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The Galip Weevil (*Ectatorhinus magicus*) ecology and life cycle

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Abstract

The Galip Weevil (*Ectatorhinus magicus*) is the main pest of the Galip Nut (*Canarium indicum*). The adult is free-living but its larva bores tunnels in galip trees causing severe damage to the improved, elite trees in plantations and smallholder blocks in East New Britain and New Ireland Provinces. The life cycle and ecology of the weevil were studied under field and laboratory conditions using a simple cost-effective rearing technique during 2022-2023.

Larvae were reared using 25 cm cut host branches as food substrate. We found that the Galip Weevil has a complete life cycle with four larval stages. The complete cycle takes about 100 days. The cycle from egg to pupa took place inside the galip tunnels. This makes it impossible to immediately develop management strategies to control the pest. We currently recommend hand collection of the adult weevils, severing off their heads, burning them on a fire and keeping the galip blocks clean and tidy.

Keywords: Oviposition, life cycle, galip nut, rearing, weevil, larva

Introduction

The Galip Weevil (*Ectatorhinus magicus*) was described by the German entomologist Carl E. A Gerstäecker from type specimens collected around mainland New Guinea, Duke of York Island and New Ireland (Gerstäecker, 1860; Fairmaire, 1881; Setliff, 2007). It was recorded as a minor pest of Galip Nut in their natural habitat by Bruce French (French, 2006). But the introduction of a geographically distant elite galip variety into Keravat and East New Britain (ENB) saw serious damage by the weevil (Cassis *et al.*, 2017).

In August 2015 an adult *E. magicus* was collected from a heavily damaged galip tree at the National Agricultural Research Institute (NARI) Keravat germplasm block. A closer inspection on all the galip trees at the same block revealed similar damage on all standing and dead galip trees. It was therefore concluded that the infestation may have occurred in this block and the surrounding areas some years earlier - most likely after the elite galip was introduced but the infestation had gone unnoticed until 2015 (Hela, unpubl. data).

The combined NARI and National Agriculture Quarantine Inspection Authority (NAQIA) survey in 2015 also revealed that the weevil was severely damaging the elite galip trees but was not found boring into the abundant East New Britain galip trees in their natural habitat (Moxon, unpubl. data). More recent Galip Weevil surveys were conducted at Wasum and Pelilo in the Kandrian area of West New Britain, Nissan, Buka and Matsungan Islands of Autonomous Region of Bougainville (AROB) in 2017 and on Duke of York Island in East New Britain between May to June 2017 with follow up surveys to New Ireland and West New Britain between 2021 and 2024. The Galip Weevil was not detected in Arowe, Duke of York Islands and Nissan Islands but was detected in elite galip blocks in New Ireland Province (Yombai *et al.*, 2025).

A similar situation was experienced in mainland New Guinea (now Papua New Guinea) when the Hoop Pine Weevil (*Vanapa oberthuri*) caused serious damage to Hoop Pine (*Araucaria cunninghamii*) plantations and native stands (Barrett, 1967). The Department of Agriculture, Stock and Fisheries managed to control the Hoop Pine Weevil through early detection and removal of diseased pines after continuous entomological investigations on its biology and ecology. Our study aimed to develop a standard method of raising Galip Weevil in controlled, artificial conditions so that the life cycle of the weevil and the duration of each life stage (egg-larva-pupa-adult) could be determined. This information is essential for the development of strategies to manage the pest.

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Materials and Methods

We conducted three separate life cycle studies namely, adult breeding in captivity, rearing of weevil larvae on formulated artificial diet and the simple rearing technique using the host plant (Yombai, unpubl. data). However, only the simple rearing technique is reported here as it was a success.

Simple laboratory rearing technique

A soft forcep and bush knife were used to retrieve and remove larvae of different sizes and ages from their feeding galleries on galip trunks. The larvae were put in plastic take-away containers with their fresh frass and brought back to the laboratory where they were transferred into young split Canarium branches, 25 cm long and used as feeding substrate (Fig. 1A). The branches were split longitudinally into equal parts and a small groove was made at one of the inner sides of the branch to accommodate the larval development (El-Shafie & Faleiro, 2021). A larva was introduced and the two halves were fastened firmly with elastic bands.

The collection of required larval sample for our experiment was difficult due to the larvae living inside galip tunnels so we were using convenience sampling. For the first and second days, we collected 10 larvae. Those larvae that died were replaced immediately with fresh larvae at the same life stage. In total, we reared about 24 larvae of various sizes and ages at one time at mean temperature of 35.5 °C and relative humidity of 67%.

The emerged weevils died before mating so we resorted to collecting 18 adult weevils (9 male and 9 female) from infested galip trees. These were paired and bred in take-away containers (6.5×15.5 cm) at mean temperature of 35.5°C and relative humidity of 67%. Immature galip leaves were used as feed for the adult weevils. We had three eggs oviposited after 15 days of captivity. The eggs were incubated in a petri dish for over 2 months but only one hatched - after day 14. The monitoring of other pairs continued for over 26 days but no eggs were laid.

