LIFE Project Number
LIFE19 ENV/BE/000102

B.3 Breeding of *Calosoma sycophanta*

Final version

Reporting Period
01/09/2020 - 31/08/2025

Report Delivery Due Date – Actual Date
30/11/2025 – 22/12/2025

LIFE PROJECT NAME or Acronym
LIFE Oak Processionary

Authors
Toon Willems, Luc Crevecoeur, Johan Neegers, Kathleen Verstraete

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1. Context

This report is a result of Action 'B.3 Breeding of *Calosoma sycophanta'*. It is the second project report on this topic as we already delivered a report on the 'Reasons why the CS Beetle disappeared and current mitigations'.

This report combines the initially planned reports 'Report on CS Breeding', 'Reporting on tracking beetle' and the 'CS Habitat Model'. This report covers the whole project research period (2020 to 2024).

Previous research on *Calosoma sycophanta* has demonstrated that the species can be successfully established in new environments when sufficient populations of its target prey are present. Between 1905 and 1910, a reintroduction program was conducted in New England (USA) to control the gypsy moth (*Lymantria dispar*). The beetle not only survived under these conditions but also reproduced successfully and subsequently expanded its distribution to larger areas (Burgess et al., 1916). Furthermore, *C. sycophanta* has been employed as a biological control agent against the pine processionary moth (*Thaumatopoea pityocampa, PPC*). In Turkey, approximately 500,000 beetles are mass-reared annually and released into *T. pityocampa*-infested areas, yielding favourable results (Toprak O, 2014). Also in other countries within the region, such as Cyprus and Kyrgyzstan, this approach has recently been tested against the pine processionary caterpillar. The method was also proposed in several publications in the Netherlands and Germany during the 1980s and 2010s. The aim of the LIFE project was to determine whether it could be successfully applied in this region.

In Western Europe, initial contact was made with various experienced ground beetle breeders. A first digital meeting was organized to form a steering group, which included approximately ten interested parties. All participants had experience with large ground beetles of the genus *Carabus*, but none had prior experience with Calosoma. Even in southern European countries, such as France, no specialists with Calosoma expertise could be identified. The life cycle of *Calosoma*—approximately 40 days—is substantially shorter than that of *Carabus*, which requires several years to develop from egg to adult beetle. It was

2. Objectives

As shown in the already mentioned studies, CS beetle has a negative effect on population of PPC and gypsy moths. In our experiment we try to obtain the same results in OPC-infested area's.

The main objectives of this action are to:

1. Create a habitat model for *Calosoma sycophanta*
2. Rear *Calosoma sycophanta* under lab conditions from egg to beetle
3. Release and track the CS beetle in the wild

3. Materials and methods

This action is coordinated by the Province of Limburg. Luc Crevecoeur is the work package leader. Our field assistant Toon Willems, who is employed by the Province of Limburg will assist in the breeding process. The beetles were reared at two different locations to mitigate risks associated with potential disease outbreaks

3.1. Internship in Türkiye

The initiation of the project did not proceed smoothly with respect to beetle rearing. The first step involved a planned visit to the facilities in Izmir (Turkey) for a one-week internship aimed at acquiring their expertise. However, due to travel restrictions imposed by the COVID-19 pandemic, this visit was postponed, resulting in a one-year delay in the start of the beetle breeding program.

This internship in Turkey is essential for establishing a solid foundation for our research. In this region, *Calosoma sycophanta* beetles (CS beetles) are employed as biological control agents against the pine processionary moth (*Thaumetopoea pityocampa*, PPC), which locally causes disturbances in both residential and touristic areas. The beetles still occur naturally here in large numbers, and to initiate a new breeding colony, wild specimens are collected and subsequently maintained under controlled laboratory conditions.

Figure 1: External view of the rearing site (left). Interior of the facility showing adult beetles maintained in containers, provisioned with PPC, and ovipositing in the soil (right).

In certain areas, as many as 1,000 beetles can be collected in a single morning. Once in the laboratory, groups of 50–80 beetles are placed in containers filled with substrate. This substrate consists of soil that is sterilized by heating it in a large kettle over an open fire. The beetles are fed with PPC nests. To determine whether egg-laying has occurred, the containers are inspected daily.

The eggs are transferred to small individual containers, ensuring that they do not encounter one another, as the larvae are cannibalistic and would otherwise consume other eggs. These containers are checked daily starting from day four, which corresponds to the expected hatching period under optimal conditions. After hatching, the larvae are individually reared and fed in separate containers. In total, approximately 500,000 beetle larvae are reared and purposefully released on an annual basis in Turkey. This entire procedure takes place in a ventilated room, where staff members wear protective suits, masks, and operate with an independent oxygen supply to ensure safety during handling.

Figure 2: Daily collection of eggs from plastic containers using protective equipment, with eggs transferred into layered pots to prevent larval cannibalism.

In 2022, a team of four travelled to Izmir, where extensive expertise was shared over the course of a week, and agreements were made regarding the export of beetles to initiate the breeding activities in Belgium.

3.2. Preparation of rearing sites

Upon returning to Belgium, two rearing sites were prepared for the arrival of 100 adult beetles (50 males and 50 females) and 300 eggs. These facilities in the city of Antwerp and Genk were equipped with appropriate breeding containers and lighting systems. In addition, humidifiers and heating elements were installed to simulate optimal rearing conditions. In these rooms, the temperature was maintained at 26 °C, and the relative humidity was kept at 60%. The substrate was also carefully monitored to ensure a neutral pH and a soil moisture content of approximately 40%.

3.3. Arrival of the CS beetles

Prior to the shipment of the beetles, extensive documentation had to be completed, as the transport involved live animals. In addition, both customs authorities and a veterinarian were required to inspect the contents of the package and verify the health status of the beetles at both departure and upon arrival in Zaventem. These procedures were time-consuming, raising concerns that some beetles might not survive the extended period without food or water. But on April 8, 2022, the first beetles and eggs were received. All eggs were immediately placed in the appropriate substrate, and the adult beetles were distributed into breeding containers in groups of five (three females and two males).

