SIGASTUS WEEVIL - AN EMERGING PEST OF MACADAMIAS IN NORTH QUEENSLAND

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Abstract

A large weevil was found infesting macadamia nuts on the Atherton Tableland during the 1994/95 season. It was unrepresented in various Australian insect collections but thought to belong to the genus *Sigastus*. This paper reports some preliminary studies on its biology, pest status and control. From 4-6 weeks after first nut-set adult females commence laying single eggs through the husk, after first scarifying an oviposition site. The nut stalk is then cleaved leading to rapid abscission. Nuts were generally attacked up until hard shell formation. Weevil larvae consumed whole kernels, with % survival higher and larval duration shorter in larger nuts. Infestation rates increased with increasing nut diameter, reaching 72.8% of fallen nuts by mid-October. A crop loss of 30% could be attributed to weevils in an unsprayed orchard. However, adult weevils are very susceptible to both carbaryl and methidathion sprays. In addition, exposure of infested nuts to full sunlight over several weeks kills 100% of larvae. Crops should be surveyed for weevil damage from the 5-10 mm diameter stage until mid-December. Methidathion used as an initial spray for fruitspotting bugs should provide control. Organic growers are advised to sweep infested nuts into mown interrows where solarisation will kill larvae.

Introduction

The major pests of macadamia in north Queensland include macadamia nutborer, *Cryptophlebia ombrodelta* (Lower), fruitspotting bugs, *Amblypelta* spp., and macadamia flower caterpillar, *Cryptoblabes hemigypsa* Turner (Ironside 1981). Other pests, such as macadamia lace bug, *Ulonemia concava* Drake, can cause severe damage at times but activity tends to be localised. Weevil pests had been a rare feature of the macadamia industry worldwide, until the appearance of the nut-infesting scolytid, *Hypothenemus obscurus* (Fabricius), in Hawaii in 1988 (Beardsley 1990). During the 1994/95 season a large weevil was found damaging developing nuts in several commercial macadamia plantations on the Atherton Tableland. The insect was unrepresented in the QDPI Mareeba insect collection, as well as those of the ANIC and the Queensland Museum. The apparently undescribed species is thought to belong to the genus *Sigastus* Pascoe (Curculionidae: Molytinae: Haplonychini)(Zimmerman pers. com.), and while considered to be native, the possibility that it is a New Guinean species cannot be discounted. The usual hosts of this group of weevils are species of *Eugenia* and *Ficus*. This paper reports some preliminary studies on the *Sigastus* weevil, including its biology, pest status and control.

Methods

Study sites

Studies were conducted on a number of commercial macadamia plantations on the Atherton Tableland, in the Atherton and Kairi areas. Most work was undertaken during the 1997/98 season on the Kairi property of J. Rees, which contained a block of about 1000 mature trees of the varieties 344 and 741. These trees received no pesticide treatments and were not irrigated.

Behaviour and biology studies

Weevil behaviour was largely observed in the crop during surveys for fruitspotting bug damage. Adult feeding and oviposition was noted. In addition, weevil damaged nuts were collected from the ground to determine any relationship between nut size and weevil emergence rate. On two occasions about six weeks apart 50 nuts were placed individually in 250 ml polystyrene containers, sealed with gauze tops, and held at ambient temperature until adult weevils emerged.

Crop damage assessment

At fortnightly intervals from nut-set to maturity, nuts beneath 30 trees were sampled for weevil damage. Up to 15 freshly fallen nuts were randomly selected from the ground beneath a tree and the proportion with weevil oviposition scars recorded. Nut diameter was measured with microcallipers. This data provided an estimate of fallen nuts with weevil damage, but not of total crop loss per tree. However, as counts of nuts on panicles were taken before weevil activity commenced, and at the time damage ceased, some crop loss estimates were possible. Virtually all nuts with oviposition scars fell from panicles.

Insecticide evaluation

Macadamia branches were sprayed *in situ* with carbaryl, methidathion or β-cyfluthrin and allowed 1-2 hours to dry. The application rates are given in Table 2. All insecticides and the water control were applied with a wetting agent (Agral @ 25 ml/100L). Adult weevils then were enclosed in 1 m long gauze sleeves over the treated branches for 24 hours. There were 5 weevils/sleeve and 6 replicates of each treatment. After 24 hours the weevils were assessed as alive or dead, and later at 72 hours after holding in 250 ml polystyrene containers.

Results

Behaviour and biology

Female weevils began laying eggs in nuts about 4-6 weeks after first nut-set. The female scarifies an area about 3-4 mm in diameter in the husk and lays a single egg into it. The egg is either lodged within the husk or intrudes into the surface of the kernel. After oviposition the nut stalk is chewed about half through to induce drop. Generally, a single egg was laid per nut, although up to three eggs (or larvae) were observed in a nut representing different oviposition dates. Although a large proportion of nuts within a panicle could be affected it was rare to find that all were. Nut fall was rapid and generally occurred from a few day after oviposition. Mating was observed on nut panicles. After nut shells hardened (about mid-December) and were no longer suitable for oviposition, adult weevils commenced to feed on the green surface of the husk, in some cases completely removing the epidermis. Adults will also feed on young leaves.

Larvae consumed entire kernels before pupating and chewing exit holes as adults. Table 1 provides details of adult emergence based on different nut size ranges. Survival was higher and average development time was shorter in larger nuts. Larger weevils emerged from larger nuts, as reflected by emergence hole diameters. The minimum development time in nuts was about 6 weeks, but nuts were not retrieved from the time of oviposition to confirm this.

