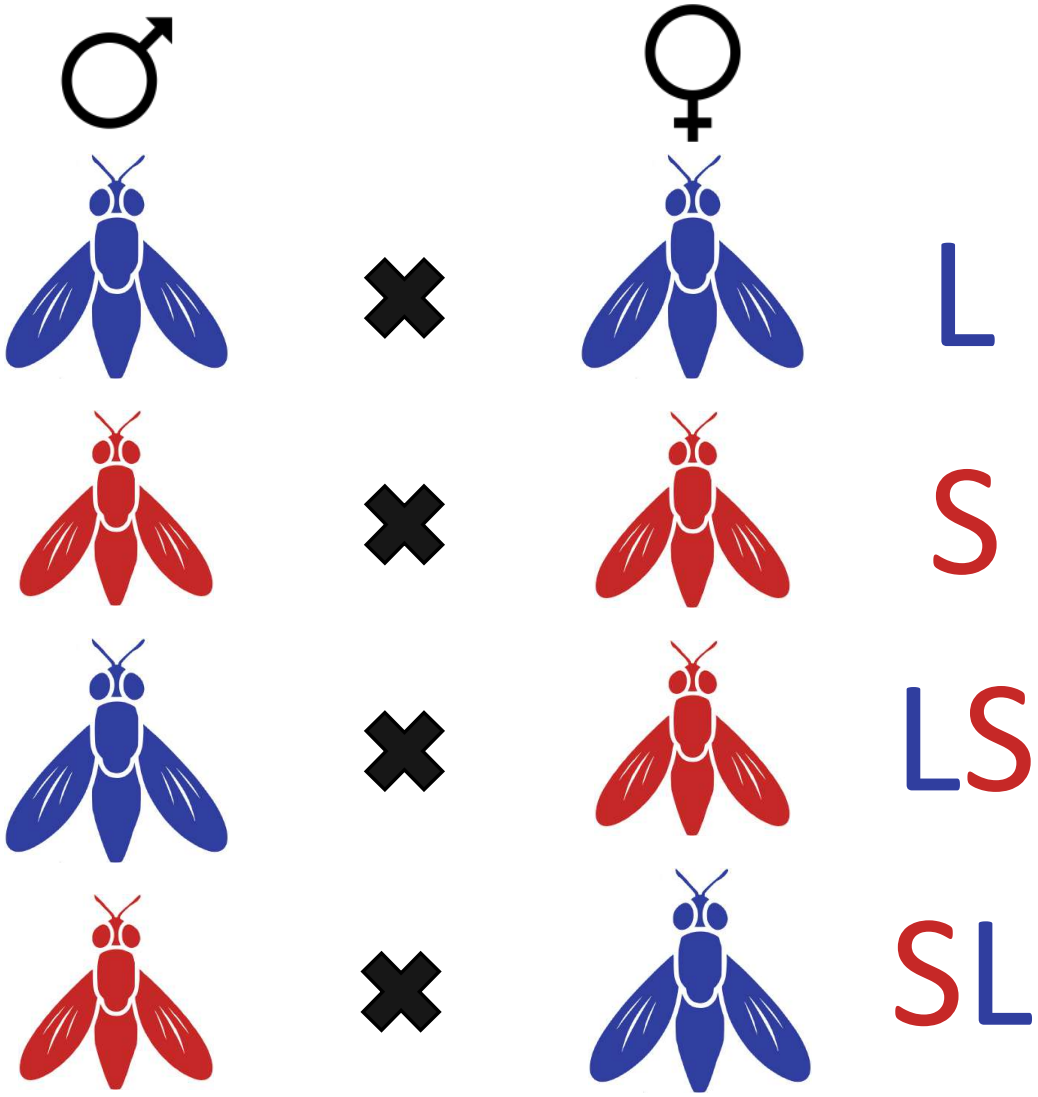
Large females were **more fecund** than small females. The egg hatch rates were potentially influenced by the size of adult male (Jones, Tomberlin, 2021).

Smaller males have a **reproductive advantage**. (McLachlan, Allen 1989). Aerobatic ability may be conferred by small size.

The objective of research was to investigate how adult body size influences the reproductive performance in BSF.

Nasekomo

Nasekomo



Adult fly density for all experiments was 60 flies/cage.

Three repetitions were conducted for each experiment.

Total number of investigated flies was **720.**

Nasekomo

Material and methods

Thorax Length (**TL**) was measured as an indicator of adult body size.