Figure 3: Arrival of the beetles. Each beetle is transported in a plastic jar to prevent cannibalism on transport.

3.4. Rearing

The preferred food source for the beetles is OPC/PPC depending on the habitat from which they were collected. However, due to timing mismatches during transport or beetle emergence, it was necessary to experiment with alternative food sources. These alternative food sources were provided, including chicken liver, mealworms, wax moths, and gypsy moths. The beetles are provided with an adequate food supply daily and are monitored several times per day to assess their feeding activity and determine whether additional food is required.

When the beetles are fed, they are also examined daily for the presence of eggs. When eggs were observed on the underside of a container, the entire box was carefully examined using a small spoon to locate additional eggs. The collected eggs were then placed in individual 100 mL containers containing a few spoonsful of soil. These containers are checked daily starting from the fourth day to monitor larval emergence. Once hatched, the larvae are individually transferred to larger containers and provided with food. In the first year, various food sources were tested due to a shortage of OPC, but from the second year onward, the larvae were immediately fed OPC.

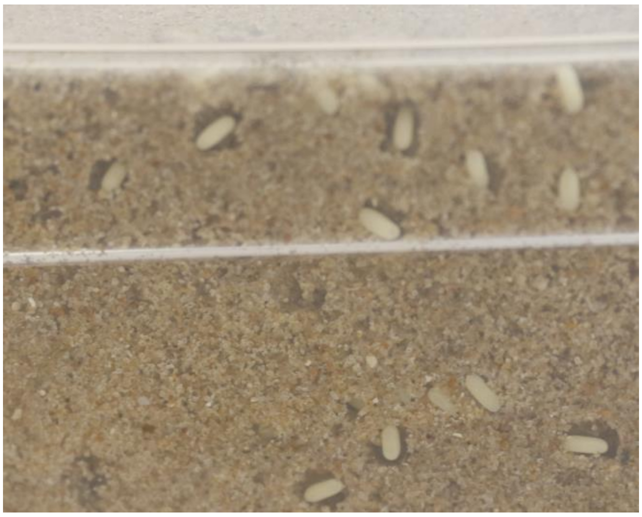

Figure 4: Eggs collected from the bottom of the container (left) are placed individually in small containers with 2 cm of soil to prevent cannibalism (right).

When the larvae reach a sufficient size to pupate, they are placed in deep containers filled with 20 cm of soil. The lower layers of the soil are compacted to ensure that the beetles can create an adequate pupation chamber.

The remaining adult beetles enter summer/winter dormancy starting in July. During this period, the beetles and the large containers containing the pupae are kept in enclosed outdoor greenhouses filled with 20 cm of soil. These greenhouses are made of a water-permeable material to simulate outdoor conditions as closely as possible.

In spring the greenhouse will be checked on a regular basis to check for active beetles.

3.5. Tracking the beetle

The beetles are not permitted to be released into the wild in Belgium or the Netherlands. Therefore, beetle tracking at a small scale was conducted within a large, enclosed greenhouse. To facilitate tracking, Nano Pin tags (Lotek) were affixed to the elytra of one beetle. These transmitters weigh 0.14g and have a range of 100m.

Figure 5: Beetle equipped with Nano Pin tag on right elytra.

3.6. Habitat model

In 2022, the Research Institute for Nature and Forest (INBO) produced a habitat model for the forest caterpillar hunter, to allow us to select the most promising locations for reintroduction. The habitat model is a GIS layer (Geographic Information System) built on the most up-to-date habitat map of Flanders.

As a basis for this model, we used the known habitat requirements of the beetle populations from neighbouring countries (Germany/France). We considered the major factor to be the availability of their potential prey. The main prey species are gypsy moth (*Lymantria dispar*), brown-tail moth (*Euproctis chrysorrhoea*), nun moth (*Lymantria monacha*) and oak processionary caterpillar (*Thaumetopoea processionea*).

It appears that these four species are widely distributed in Flanders.

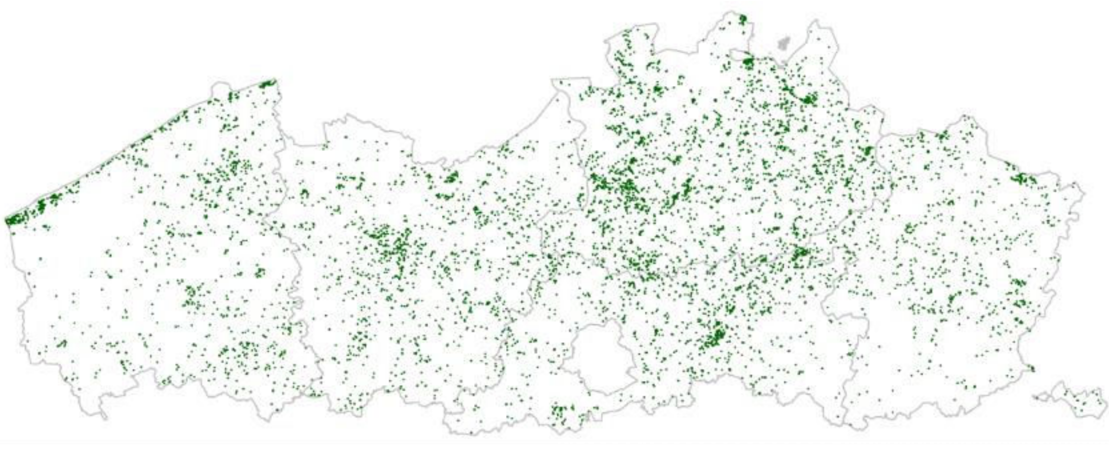

Figure 6: Habitat model for Calosoma sycophanta in Flanders based on observations of the four prey species

This map does not explain why *C. sycophanta* is so rare in Flanders. Availability of prey species is clearly not the limiting factor here. Given that the beetle has a rather Mediterranean distribution, possibly temperature plays a role.

