CONTROL OF FUNNEL ANTS, *APHAENOGASTER LONGICEPS* (SMITH) IN AUSTRALIA USING SYNERGY PRO® ANT BAIT

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Summary
Funnel ants (*Aphaenogaster* spp.) in general are considered nuisance species because they create unsightly mounds in gardens and cultivated turf in domestic and commercial situations, but can be of economic importance in sugarcane and pasture. *Aphaenogaster longiceps* (Smith) occurs along the south-east coast of Australia from Mt Gambier in South Australia to Rockhampton in Queensland. It overlaps in range with a very similar species *Aphenogaster pythia* Forel from Port Macquarie in New South Wales northward. Around Sydney *A. longiceps* is common in parks, playing fields and semi-rural areas. Trials were conducted at three sites, one in Sydney and two in the southern highlands of NSW near Robertson, to evaluate the efficacy of Synergy Pro® Ant Bait. In all trials, Synergy Pro was applied at two rates: 2 and 4 kg/ha by handspreading. In all three trials Synergy Pro reduced the number of mounds down close to zero over a period of 14 days and maintained low mound counts out to 10-12 weeks.

Key words: *Aphaenogaster longiceps,* control*,* bait, funnel ants

INTRODUCTION

Aphaenogaster is a cosmopolitan genus occurring through most of the world except southern South America and southern Africa (Richards 2009). Six species of *Aphaenogaster* are recognised from Australia (Shattuck 2008) but only one, *Aphaenogaster pythia* Forel, is an acknowledged pest species mostly of sugarcane and pasture (Hitchcock 1958, 1968, Saunders 1967, 1969, 1970, Wilson 1962). *Aphaenogaster longiceps* (Smith) and *A. pythia* overlap in eastern Australia with the most southern extent of *A. pythia* at Port Macquarie (NSW) (Shattuck 2008). *A. longiceps* is most often encountered in sandy soils and is an important agent of soil bioturbation in natural ecosystems in southeastern Australia (Andersen 1988, Richards 2009, Shattuck 2008). They have large subterranean colonies with multiple funnel-shaped entrances and they regularly move nests and entrances contributing to local surface disturbance (Hughes 1990).

In cultivated turf *A. longiceps* is considered a nuisance causing unsightly mounds and bare patches (Murray 1982) and may cause more extensive damage to even surfaces on golf courses, pasture and unsealed airstrips (Shattuck 2008). *Aphaenogaster*-infested sugarcane and turf is usually treated with liquid insecticides (Murray 1982, Saunders 1969, Wilson 1962). To my knowledge bait treatments (successful or otherwise) have not been reported in any detail. Wilson (1962) reported that an undisclosed "poisoned bait" had no effect on *A. pythia* in sugarcane. In the process of development of a bait, presumably in the laboratory, *A. pythia* readily took sugar and molasses but showed no interest in bran and pollard (from the grain-milling process) and meat-meal (slaughterhouse waste) (Hitchcock 1958).

Synergy Pro is a new ant bait commercialised in Australia which combines two active ingredients (2.5g/kg pyriproxyfen, 3.65g/kg hydramethylnon), and two granule types based on reprocessed granulated corn and extruded protein, which is designed to be attractive to a wide range of pest ant species. Three sites with moderate to high *A. longiceps* activity were selected as trial sites to assess the efficacy of Synergy Pro. All three sites were close to Sydney (NSW) and typically semi-natural with sparse grass and herb cover under a eucalypt forest canopy.

MATERIALS AND METHODS

Three trials were conducted during late summer and autumn of 2016 near Sydney (NSW) in three moderate to heavily infested areas to evaluate the efficacy of Synergy Pro against *A. longiceps*. Commercially available 500g containers of recently manufactured material (August 2015, batch no. 201508Syn) were used in all three trials. Bait was applied by hand after weighing out the required amount of bait into clip-seal bags. Bait was evenly distributed across each plot. In the absence of rain or other physical disturbance *Aphaenogaster* mounds can appear intact for long periods of time. Hence, immediately after each assessment in each trial each visible mound was stomped on with the heal of a boot so only freshly created or repaired mounds were counted at the next assessment. For the first assessment, mound destruction occurred the day after bait application and the first mound count.