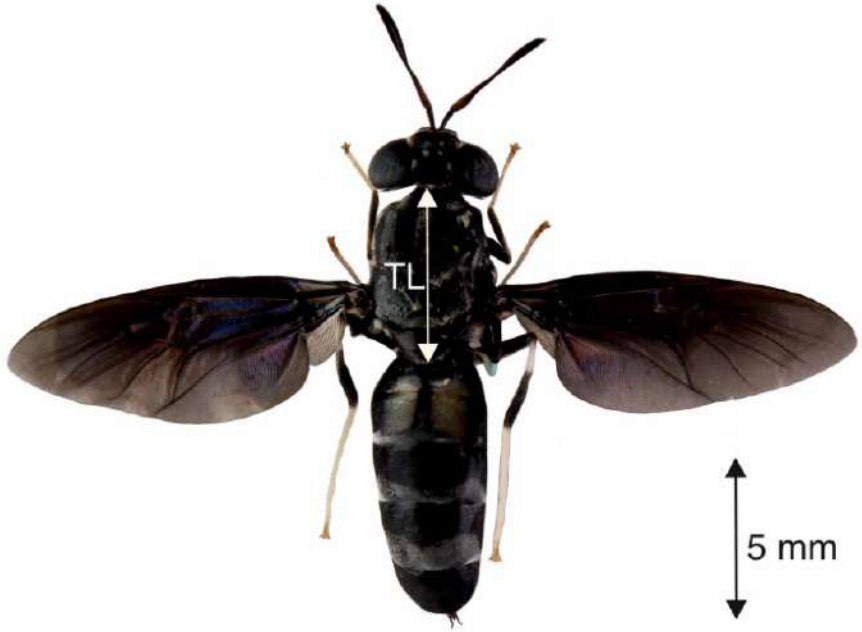
Females were randomly selected from each mating cages on daily basis during whole life cycle.

Flies were dissected.

We evaluated:

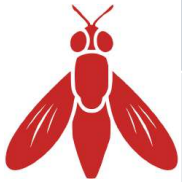
- **mating status**
- **ovarian development**
- **egg fertility**

Data were analyzed using IBM SPSS Statistics.