To validate this model, we aimed to check these predictions against actual observations of the beetle in the wild. That is why in 2023, 2024 and 2025 we closely followed the reports of this species in Waarnemingen.be and iNaturalist. However, those three years no beetles were observed in the region, so unfortunately this was not possible.

4. Results

4.1. Egg production

When the beetles have consumed sufficient protein from hairy caterpillars, they lay eggs. During the first shipment of beetles, they still had adequate reserves to lay eggs shortly after arriving in Belgium. In subsequent years, OPC caterpillars were available, and egg-laying occurred after the beetles fed on these hairy larvae. The number of eggs laid decreased over the years due to a declining number of adult beetles available. In the first year, at least 250 eggs were laid, whereas in the most recent year only around 200 eggs were produced (Figure 6).

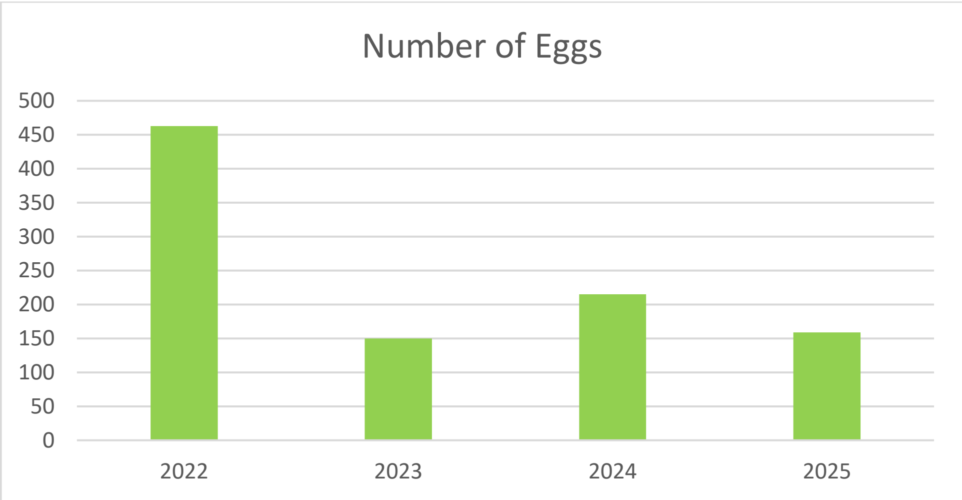

Figure 7: Number of eggs produced per year

4.2. Larval development

Since 2022, larvae have been produced each year, some of which successfully pupated into adult beetles while others did not. The hatching rate from egg to larva has remained relatively consistent each year, ranging from approximately 50% to 75%. Only during the first year the eggs laid after the beetles' arrival in Belgium failed to hatch (Figure 7).

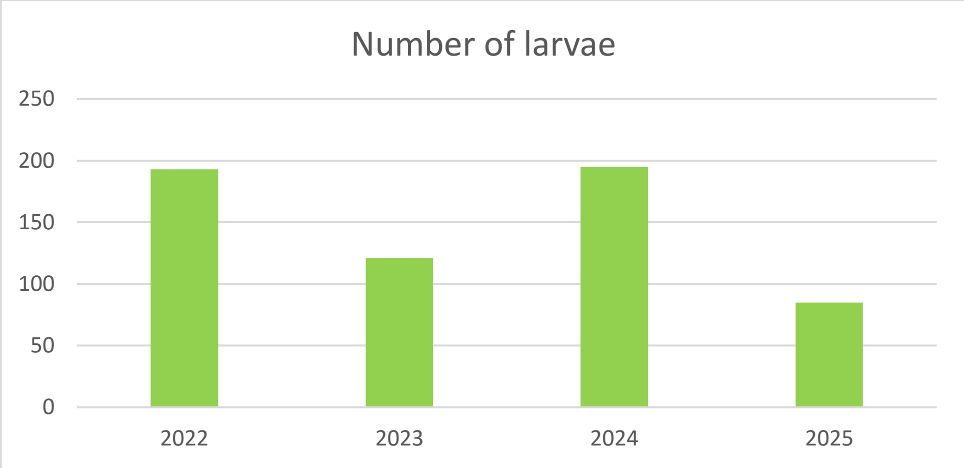

Figure 8: Number of larvae hatched per year.

4.3. Pupation

The goal of this experiment was to recreate the complete life cycle of the CS beetle under laboratory conditions. During the first two years, this was not achieved; however, in the last two years, some larvae successfully reached the pupal stage and subsequently developed into adult beetles. Approximately 75% of the larvae that reached the pupal stage successfully emerged as adults (Figure 8 and 9).

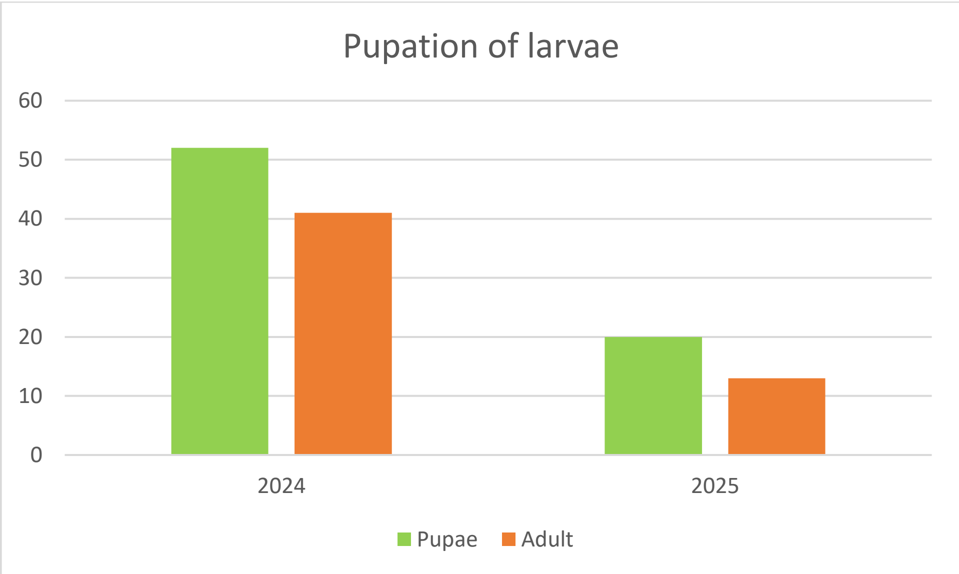

Figure 9: Number of larvae reaching the pupal stage compared to the number of pupae that successfully develop into adult beetles.