Carss Park (33°59'21''S, 151°06'53''E)

The trial was located along a sealed path with a timber railing fence separating the edge of the path and the adjoining natural bushland. Fence posts were spaced 2.6m apart and square plots were assigned to an area of 2.6 x 2.6m leading back from the posts into the bushland. There were 144 available plots of which 55 plots contained zero mounds and were excluded. Of the remaining 89 plots, 30 were randomly chosen and assigned to three treatments (untreated control - UTC, Synergy Pro 2kg/ha and Synergy Pro 4kg/ha). Bait was applied twice, firstly on 2 March 2016 and then again on 1 April 2016. Mound counts were conducted at roughly weekly intervals until 22 April 2016 (51 days after treatment 1) and then again at 62 and 69 DAT1.

Robertson (1) 34°37'22''S, 150°34'56''E

The trial was located along a fenceline in a paddock grazed periodically by cattle with a ground cover of various grasses, herbs and leaf litter (Figures 1 and 2). Fence posts were spaced 3.8 m apart square plots were assigned to an area of 3.8 x 3.8 m leading back from the posts into the paddock. There were 64 available plots of which 14 plots contained zero mounds and were excluded. Of the remaining 50 plots, 30 were randomly chosen and assigned to three treatments (UTC, Synergy Pro 2kg/ha and Synergy Pro 4kg/ha). Bait was applied on a single occasion on 18 February 2016. Mound counts were conducted at roughly weekly intervals until 15 April 2016 (57 days after treatment) and then again at 74 and 82 DA.

Figure 1: Typical environment for *A. longiceps* (Robertson 1 site)

Figure 2: Typical *A. longiceps* mounds.

Robertson (2) 34°37'34''S, 150°34'51''E
The trial was located along a fenceline in a nearby paddock to Robertson 1 with the same environmental conditions and plot layout. There were 36 available plots of which just one plot contained zero mounds and was excluded. Of the remaining 35 plots, 21 were randomly chosen and assigned to three treatments (UTC, Synergy Pro 2kg/ha and Synergy Pro 4kg/ha). Bait was applied on a single occasion on 18 February 2016. Mound counts were conducted at roughly weekly intervals until 15 April 2016 (57 days after treatment) and then again at 74 and 82 DAT.

Weather Conditions
During the period of the trials (February to May 2016), weather conditions in both Robertson (nearest weather station Moss Vale) and Carss Park (nearest weather station Sydney airport) were similar to the long term averages for both rainfall and maximum temperature. For Carss Park, average annual rainfall is 1080mm with predominantly summer-autumn rainfall. Average summer (January) minimum and maximum temperatures are 18 and 27 °C respectively and the average winter (July) range is 7-17 °C.

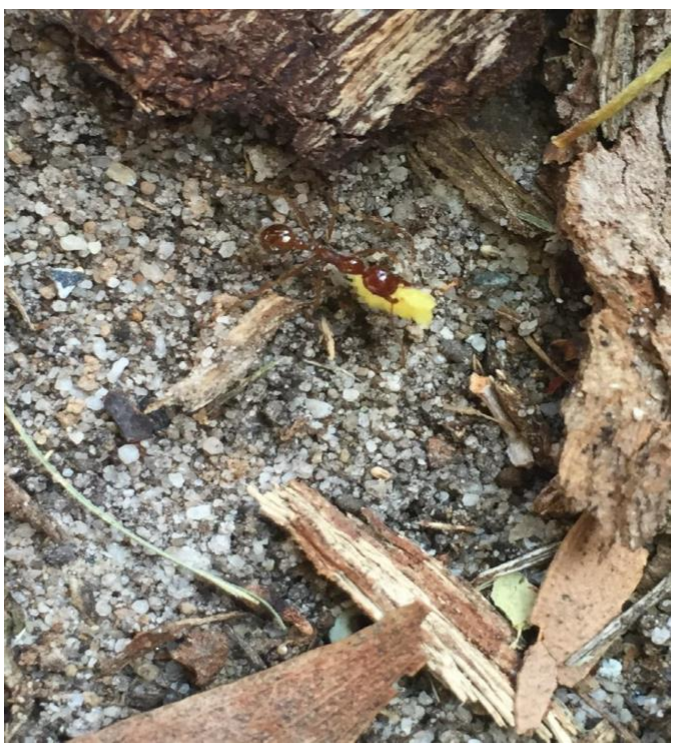
For Robertson, average annual rainfall is 1659mm which is spread fairly evenly across the year. Average summer (January) minimum and maximum temperatures are 16 and 26 °C respectively and the average winter (July) range is 6-16 °C.