Nasekomo

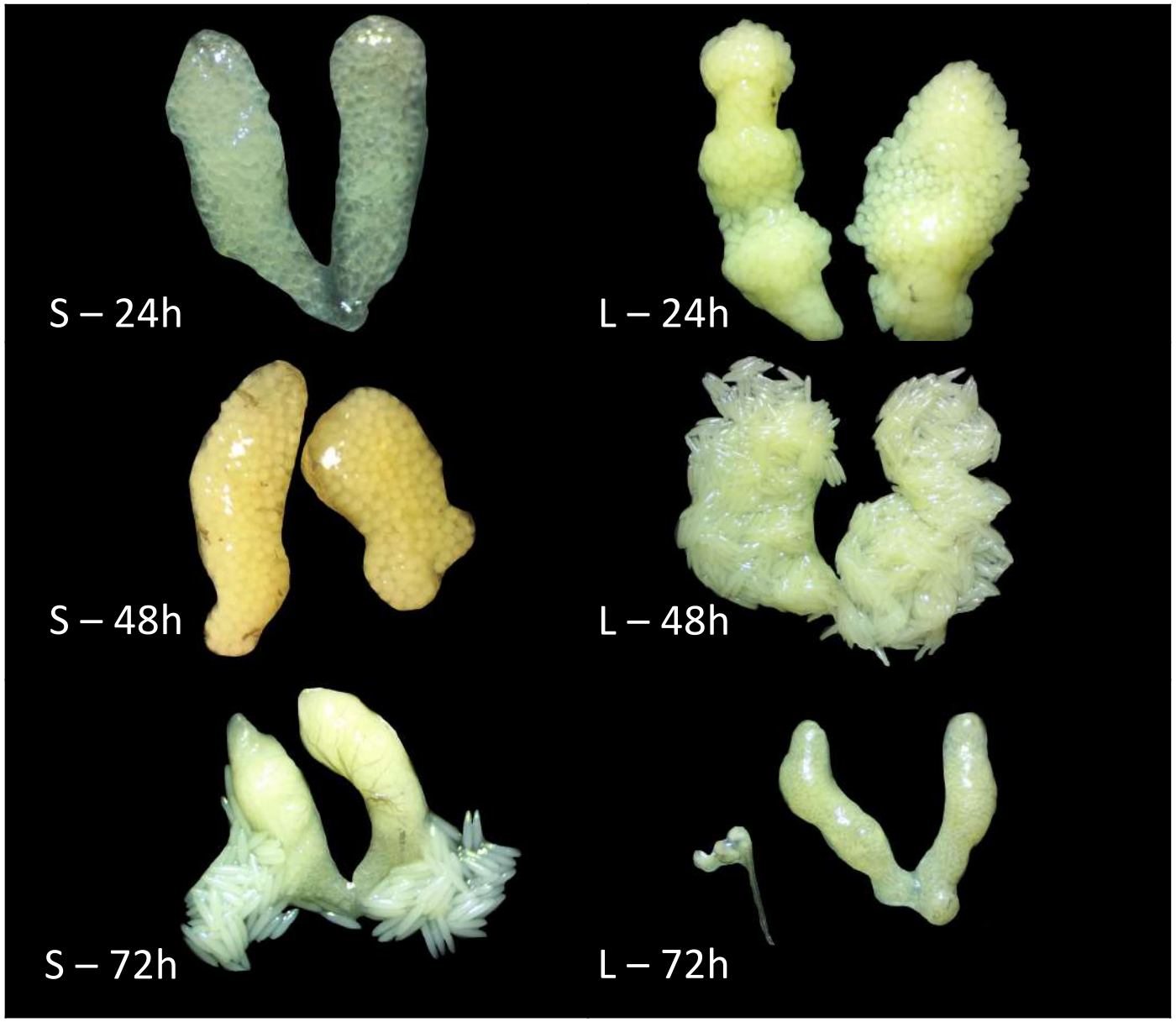
RESULTS AND DISCUSSION



	N	$\bar{x}$, mm	σ, mm	SE, mm	min, mm	max, mm
Males S	90	5.9	0.38	0.07	5.03	6.45
Females S	90	5.96	0.34	0.06	5.2	5.5
Males L	90	6.94	0.21	0.03	6.51	7.5
Females L	90	6.97	0.34	0.06	6.54	7.87

F_S = 0.363, p>0.001

F_L = 0.16, p>0.001



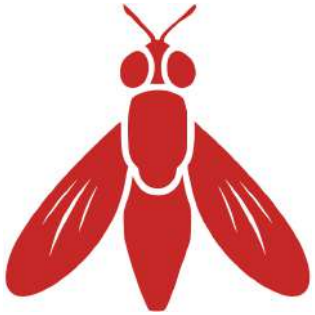
OVARIAN DEVELOPMENT

A 24-hour delay in ovarian development in smaller females

Mating success after 24 h after copulation and fecundity (homogenous population)

- **Large (89%)**

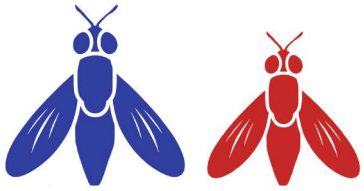
- **Small (88%)**

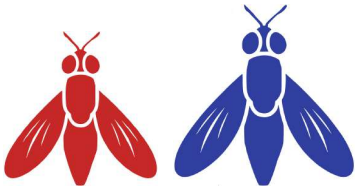


Larger females produced **+2.23%** more eggs
in a shorter period.