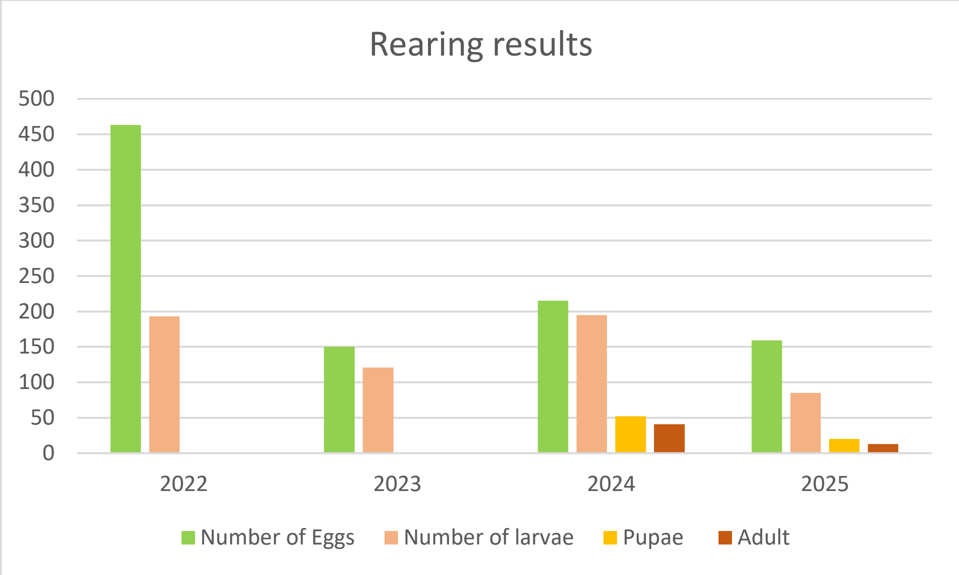

Figure 10: Overall rearing results of the different stadia per year.

5. Discussion

5.1. First year rearing CS beetles

After the arrival of adult beetles from Turkey, various food sources were provided. This was necessary because OPC were not yet available in Belgium, as the beetles had arrived early in the season. The offered food sources included chicken kidneys, mealworms, wax moth larvae, and gypsy moth larvae. Although the beetles did feed on these, they clearly preferred a different food source (PPC) that was not available in Belgium.

Nevertheless, within a week after their arrival, the beetles laid more than 200 eggs. These eggs are very small (5 mm in length and 2 mm in width) and are typically deposited on the bottom of the transparent plastic containers, which were filled with 7 cm of soil.

Together with the 213 viable eggs received from Turkey, the breeding phase could commence. The eggs hatched within six days; however, it soon became evident that the larvae did not accept any of the offered food sources. Several setups were tested to stimulate feeding behaviour, but without success. Consequently, in 2022, none of the larvae developed to the pupal stage. The adult beetles, on the other hand, performed well, and a total of 93 individuals entered summer/winter dormancy starting in July. During this period, the beetles are kept in enclosed outdoor greenhouses filled with 20 cm of soil. These greenhouses are made of a water-permeable material to simulate outdoor conditions as closely as possible.

Figure 11: Greenhouse used for beetle overwintering (left) and interior view showing the provision of wood and bark as hiding places (right).

5.2. Second reproductive season and import of new beetles

In the first week of April, the beetles emerged from hibernation and began actively searching for food. However, the same issue as in the previous year persisted: the beetles did not feed on OPC, and they became active slightly too early. At that time, the OPC caterpillars in Belgium had only recently hatched and were still very small. Over a two-month period, various food sources were offered again, which provided sufficient nourishment for the adult beetles to survive. However, for egg production they require a highly protein-rich diet, specifically PPC.

Behind the scenes, new contacts were established with our partner in Turkey to transport beetles from areas infested with OPC. Initially, this was not possible due to unusual climatic conditions in Turkey that year. Nevertheless, by the end of June, confirmation was received that beetles from the appropriate regions could be shipped, and their arrival in Belgium was expected within a few days. During this period, the OPC population in Belgium was already progressing towards the pupal stage, making it crucial to collect caterpillars as soon as possible. Over two days, several 10-liter boxes filled with caterpillars were collected in Oostmalle and Dessel. This was only possible once, as most caterpillars began pupating the following week.

Figure 12: Caterpillars collected in Oostmalle were kept in plastic containers with oak leaves (left) and subsequently stored in a cooling chamber (right).

The collected caterpillars were stored at 6 °C to slow down further development. Every two days, they were briefly removed from the cooling chamber to replenish oak leaves and to reduce condensation and fungal growth. In the following week, additional nests containing pupae were collected from the same locations.

On June 26th, 2023, another shipment of 100 beetles was sent from Izmir, Turkey, to Belgium. These newly imported beetles from OPM-infested regions performed very well in the laboratory and readily consumed the Belgian OPC. In total, approximately 200 eggs were laid, of which 130 successfully developed into larvae. These larvae actively fed on the OPC and exhibited substantial growth.

Figure 13: Large Calosoma sycophanta larvae almost ready to pupate. They grow to about 3-3.5cm in length and weigh between 1-2g right before pupation.

Unfortunately, none of these larvae reached the pupal stage. This failure was attributed to the caterpillars, which appeared weak and dehydrated by the end of July—likely due to prolonged storage at low temperature, leading to protein depletion. Consequently, the beetles arrived in Belgium slightly too late to complete a successful reproductive cycle. Nevertheless, these results provided promising perspectives for the following years.