Figure 1. *First instar inserted in groove (A), third instar stage with frass (B), pre-pupa (C), pupa (D) and emerged adult weevil (E). Immature galip stem is used as food substrate.*

Results

Egg

The female weevils oviposit single, oval-shaped eggs in bored tunnels or other cavities on galip trees (Fig. 2A-B). The egg is 4 to 5 mm long and can weigh up to 2 mg. It is oval-shaped with a smooth white surface and with a creamy colour. Initially, adult weevils oviposit at galleries at the first branch, at the bottom or cavities on the trunk. Mostly a single egg is laid, hidden inside bored tunnels and covered with frass to avoid detection from potential predators. Under suitable environmental conditions (e.g. mean temperature of 35.5 °C and mean humidity of 67%), the egg can hatch after 13 to 14 days. NARI field observations noted that the adult female re-visited exited weevil tunnels and oviposited a single egg inside the cavity.

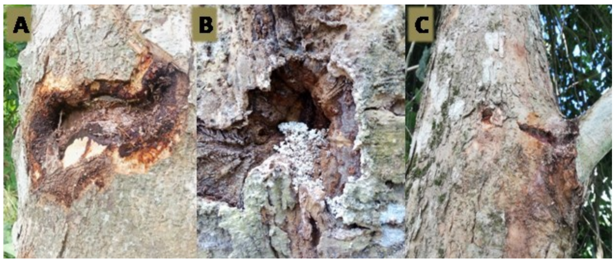

Figure 2. *Preferred oviposition sites of female weevils on galip trees. Exit tunnels on trunk (A), 2nd to 3rd instar larva frass inside old gallery of weevil (B) and 3rd larval stage boring on first galip branch (C).*

Larva

The larva has four instar stages. It increases in size by moulting the whole cuticle. It has a deeply embedded head capsule and usually well-developed mouth parts. There are many folded segments with two spiracles located on each side of the head usually visible in the third to pre-pupal stages.

The first instar commences chewing through the remaining layers deposited near the oviposition site and into the cuticle of the tree. The boring continues into the epidermis and bark after 14 to 15 days. The most destructive larval stage is the third to fourth stage where rate of consumption increases to provide enough energy for pupal hibernation. At this stage the larva bores into the cortex. This will result in increased flow of resin on the galip trunk. The resin from a clean cut is milky white and its presence on the tree indicates attack by the galip weevil although it is sometimes a result of knife wounds. It becomes thick and viscous over time (Fig. 3A-D). During this phase a lot of white resin is excreted on the galip trunk or deposited at the base of the tree. The exit tunnel is covered with resin and frass.

Figure 3. *White resin on trunk as 1st to 2nd larva chewing through galip bark (A-B) and white milky resin become viscous after exposed (C-D). Typical boring of 3rd to 4th instar.*

Pupa

A fully developed weevil pupa is creamy white and takes about 21 days to reach this stage. It lacks urogomphi at the apex of the abdomen and can weigh up to 4.18 mg and be 25 mm long. The weight of the pupa might vary with sex due to the amount of food consumed during larval stages. After the fourth stage, it moults to pupal stage, and prepares to exit (Fig. 4C) as an adult. The wing patterns are obvious as are the mouth parts. The pupation period last 10 to 12 days.

It takes about 21 days of hibernation in the pupal chamber. The exit hole is developed during the third-fourth larval stages and sealed with chewed frass. When the weevil pupates and is ready to exit, it uses its rigid rostrum to remove the sealed frass blocking the exit tunnel and slowly crawls out (Fig. 4B-C).

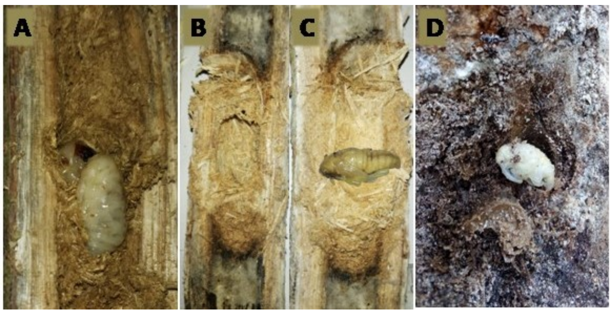

Figure 4. *Initial stage of the hibernation period, where pre-pupa covered itself with its frass (A), hibernating compound (B), moulting pupa (C) and pupa in a young galip trunk cavity at NARI block 409 (D).*

Adult

Adult females are bigger than adult males (Fig. 5B). The body is mostly brownish, white spotted with black elytrons (wing coverings) and pronotum. Towards the centre of the abdomen there is a cross-like structure coloured white with light brown to orange. The metepisternum is whiter but is very dark from the centre of pronotum to the apex. About 30 connected black circular structures occur at the centre of the pronotum at the apex above the mesepimeron. There is a chain of square shapes on the elytra and 3 pairs of nodes: medium nodes just above the mesepimeron and 2 very short node-like structures at the abdomen (near the anus) elytron. The last pair of nodes is more prominent but shorter than the one at the mesepimeron. The middle node is not prominent. For a more detailed description of the adult weevil see Cassis *et al.*, 2017.

