

COMMERCIALISATION OF BLACK SOLDIER FLY EGG PRODUCTION

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After 4 years of hard work, Beta Bugs started to sell **Black Soldier Fly (BSF)** eggs on a commercial basis at the start of 2022. At this time the Company produced about 10g of eggs a day. The production facility was upscaled and at the present time the Company produces approximately 400g of BSF eggs per day. The Company is further up-scaling its production processes with the aim to produce 20kg of eggs per day by 2026.

EGG PRODUCTION

The number of **BSF** required to achieve this is shown in Table 1 below.

Grams of Eggs Produced	Number of Flies Required
10	1,200
400	235,000
20,000	2,400,000

Table 1. Number of flies required to produce eggs.

The production of this number of flies requires larvae and eggs of this number in order to keep the supply of eggs constant. However, scaling the number of flies from a 10g production to 20kg production and the amount of space required per breeding cage is not linear.

EGG COLLECTION

Initially, collection of the eggs from egg-collection devices was performed manually with a spatula, however this was not feasible at larger scales since it took more than 8 hours to collect 200g of eggs. The Company's R&D team designed a new collection method to reduce the time required. It is likely that this method will have to be redesigned in order to collect 20kg per day. Once collected, the eggs are then aliquoted into the customers requirements, which can range from 0.5g up to 400g within a single order.

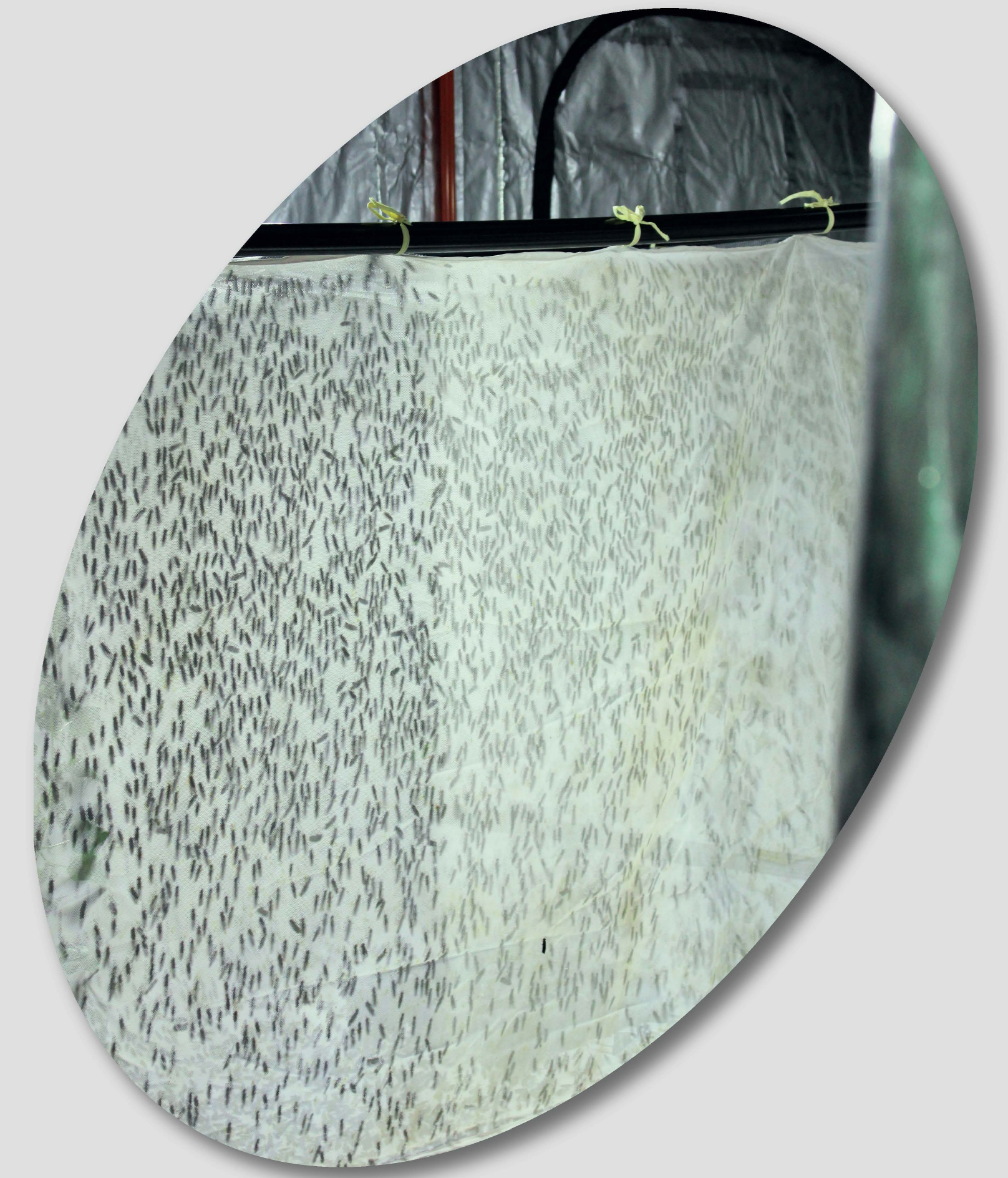
TRANSPORTATION

The shelf life of the eggs from collection to hatching is about 4 days. Therefore, order fulfilment, from collection to delivery to the customer has to be within this time period. By cooling the eggs to 20oC the time period can be increased to 5 days, but below this temperature egg viability decreases. Delivery by courier within the UK works well, but when sending abroad documentation is required. In the EU a limited number of countries have produced an Export Health Certificate which is required in order for the eggs to pass through Customs. In order to satisfy the criteria Veterinary Checks need to be undertaken prior to the eggs leaving Beta Bugs. The eggs are also checked by another vet at the entry point of the country. The final shipment contains a commercial invoice indicating package contents and a Certificate of Origin from the Edinburgh Chamber of Commerce stating the eggs were produced in Scotland. Some countries also require a risk assessment of the BSF indicating the hazard and risk involved if the BSF escape, either accidentally or deliberately.

These forms all need to be signed, stamped and ready before shipment begins. Even with these forms the package is not guaranteed to pass through customs and be delivered as the majority of custom's people do not know what BSF are, which can cause delays in arrival and loss in viability.

STANDARDISATION

Consistency in production is essential for commercial scale production of BSF eggs. Every process has to be standardised, documented and adhered to, so that anyone can perform the task and achieve the same standard result as any other member of staff.



SELECTIVE BREEDING

The Company has also been selectively breeding a high performance BSF – **HiPer-Fly®**.

Over the last 5 years we have selectively bred for 3 genetic phenotypes:

- 1 Larvae mass at harvest**
- 2 Development time form hatch to harvest**
- 3 Number of eggs laid per female fly**



The first two traits enhance the performance of the BSF so that our customers get a larger mass of larvae at harvest. This mass is directly translated into the amount of protein they obtain. By reducing the development time our customers can produce more generations of BSF in a year which also increases the amount of larvae they produce. By increasing the number of eggs produced per fly the number of eggs Beta Bugs produces increases thus reducing the price of the eggs for our customers.

Genetic Phenotype	Percentage Change
Larvae Mass	+183
Development Time	-84
Number of Eggs	+115

Table 2. Change in Phenotype Traits.

If calculated over a one year time period 100g of BSF eggs would produce, 13t of larvae. Using HiPer-Fly® 100g of eggs would produce 28.4t of larvae. This more than doubles the amount of larvae and therefore the revenue that the customer captures from their commercial site and corresponding investment.