5.3. Full reproductive cycle completed in 2024

In the spring of 2024, 53 beetles emerged once again in our overwintering facilities. During this period, the greenhouse was visited multiple times per week to collect the above-ground beetles and transport them to the laboratory. Some beetles, however, could always burrow back into the soil, escaping collection. The remaining beetles were all sourced from OPC-infested regions in Turkey.

All beetles were placed in plastic containers with soil, maintaining a sex ratio of five females to three males. For the first time, branches and leaves were added to the enclosures, allowing the beetles to climb and exhibit more natural behaviours. By the end of May, caterpillars were collected for the first time to serve as food for the beetles. These caterpillars were readily consumed, and over a four-week period, nearly 300 eggs were laid. The larvae exhibited strong growth again this year, prompting the decision to expand rearing to a new location.

The Expertise Centre for Sustainable Biomass and Chemistry at Thomas More became a partner, bringing substantial experience in beetle rearing. Here, 32 beetle larvae were raised on various food sources with mixed success. All larvae reached the pupal stage, and only one failed to emerge as an adult beetle. The detailed report of this collaboration is provided in the appendix.

Figure 14: Two different pupae in pupation chambers, both of which successfully developed into adult beetles.

At the Genk rearing facility, many larvae reached their final instar stage. Despite continued provision of caterpillars, larval vitality declined. Consequently, larvae had to be transferred to deeper pots with sufficient soil for pupation. Most larvae pupated but subsequently died due to insufficient energy reserves. Ten larvae successfully pupated into adult beetles.

This final phase of rearing had not been observed previously, as in Turkey, large larvae are released into the wild to pupate naturally. As a result, a high larval mortality occurred in Genk, which had not been anticipated. In contrast, in Geel, larvae were transferred to pupation enclosures at the first signs of weight loss, resulting in successful development.

On 5 July, the overwintering facility was relocated, requiring the removal of all soil from the greenhouse. Surprisingly, 19 living beetles were found beneath the soil and were transferred to the laboratory. However, it was too late for these beetles to reproduce. The greenhouse was reconstructed at a new location, and by the end of August, the beetles were able to enter hibernation again.

On April 30, 2025, one beetle was observed actively moving in the greenhouse. It was not until May 13 that an additional 14 beetles emerged from hibernation. In the following days, 19 more beetles became active, resulting in a total of 34 beetles available for breeding at the Genk facility.

The beetles were distributed across three 15-liter containers, each containing a 5 cm layer of fresh soil and several pieces of oak bark and branches to provide cover and environmental enrichment. Sufficient OPC were supplied as food. The sex ratio among the beetles was approximately 30% males and 70% females, which is considered optimal for maximizing reproductive output.

The containers were inspected every other day for the presence of eggs. As in previous years, collected eggs were transferred to separate small containers and checked daily for hatching. Newly hatched larvae were placed in larger containers and immediately provided with OPC as food. The larvae exhibited exceptionally rapid growth. During this phase, it was observed that the larvae could climb out of the plastic containers, necessitating the use of fitted lids to prevent escape.

Figure 15: Newly hatched larvae.

5.4. Scaling up production

During the autumn of 2024 and the spring of 2025, several experiments were conducted on adult beetles to induce multiple oviposition events per year to increase reproductive output. The beetles were maintained at elevated temperatures of 24 °C with plenty of food provided to prevent hibernation. Despite these conditions, the beetles remained largely inactive and burrowed into the soil within the containers.

An alternative approach involved subjecting the beetles to a cold period. In this experiment, the beetles were kept for several weeks in a cold chamber at 6 °C and subsequently returned to a room at 26 °C. This treatment did not appear to trigger renewed activity; the beetles remained inactive beneath the soil.

5.5. Exploitation

The project proposal also stated that an exploitation plan would be developed. It has become evident that integrating the rearing of CS beetles into an annual program for a commercial partner is highly challenging. Several obstacles remain to be overcome and must be considered.

Beetles do not lay eggs until they are provided with OPC as food. This alone can represent a significant barrier for a company attempting to establish a breeding program. Additionally, beetles lay eggs in clusters; however, these eggs cannot hatch in situ, as the first larvae to emerge would consume the remaining eggs and other larvae. Larvae are extremely cannibalistic during the early instar stages. Therefore, eggs must be placed individually in containers. One potential method to facilitate this process is to use a mesh at the bottom of the container, allowing eggs to fall through, although this approach has not yet been tested.

Furthermore, beetles typically lay eggs only once per year, which could be a major limiting factor in a cost–benefit analysis for commercial production. Lastly, there is the question of how to manage the beetle population in years with very low OPC abundance and consequently no demand for CS beetles.

Taken together, these considerations lead to the conclusion that commercial-scale CS beetle rearing is highly unlikely soon. Nevertheless, the necessary expertise has been developed, allowing for a breeding program to be initiated when required. This can be the case rather sooner than later when the PPC arrives in large numbers across Belgium and the Netherlands.

5.6. Tracking the CS beetle

The beetles in the greenhouse all possessed fully developed wings; however, they consistently moved by walking, even when climbing to the top of the greenhouse. On several occasions, individuals were observed opening their elytra and assuming a flight posture, yet no actual flight activity was recorded, even when they were provided with a larger space. The reason for this behaviour remains unknown and does not correspond to their natural behaviour in the wild in Western Europe.

During the tagging period, the beetle was closely monitored. It remained highly mobile and climbed the branches provided in the greenhouse without difficulty. At first glance, its freedom of movement did not appear to be affected. However, as no flight activity was observed, it is possible that flying would be more difficult when a transmitter is attached.

Due to the limited size of the enclosure, the performance characteristics of the transmitters could not be adequately tested.

5.7. Status of the CS beetle

During this project, the beetles were not released into the wild. As a result, plans for tagging and mapping habitat use were not implemented. This was not possible because the beetles originated from Turkey, and their genetic relationships with individuals from Belgium and Western Europe have not yet been compared. These analyses are currently ongoing and may provide the necessary insights in the future. The preliminary results can be found in the attachments.