No significant difference in number of successfully mated females

RESULTS AND DISCUSSION

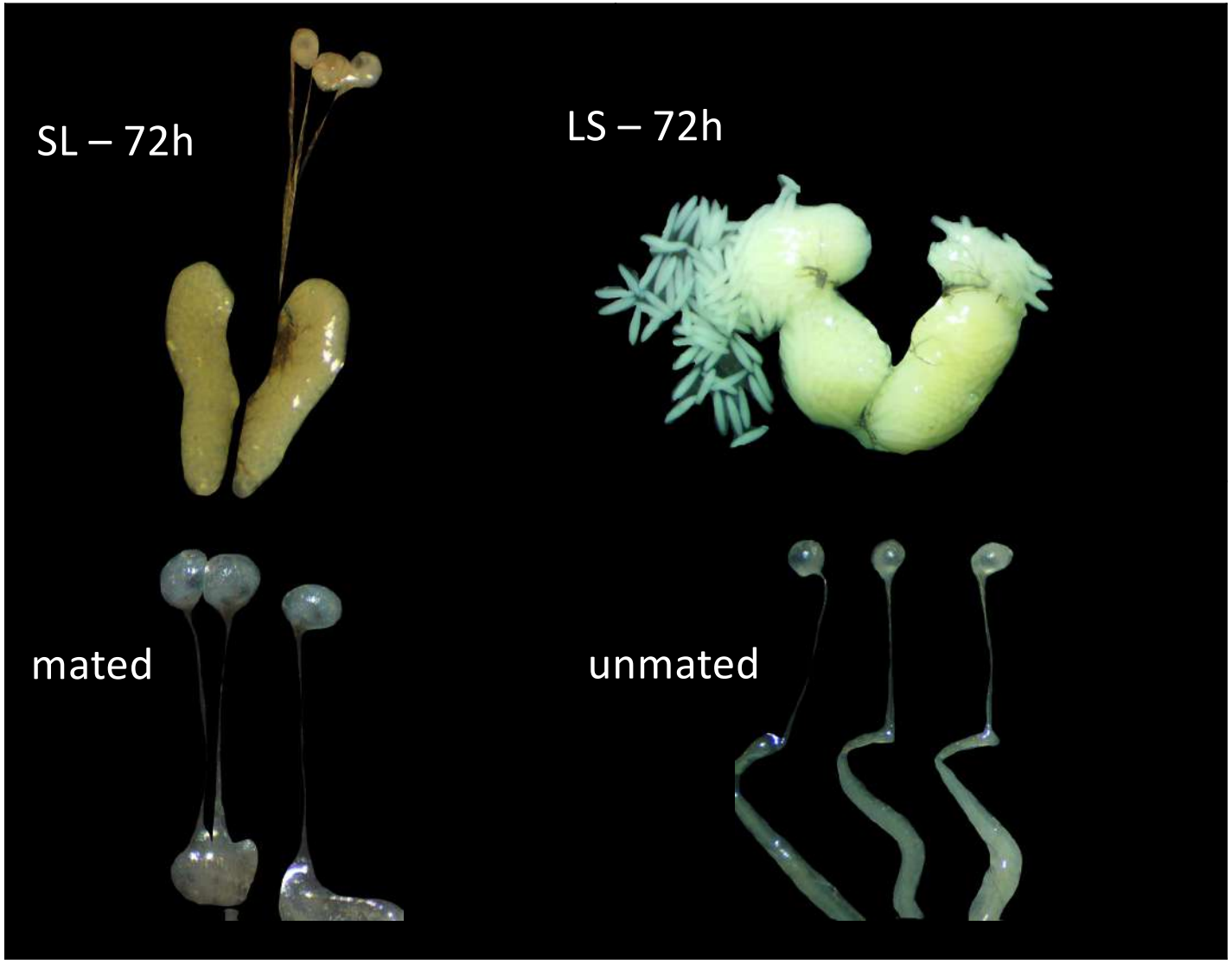




	N	x̄, mm	σ, mm	SE, mm	min, mm	max, mm
Males LS	90	6.88	0.2	0.04	6.51	7.4
Females LS	90	5.50	0.32	0.06	4.87	5.93
Males SL	90	5.92	0.31	0.06	5.01	6.29
Females SL	90	6.61	0.36	0.06	6.51	7.3