Statistical Analysis
A non-parametric Kruskal-Wallis one-way ANOVA and Dunn's all-pairwise comparison test (Statistix ver. 10, Analytical Software, Florida) were used to compare differences in active mound numbers between treatments within each time period in each trial.

RESULTS

Few workers were observed foraging during the day. Nevertheless, bait was carried back to the nest (Figure 3). Observations during the day following bait application indicated that all or most of the bait granules had been retrieved during the previous day or overnight.

Figure 3: ***A. longiceps*** **worker retrieving a corn granule.**



By the first post-application assessment, there was already evidence of *A. longiceps* mortality with graveyards forming at the base of most mounds (Figure 4). During the first week after application all or most mounds were repaired or new ones established indicating that colony collapse had not occurred during that first week. At all three sites the decline in funnel ant mounds began between week 1 and week 2 after application and from week 2 onwards until completion of each trial there was a significant difference between the two rates of Synergy Pro and the untreated control ($p < 0.01$) (Figures 5, 6, 7). By 2 weeks after application almost no active mounds were present in treated plots in all 3 trials. At no point in time in any of the three trials was there a significant difference in active mound numbers between the two rates. There was no apparent difference between a single treatment (Robertson 1 and 2) and two treatments 1 month apart (Carss Park).

Figure 4: A weathered and damaged *A. longiceps* mound with dead workers scattered around the mound.

Figure 5: Results of trial 1 (Carss Park site). DAT = days after treatment, UTC = untreated control. Error bars are only shown for Pre and 7DAT assessments.

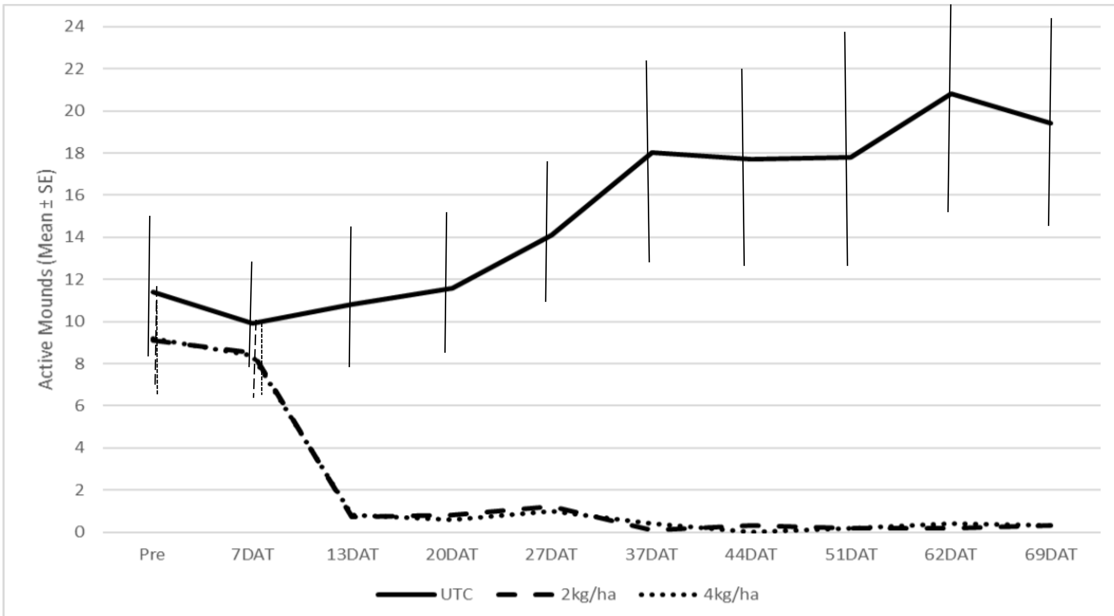


Figure 6: Results of trial 2 (Robertson 1 site). DAT = days after treatment, UTC = untreated control. Error bars are shown only for Pre and 8DAT assessments.