At present, the CS beetle is a protected species in Western Europe and cannot be collected. Consequently, establishing a breeding program using native material is not permitted. Even if this were allowed, there are currently insufficient numbers of beetles available for collection in Belgium and the Netherlands.

From 2010 to 2020, only three individuals were recorded. However, during the project period, a total of 41 individuals were observed in Belgium and the Netherlands, possibly due to the increased attention to the species generated by this project.

It may be an option to collaborate with regions in Western Europe where the beetle is more common, as this would provide greater opportunities to collect enough individuals and could also facilitate obtaining the necessary permits. An additional advantage is the potential to use the species as a predator of PPC in these regions.

During this project, connections were also established with the United Kingdom. There is a shared interest in developing more ecological methods to control the OPC, and alternatives such as the CS beetle are being explored. A team of representatives from the UK's Forest Research agency visited our rearing facilities, where valuable knowledge exchange took place. Initial steps to establish a breeding program and obtain the necessary permits in the UK are currently underway.

6. Conclusion

After three years of intensive beetle rearing, substantial experience and knowledge have been gained, enabling the potential application of this approach on a larger scale. The beetles can be induced to lay eggs after being fed on oak processionary caterpillars, and the larvae can be reared on various diets, successfully pupating into adult beetles.

The main constraints for commercial breeding are that the beetles can produce only one generation per year and must be fed with OPC before they lay fertile eggs. Additionally, the newly hatched larvae are highly cannibalistic and must therefore be reared individually from the start, making the breeding process extremely labour-intensive.

A key consideration for future scalability is whether commercialization would be feasible, given the fluctuating populations of oak processionary caterpillars.

7. Acknowledgements

We would like to thank the members of the *Calosoma sycophanta* expert group, formed at the outset of the project, for providing essential knowledge on the rearing of Carabid beetles. We also extend our gratitude to

Ozgür Toprak and the General Directorate of Forestry in Turkey for their excellent internship, hospitality, and for providing the two subsequent batches of CS beetles.

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Appendices

Appendix 1: Rapport kweekproef en proef voedselvoorkeur CS – Thomas More

B.3 monitoring report CS Breeding - Appendix 1 - Rapport kweekproef en proef voedselvoorkeur CS – Thomas More

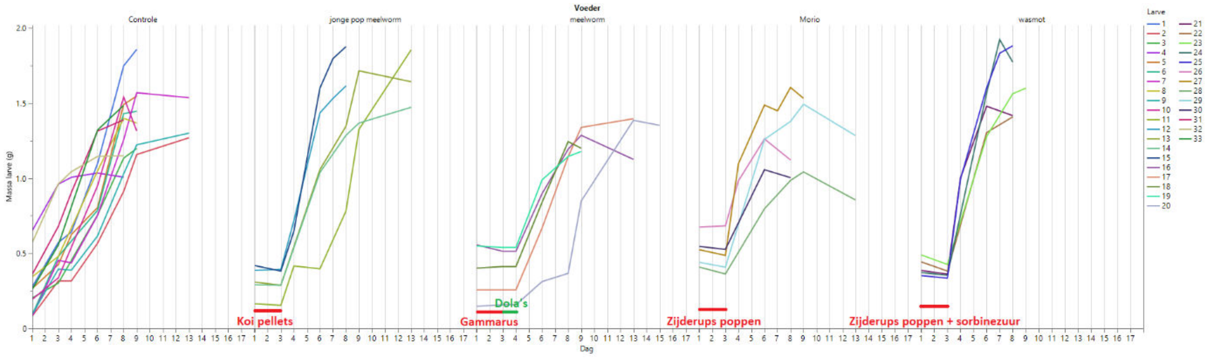
We hebben gebruik gemaakt van de volgende glazen potjes: deze werden gevuld met 40g vochtige potgrond, de potjes werden genummerd, er werd een gaasje geknipt en hierover werd een deksel vastgeschroefd:

Vervolgens werden telkens de droge voeders geweekt in water of in 0.3% kaliumsorbaat:

Vanaf nu werd:

- Dagelijks nieuw voeder gegeven (en afgewogen op 0.0001g nauwkeurig)
- Dagelijks oud voeder verwijderd (en afgewogen op 0.0001g nauwkeurig)
- (Minstens) op maandag, woensdag en vrijdag de larve gewogen (0.0001g nauwkeurig)

Hieronder worden de groeicurves van alle larven individueel weergegeven per voeder:



Zoals ik al eerder had aangehaald: We zijn begonnen met:

- Controle (processierupsen)
- Koi pellets
- Gammarus
- Zijderups poppen
- Zijderups poppen + sorbinezuur

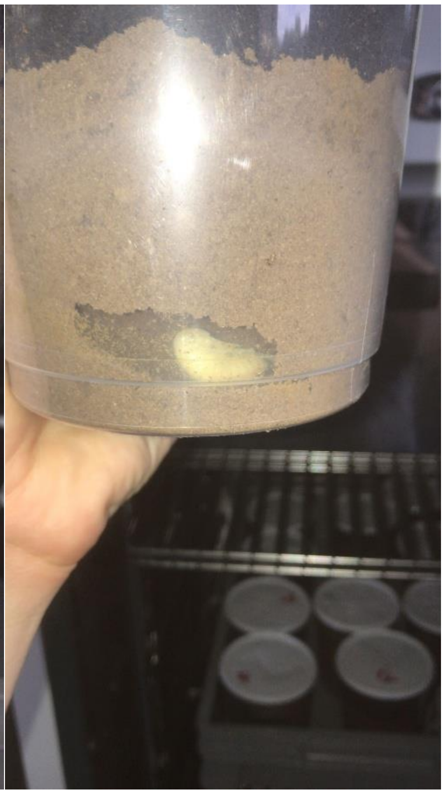
Bij aankomst (woensdag 03/07/2024) werden alle larven gewogen, de larven werden dagelijks gevoederd en op vrijdag werden ze opnieuw gewogen. Zoals duidelijk wordt op de bovenstaande figuur waren tussen dag 1 en dag 3 enkel de larven die met processierupsen (controle) gevoed werden gegroeid. De rest bleef hangen op de startmassa. Daarom moesten we op vrijdag meteen de planning shiften:

- Controle (processierupsen): OK
- Koi pellets -> Meelwormpoppen (levend)
- Gammarus -> dola's (fruitkeverlarven, levend)
- Zijderups poppen -> Moriowormen (onthoofd & in 2 geknipt)
- Zijderups poppen + sorbinezuur -> Wasmotlarven (levend)

Op zaterdag werden uit elke conditie een paar larven gewogen en we zagen dat de larven nu wel groeiden op alles behalve de dola's. Deze conditie werd daarom op zaterdag vervangen door onthoofde meelwormen. Dit is dus de reden waarom we de vlakke fase zien van 2 dagen bij jonge pop meelworm, Morio en wasmot, en waarom we een vlakke fase zien van 3 dagen bij meelworm.

Vanaf de larve 1.0 - 1.9g behaalde, zagen we een daling in het gewicht, wat aangeeft dat de overgang naar prepopfase eraan begint te komen. Telkens na het wegen van de larven werd de groeicurve van elke larve eventjes bekeken, waarna werd geëvalueerd of een larve al dan niet naar een verpoppingsbak overgebracht moest worden. Wanneer een curve plots stopt, wil dit dus zeggen dat de larve naar een verpoppingsbak werd overgebracht. De verpoppingsbakken zien eruit als volgt: Soeppot, 60-70% hard aangedrukte leemgrond, 40-30% potgrond. Bovenop deze potgrond werden bij het overbrengen nog telkens enkele meelwormpoppen toegevoegd, maar deze werden nooit meer aangewreten en werden na 2 dagen terug verwijderd. De potten zien er als volgt uit:

De dag na het toevoegen van de larven zijn meteen gangen te zien en de larve kruipt diep in de leemgrond. De eerste larven zijn hierin overgebracht op donderdag 11/07/2024. Vandaag zijn we 6 dagen later (17/07/2024) en de eerste poppen zijn zichtbaar. De leemgrond helpt de larven duidelijk om een stevige popkamer te bouwen:

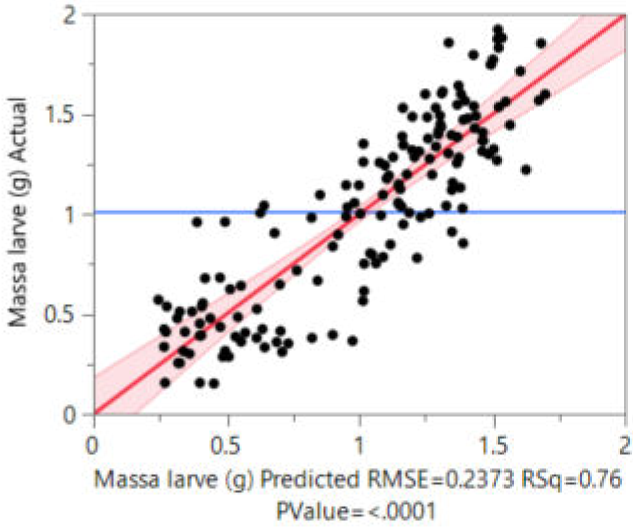


Dus hopelijk zijn over 2 weken de eerste kevers zichtbaar! Ik heb ook al eens snel een beetje dataverwerking gedaan. Eerst en vooral survival rates:

- Controle (processierupsen): n=13 ; 100% survival
- Meelwormpoppen (levend): n=5 ; 100% survival
- Meelwormen (onthoofd): n=5; 100% survival
- Moriowormen (onthoofd & in 2 geknipt): n=5; 100% survival
- Wasmotlarven (levend): n = 5; 100% survival

Goed nieuws dus als het op survival aankomt. Alle larven hebben het overleefd! Nu hopen dat de trend verderzet naar poppen toe!

Op vlak van groei heb ik snel een model getest waarin ik de ontwikkelingsduur (dag), de hoeveelheid opgenomen voeder (gegeven voeder - niet opgegeten voeder) en het type voeder (voeder) heb in rekening gebracht.