$F_{LS} = 73.4, p<0.001$

$F_{SL} = 63.5, p<0.001$

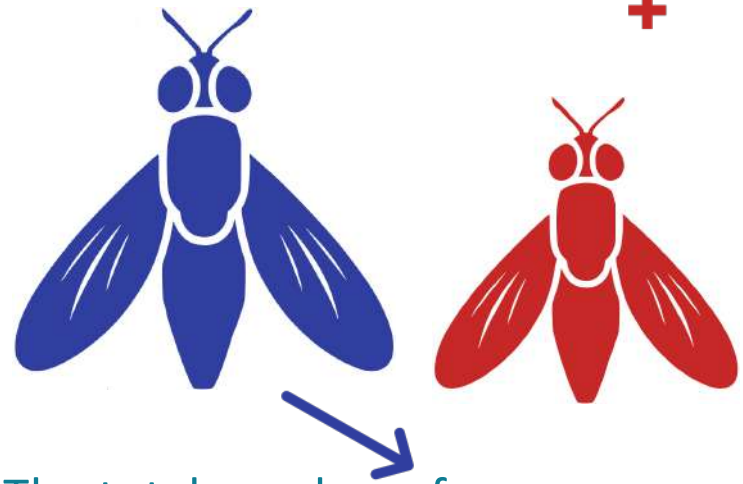


OVARIAN DEVELOPMENT

A 24-hour delay in ovarian development in smaller females

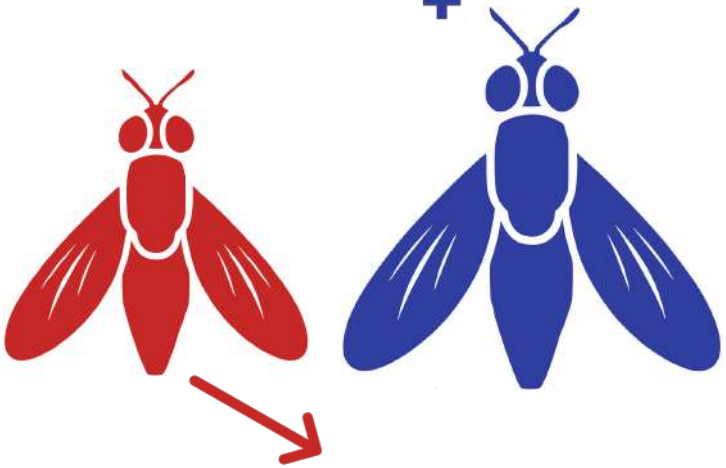
Mating success after 24 h after copulation and fecundity (heterogenous population)

• **Large ♂ - Small ♀ (72%)**



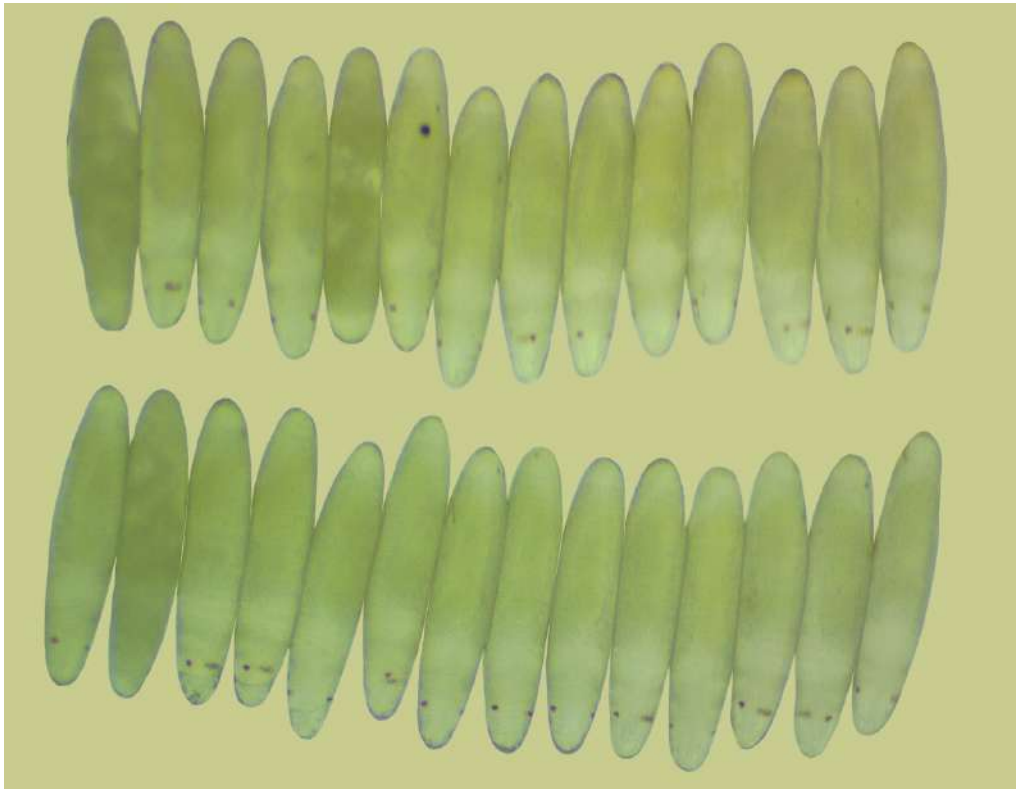
The total number of eggs was significantly lower, showing **55%** reduction compared to the number of eggs produced by small females mated with small males.