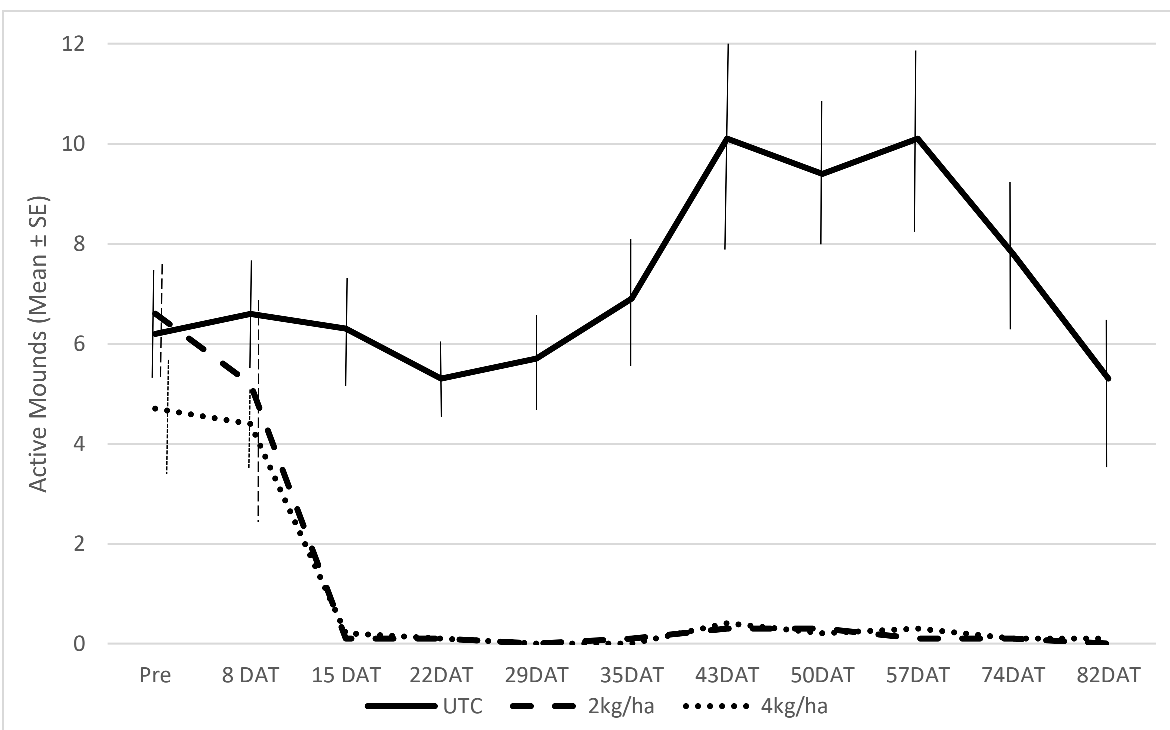
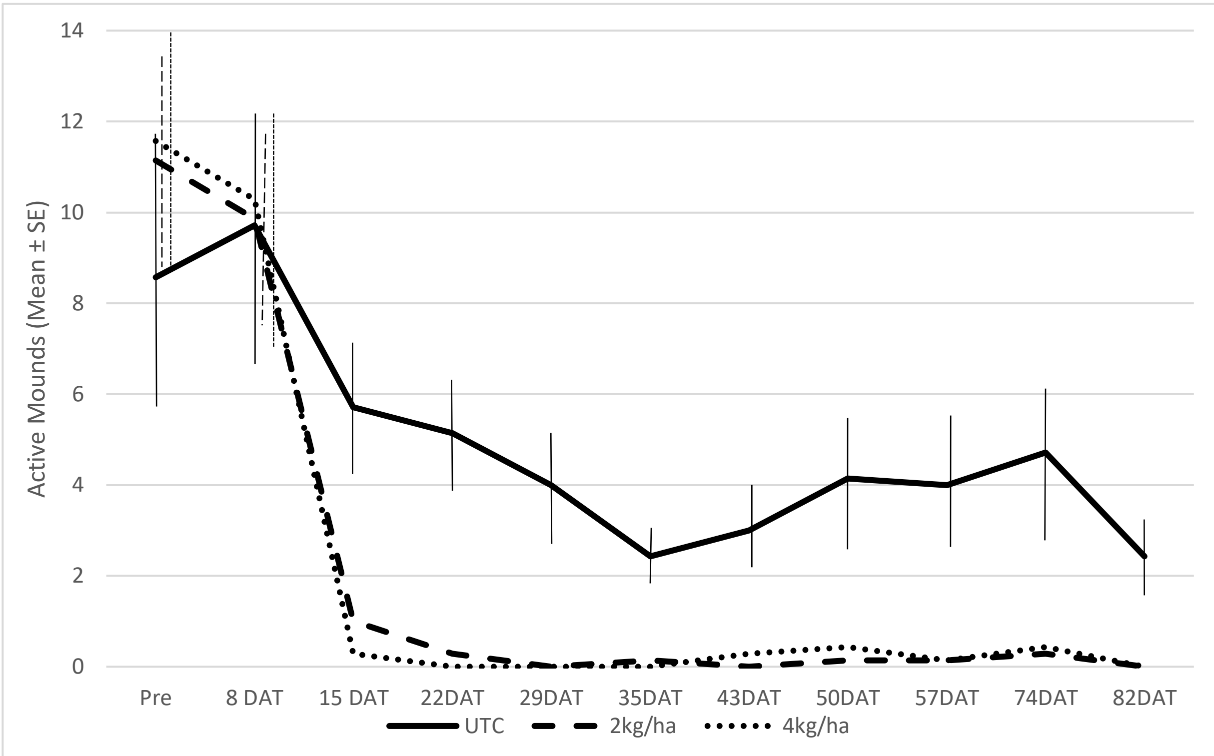