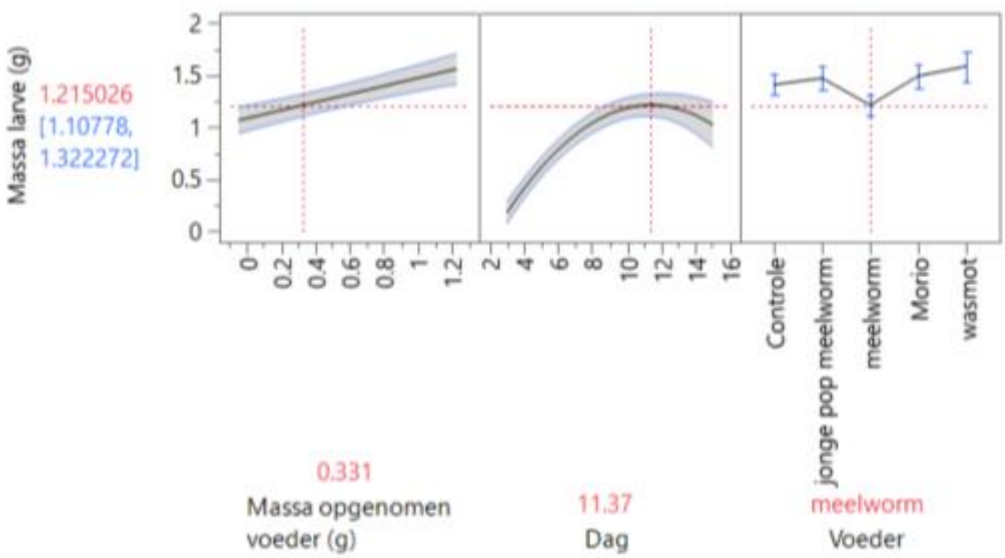


Effect Summary

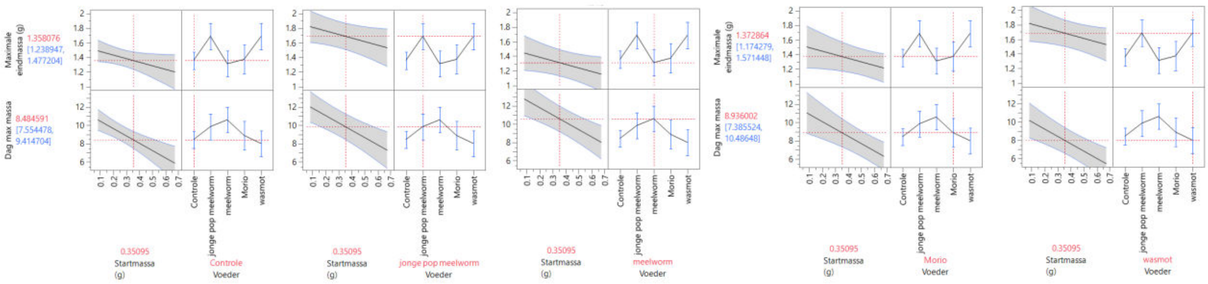
Source	LogWorth	PValue
Dag	41.675	0.00000
Dag*Dag	12.382	0.00000
Massa opgenomen voeder (g)	7.251	0.00000
Voeder	5.457	0.00000

We zien dat de larvale massa beïnvloed wordt door de tijd (dag), dat dit een kwadratisch effect is (wat wil zeggen dat er een bepaalde dag is met een maximum -> logisch, want de larve heeft ergens een piekgewicht en valt daarna af). We zien ook dat de totale massa die de larve opgegeten heeft zwaar gecorreleerd is met de massa van de larve en we zien dat het type van voeder een significant effect heeft.

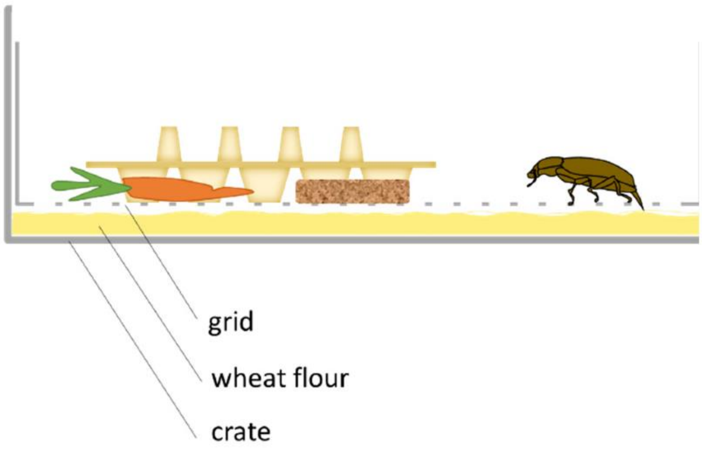
Via de profiler kun je duidelijk zien hoe meer de totale opgenomen massa was (massa gegeven - massa niet opgegeten voeder), dat bv bij meelwormen dag 11 de piekmassa gaf en dat we de beste groei zagen bij wasmot > morio > meelwormpop > processierups > meelworm.



Voor de rest wou ik ook eens een keer nagaan of het initieel startgewicht een impact had op het larvaal eindgewicht en op de tijd waarop de larve de maximale larvale massa bereikte. Het was heel logisch om te zien dat de larven er minder lang over deden om hun piekmassa te bereiken wanneer ze een hogere startmassa hadden, maar wat me opviel was dat de larven (in alle condities) grotere eindmassa's behaalden wanneer ze een lager initieel startgewicht hadden. Dus mogelijks betekent dit dat de larven met een hogere initiële startmassa al door een (korte) hongerperiode gegaan waren, waardoor hun finale eindmassa lichtjes gecomprimeerd werd (zie hieronder).



Ik vind het persoonlijk een geweldig tof project om aan deel te mogen nemen, en ik vind het heel boeiend om deze larven op te kweken. Voor de toekomst heb ik nog een paar plannen. Eerst en vooral moet er nu gewoon gewacht worden (3 à 4 weken waarschijnlijk, tot er actieve kevers tevoorschijn komen. Daarna wil ik een low-tech eilegproef uitvoeren, analoog aan een meelwormen-eilegbak, zoals hieronder:



Het enige verschil zou dan zijn dat er grond/compost onder de eilegzeef wordt aangebracht. Het idee is dat de kevers dan door de zeef eitjes leggen en deze niet kunnen kannibaliseren. Verder zorgen we voor genoeg beschutting voor de kevers en voedsel (waarschijnlijk zijn meelwormpoppen hier het interessantst, omdat deze heel lang stabiel blijven). Het idee is om dan wekelijks de eilegzeef inclusief kevers over te plaatsen naar een nieuwe bak met nieuw substraat en dat de eitjes uit de originele bak met potgrond/zand geteld worden.

Daarna zou ik een groep-opkweek willen testen om de haalbaarheid van grootschalige kweek te evalueren. Het idee is om een overmaat aan voedsel te voorzien, zodat kannibalisme beperkt wordt. Hiervoor is het het gemakkelijkst om opnieuw te werken met meelwormpoppen (schimmelen niet, blijven intact, blijven voedzaam over een periode van 2.5w). Vanaf larven van 2-3 weken gespot worden die 1g+ zijn, kunnen deze overgezet worden naar een grote, diepe bak met leemgrond en bovenaan nog een beetje potgrond. Hier kan nog eventueel nog bijgevoederd worden, maar de larven kunnen dan meteen onder de grond kruipen als ze klaar zijn om te verpoppen. Dan kunnen we op het einde de kannibalisatieratio's bepalen en als deze pakweg <50% zijn, lijkt dit me een haalbaar protocol om opschaling mee te doen.