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Maintenance of O. Vacca Beetles (Dung Beetles)

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Executive summary

The European spring active dung beetle *Onthophagus vacca* was imported to Australia in 2012 and has been reared to increase the population mass of dung beetles for future release onto Australian farms. An estimated 3200 *O.vacca* beetles were received by Invetus P/L in November 2017 from Creation Care and placed into a purpose built rearing facility. Beetles were supplied with freshly thawed dung three times a week until the end of January 2018, after which all adult beetle activity ceased. Broods were checked in late December 2017, late January 2018, and April 2018 and showed a steady decline in live larvae and pupae; by April 2018, all instars were dead.
It appears that *O.vacca* immature instars were not able to successfully survive in the environment in the mass rearing field cage, as the beetles were unable to complete a full life cycle under these conditions. The reasons for this are unclear and need further investigation.

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1 Background

1.1 Rearing of *O. vacca*

1.1.1 Justification

An estimated 80M tonnes of dung produced each year by Australian livestock is valued in the A$Billions. Unburied dung means nutrients are unavailable for pasture; worse, dung smothers pasture, pollutes waterbodies, breeds pest flies and allows the spread of parasites. Dung beetles can assist in the reduction of these issues by burying the dung into the soil, increasing the nutrients in the soil and reducing the breeding habitat if pest flies and parasites. The introduction of *O.vacca* was aimed to increase dung beetle activity in spring when a highly level of pest flies and parasites are occurring, and existing species of dung beetles have limited activity.

2 Project objectives

2.1 Rearing of *O.vacca*

This main aim of this project was to propagate *O.vacca* in a purpose built rearing facility and allow for the beetles to be bred in large numbers for subsequent transfer to Charles Sturt University.

3 Methodology

3.1 Breeding facility for beetles

3.1.1 Erection of nursey

A purpose-built nursey was constructed in October 2017. The structure of the nursery was copied from similar structures observed at Strathalbyn (Figs. 1 & 2) which were designed and built by a third party who did not supply specifications.

Fig. 1: Nursery construction and freezer.

Fig. 2: Completed nursery.

A freezer container was purchased in October 2017 for the freezing of fresh dung. 300 litres of high quality fresh cattle dung was collected in November 2017, packed into 2 litres aliquots, and stored frozen at minus 9 degrees centigrade.

Approximately 3200 newly emerged *O.vacca* were received from a third party in November 2017 and placed into the nursery. See Fig 3.

Fig 3: *O. vacca* being released into nursey

Upon release into the nursery, four litres of freshly thawed dung was provided to the beetles 3 times per week between November 2017 and January 2018. The adult beetle activity ceased in January 2018 and all beetles were dead by February 2018. After this, no more fresh dung was added to the nursery.

The nursery was monitored on average 2-3 times per week between January 2018 and October 2018. Soil moisture has been maintained at approximately 5% either by natural rainfall or by artificial watering (when soil surface became very dry). Soil surface was not watered during winter (May-August 2018).

4 Results

4.1 Emergence of beetles

4.1.1 Results

A check of 79 broods produced in early December 2017 indicated 36.7% contained live larvae and pupae by late December 2017.

A check of 48 broods produced in late December 2017 indicated 33.3% contained live larvae, pupae and teneral adults by late January 2018.

A check of 50 broods produced in late December 2017 indicated 0% contained live instars by April 2018.

As of the 26th of October, no adult *O.vacca* had emerged from the nursery.

5 Discussion

5.1 Emergence of beetles

The usual seasonal breeding cycle of *O. vacca* in southern Australia is that post-diapause adults emerge from the soil in spring (August in warm regions, September in cooler regions). These then breed for 8-12 weeks and then die. The young then grow to the adult stage over about 8-10 weeks and then emerge as adults and feed (but not to breed) for about 4 weeks before tunnelling into the soil as diapausing adults. They stay there until they emerge in the following spring to begin the cycle again.

Because the adult beetles were set up in the breeding nursery at Armidale in mid-November, the usual breeding cycle was delayed by about 4-8 weeks with most breeding occurring in late November, December and January. Thus, the emergence of the F1 beetles would have been expected to occur January to March. The presence of teneral adults in January support this interpretation but it is noteworthy that even though some beetles reach the teneral stage, none completed development and emerged as tanned adults.

The failure of the larvae produced in November to January to emerge as adults in the nursery indicates that the environmental condition were not adequate to allow most larvae and pupae to complete development. But why? It appears unlikely that high temperatures were damaging for, while soil temperatures were not measured, the conditions which prevailed in the much warmer environment in similar field cages in South Australia allowed for successful breeding (B M Doube pers comm). In contrast, *O. vacca* in the South Australian *O. vacca* nursery (of a similar construction) suffered considerable mortality as a result of dry conditions and many larvae died without reaching the pupal stage (B M Doube pers comm.). While the Armidale nursery was watered when the soil appeared dry, no moisture samples were taken from 10-20 cm (where the broods would have been lodged) and it is possible that dry conditions could have prevailed at depth in the soil, thereby contributing to larval mortality. These possibilities need further examination.

While it is tempting to suggest that these data indicate that the Armidale environment is not suitable for *O. vacca*, this is not justified. These data were derived from one nursery in one season under one form of management. Further, it is most unlikely that the condition inside the nursery are representative of the conditions that prevailed in the field outside the nursery. However clearly it is difficult to extrapolate from the nursery conditions to the variety of conditions that will be found on the New England Tablelands.

Climate matching suggests that the Armidale region is suitable for *O. vacca* and so field studies are required to assess whether the field condition in the Northern Tablelands are suitable for O. vacca.

6 Conclusions/recommendations

6.1 Suitability of *O.vacca* in the Northern Tablelands

6.1.1 O.vacca

These data indicate that *O. vacca* bred but failed to survive for one generation in the nursery condition provided in summer-autumn 2017-2018 at Armidale. The reasons for the larval mortality are not know but dry soil conditions or unfavourable temperatures may be responsible. These need further investigation. The environment in the Armidale nursery is likely to be substantially different from the field environments found in pastures in the Northern Tablelands and so it is not reasonable to extrapolate from the beetle's performance in the nursey to what might occur in the field in the surrounding districts.
We recommend that field trials with *O. vacca* should be conducted to assess the suitability of the Northern Tablelands for establishment of the species in the field.