Figure 7: Results of trial 3 (Robertson 2 site). DAT = days after treatment, UTC = untreated control. Error bars are shown only for Pre and 8DAT assessments.



DISUSSION

Aphaenogaster spp. are considered to be omnivorous and generalist feeders (Richards 2009). In Australia, *A. pythia* is most often described as a subterranean feeder on small invertebrates encountered below ground or fallen into the funnel, and even their own dead (Hitchcock 1958, 1968, Saunders 1961, 1970, Shattuck 2008). There are also records of subterranean mutualistic relationships between *A. pythia* and aphids and leafhoppers (Hitchcock 1967, Saunders 1967) and direct feeding on the sap of plant roots (Hitchcock 1958, Wilson 1962). Less is known about the feeding habits of *A. longiceps* but it is known to harvest seeds (Richards 2009). Foraging *Aphaenogaster* workers are rarely observed on the surface during the day and mostly near the nest entrance (Richards 2009, Shattuck 2008). Given that they appear to be mostly subterranean feeders, the use of bait to control this species seemed unlikely to succeed. Much of what we know about their foraging habits relate to *A. pythia* from north Queensland which are rarely encountered foraging above ground whereas *A. longiceps* clearly does forage above-ground during the day. Preliminary trials conducted in south-east Queensland on *A. pythia* (Webb pers. obs.) have shown that, although there was little or no evidence of diurnal foraging, bait was taken into the nest during the night-time and resulted in clear mortality over the subsequent week – evident in piles of dead individuals at the base of mounds.

A. longiceps workers were observed retrieving both types of granules during the day and there appear no obvious tendency towards one or other. There was no evidence of bait rejection the day after application ie. bait granules ejected from the mound.

It could be argued that the technique of stomping on active mounds after assessments could lead to disruption of the colony and maybe cessation of mound repair. There was no evidence of this in this study as the number of mounds recorded during the second assessment at each site was generally similar to the pre-treatment assessment. Further, it is known that *Aphaenogaster* spp. can refurbish or even move nests overnight (Hughes 1990, Richards 2009) and *Aphaenogaster* mounds are easily damaged by physical forces such as rainsplash and overland water flow.

The weather conditions during the trial period were similar to the long-term averages for rainfall and maximum temperature in those locations and *A.*

longiceps activity reflected that. As a postscript to this work, in the subsequent years since these trials were conducted attempts at conducting further trials have met with failure due to the prolonged drought. In most sites colonies of *A. longiceps* and *A. pythia* have retreated well below ground and discontinued maintenance of mounds with mound formation occurring only after significant rainfall. Colonies are known to remain deep underground until moisture conditions at ground level are conducive (Saunders 1961, 1970).

The three trials were consistent in that they showed a rapid decline of active mounds after week 2 and that there was no advantage of the 4kg/ha rate over the 2kg/ha rate. The three sites demonstrated effective control of *A. longiceps* for 10-12 weeks. A second application may be required around the 10-12 week mark and given the partial nocturnal activity of the species, application late afternoon may also be beneficial.

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