• **Small ♂ - Large ♀ (96%)**



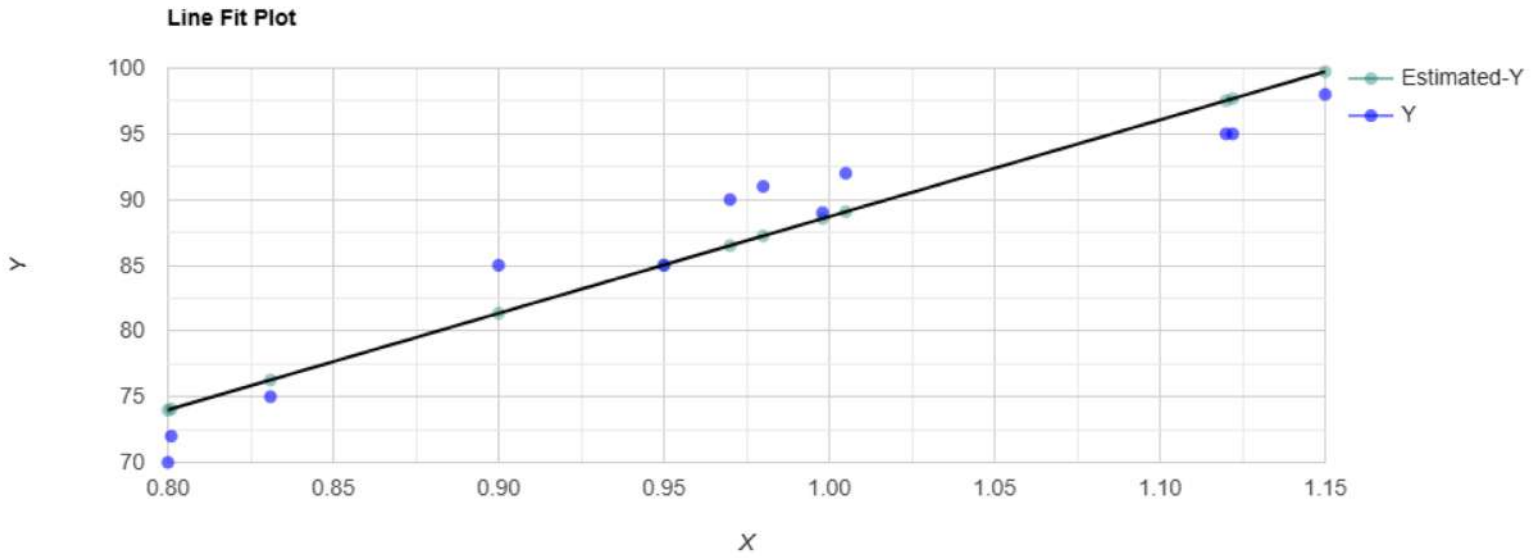
The highest egg production, with **59%** increase compared to the number of eggs produced by small females mated with small males.

RESULTS AND DISCUSSION



In all cases, there was no statistically significant difference in egg fertility. The percentage of infertile eggs ranged between 4-8%. This indicates that body size did not have a noticeable impact on egg fertility in all groups.

RESULTS AND DISCUSSION



$\hat{Y} = 15.1289 + 73.5747X$

X predicted Y, R2 = 0.91, F(1,10) = 100.92, $p < 0.001$.

The ratio of body size between males and females is a major factor regulating reproductive performance. The number of successful matings were greatest (88-96%) when the sex size ratios ranging from 0.95 to 1.12 (female:male TL). Below (0.81) thresholds resulted in a decrease up to 72% of mating successes (R2 =0.9098).

This means that 91% of the variability of successful matings can be explained by size ratio.

CONCLUSION

- **Adult body size** is clearly an important factor regulating **reproductive performance in BSF**.
- In BSF the **small males appeared to have a mating advantage**. Because of the better maneuverability of a small body compared with a large one.
- **Small females had a delay in ovarian development of approximately 24 hours**. This delay in ovarian development may be attributed to the lower fat reserves in smaller females, as fat reserves are essential for proper ovarian development.
- There was **no statistically significant difference in egg fertility** between small and large females.
- **The ratio of body size between males and females is a major factor regulating reproductive performance**. The number of successful matings were greatest (88-96%) when the sex size ratios ranging from 0.95 to 1.12 (female:male TL)

- These findings could be practically applied in the optimizing of the industrial rearing of BSF and the practice of breeding process.

INSECT-IMP

Thank you for attention!

We acknowledge the funding from the COST Action 22140 Insect-IMP: Improved Knowledge Transfer for Sustainable Insect Breeding.

Nasekomo