Adults feed on immature galip leaves and produce oval-shaped pellets of excreta. Our field observations show that the weevil favours shady areas and is more active in the early hours of morning (7-9 am) and late afternoon (3-5 pm). It normally hides on galip trunks with camouflage that is highly effective at a distance. When disturbed, the adults often drop to the ground and “play dead” on litter. After several seconds, they resume activity.

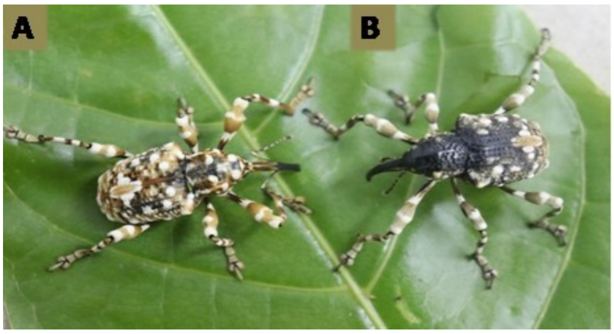

Figure 5. *Male (A) and female (B) adult weevil on galip leave. Female weevils are bigger in size.*

Mating has been observed in laboratory conditions where there was a 1:1 sex ratio but in the field multiple sex partners might be involved. The adult remains in the pupal chamber for 7 to 8 days and makes its way out. We observed that the egg-laying interval is a minimum of 14 days. The typical number of eggs per year is not known.

Weevil life cycle

We observed both in the field and laboratory that the female oviposits a single egg. Hence, a naturally occurring weevil might have one or two broods per annum. It has complete metamorphosis from egg-larva-pupa-adult, taking about 100 days (Fig. 6). The egg- pupa stages are entirely spent inside its host galleries but the adult is free-living.

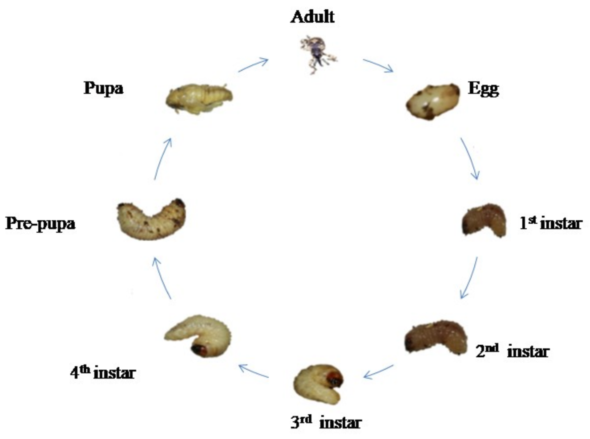

Figure 6. *Complete life cycle of the galip weevil for in vitro rearing. The number of days for each emerging stage may varies in the field condition.*

Pest Management Practice

We recommended control by hand picking of the adult weevils and severing their heads or throwing them into a burning fire near the trees. There are no recommendations for chemical control and no known natural enemies to be used as biological control agents. Since the Galip Weevil is a shade loving insect, it is important to do ring weeding around the galip trees and to always keep the galip block clean and tidy.

Discussion

The duration of each life stage of the weevil to the next stage studied varied across study years. The simple rearing technique using the host plant stem performed better than the artificial diet and adult weevil reared in captivity (Yombai, unpubl. data). The duration of each life stage of Galip Weevil may vary depending on the type of rearing techniques and food substrate used and abiotic conditions. However, the 13-14 days duration observed on the first to second instars of the larvae is similar to other weevils such as the Pecan Weevil (*Curcuilio caryae*) a major pest of North American hickories and pecan (Mulder, 2007).

The 100 days life cycle of the galip weevil observed is common to other Coleoptera groups (Andrey, 1998). However, the survival of pupated weevils at mean temperature of 35.5°C with 67% humidity inside the laboratory would be not suitable for their survival. Female adult weevils were able to survive up to 25 days in the laboratory condition while the male weevils were not able to live that long. The longer life of female weevils is a common trend in other animal groups (Fox *et al.*, 2003). One reason for this observation in our study and elsewhere is the variation in body size which relates to life span and mortality. Animals with larger body size, including weevils, tend to live longer than their counterparts with smaller body sizes (Fox *et al.*, 2003; Ricklefs & Scheuerlein, 2001).

This simple cost-effective method has provided baseline information for future research into the biology and ecology of the Galip Weevil. The weevil spends about three months inside the tunnels with the larval stage being the most important economic stage as this is when it attacks galip trees of any age. To ensure that the first and second generations of the weevil is achieved, there is a need to improve the in-vitro breeding process from larval to the adult stage. Further studies are needed to develop effective control strategies such as the use of biological control agents against the weevil larvae. We now have a better understanding of the life cycle and ecology of the weevil which will help to develop an Integrated Pest Management package for the pest.

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Data availability. Data is available upon a formal request to the lead author.

Conflicts of interest. The authors declared that they have no conflicts of interest.

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