Table 1. Some relationships between macadamia nut size and utilisation by *Sigastus*

Collection date	Average nut diameter (mm)	Nut size range (mm)	% adult emergence	Emergence hole diameter (mm)	Maximum time to emergence (days)
17 Oct. 1997	16.9	14.3-21.8	29.0	5.5	80
26 Nov. 1997	28.1	22.5-32.3	40.6	6.7	49

Damage assessment

The first weevil-damaged fallen nuts were collected on 18 September 1997 (Figure 1). Infestation rates increased with increasing nut diameter, reaching 72.8% of fallen nuts by 17 October. The infestation rate remained at about this level for about four weeks before declining in December. Nuts reached their full size by early December, with shells hardening soon after. The number of fallen nuts increased rapidly through September and early October, then levelled-off before declining in early December.

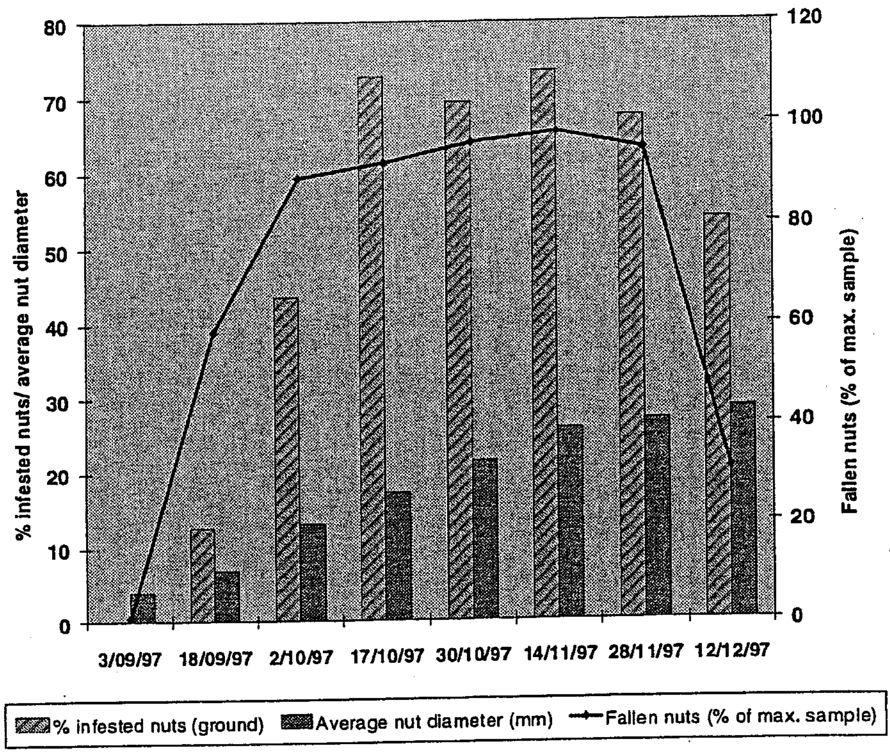

Figure 1. Rate of infestation of macadamia nuts by *Sigastus* and nut fall induced in relation to crop development

Insecticide evaluation

Both carbaryl and methidathion caused 100% mortality of adult weevils within 24 hours of application (Table 2). β-cyfluthrin was slower acting, with some repellency indicated, but a high level of mortality was recorded after 72 hours.

Table 2. The effect of 3 different insecticides on mortality in adult *Sigastus*

Treatment (+ wetting agent)	Product/100L	Post-application % mortality	
		24 h	72 h
Control	-	0.0	10.0
Carbaryl	125 g	100.0	100.0
Methidathion	125 ml	100.0	100.0
β-cyfluthrin	50 ml	46.7	86.7

Discussion

Sigastus weevil can cause significant crop loss in macadamias where insecticidal control is not practised. Although damage to nuts in individual trees varied greatly, an overall crop loss of around 30% was estimated at the monitoring site. This weevil could be a significant pest for organic growers, or those using minimal insecticidal treatments. However, trials in which infested nuts were exposed to full sunlight over several weeks indicated that solarisation caused 100% mortality of larvae. Heat treatment has previously been suggested for dealing with larvae of acorn weevils in India (Kaushal *et al.* 1993). For growers engaging in normal management practices, existing chemicals can control adult weevils. Methidathion, employed as an initial spray for fruitspotting bug, coinciding with the very first sign of nut drop, should provide effective control of *Sigastus* weevil. Follow-up sprays for nut borers would ensure further control. Nuts falling between mid-September and mid-December should be swept into mown interrows where solarisation will kill larvae. However, it appears that *Sigastus* may reoccur in a crop each season, irrespective of the control measures adopted previously. Weevil damage to nuts is obvious and crops should be surveyed thoroughly when nuts reach between 5 and 10 mm in diameter. Because weevils only appear to oviposit in nuts prior to shell hardening it seems highly unlikely that adults would emerge from mature nuts. This suggests that the chance of infested nuts being moved from the Atherton Tableland to southern shellers is negligible. However, the adults are robust and could inadvertently be moved amongst bulk nuts. The species will undoubtedly remain a nuisance to northern growers, and vigilance will be required to minimise its impact.

Acknowledgment

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References

Beardsley, J.W. (1990). *Hypothenemus obscurus* (Fabricius) (Coleoptera: Scolytidae), a new pest of macadamia nut in Hawaii. *Proc. Hawaii Entomol. Soc.* No. **30**: 147-150.

Ironside, D.A. (1981). Insect pests of macadamia in Queensland. *QDPI Misc. Publ.* **81007**. 28pp.

Kaushal, B.R.,Pant, M.C., Kalia, S, Joshi, R. and Bora, R. (1993). Aspects of the biology and control of three species of acorn weevils infesting oak acorns in Kumaun Himalaya *J. Appl. Ent.* **115**: 388-397.