EFFECTIVENESS OF THE INSECTICIDAL SMALL HIVE BEETLE REFUGE TRAP APITHOR™ IN REDUCING ADULT BEETLE NUMBERS IN BEE HIVES.

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Summary:
Research into the insecticidal control of adult small hive beetles culminated in the development of an insecticidal refuge trap for deployment inside commercial bee colonies. The device (APITHOR™) is comprised of a two piece rigid plastic shell encasing a fipronil (300 mg L^{-1}; Ensystex Pty. Ltd. Ultrathor 100SC) -treated corrugated cardboard insert. In a 36 day long field trial conducted in a beetle infested apiary at Richmond in Sydney's west, live adult beetles were eliminated from hives containing APITHOR™ while beetle numbers increased by approximately 20% in co-located control hives.

Introduction:
The behaviour of the beetles in laboratory culture (Haque and Levot 2005) suggested that a refuge trap incorporating core-fluted cardboard might be devised for in-hive use. Prototype harbourages comprised of fipronil-treated core-fluted cardboard covered with adhesive-backed 50µm thick aluminium foil were tested in the laboratory (Levot and Haque 2006) and in the field (Levot 2008a) and were found to be effective in killing adult beetles but unsuitable for use inside hives. Subsequently a more sophisticated trap comprising a two-piece plastic protective shell for the fipronil-treated corrugated cardboard insert was devised. Early field testing was very encouraging. Beetles readily sought refuge in the harbourage and were killed by contact with the fipronil treated cardboard insert. No deleterious effects on bees were observed and the hives thrived during the time the harbourages were deployed. The effectiveness of the harbourages was obvious at the completion of the trial when no, or only a few live beetles remained in the hives (Levot 2008b).

Materials and Methods:

The cardboard inserts in the APITHOR™ used in this trial were treated with Ensystex Pty. Ltd. product Ultrathor Water-based termiticide 100g fipronil L^{-1} (APVMA Registration No. 64449; Batch no. J-140-2; Date of Manufacture - July 2010). The APITHOR harbourages used in this trial were (Batch no. ENS001-0810; Date of Manufacture - August 2010). Quality control checks performed by an independent laboratory confirmed that the fipronil content of the cardboard inserts fell within specification. Boxes of cellophane wrapped harbourages were transported to Menangle where wire lanyards were attached to individual harbourages in preparation for deployment in the hives.

This trial was conducted in accordance with the conditions of APVMA Research Permit PER11184 at an apiary located at the Wheen Foundation facility at Richmond, NSW where a high endemic beetle population exists (Figure 1).

Figure 1. The Richmond apiary where the field efficacy trial was conducted.

Thirty lightly beetle infested new, single box hives with sister queens and similar worker bee numbers were transported to Richmond two weeks prior to the

commencement of the trial. The insides of the bottom boards were painted white to facilitate the counting of beetles. With few plants flowering during the trial interval each hive was provided with sugar supplement contained in a syrup feeder in place of one of the outside hive frames. The hives were arranged in a single line and oriented to face north. One week before the trial commenced the hives were checked and bee numbers manipulated to make the hives as similar as possible in terms of strength. During this preparatory phase, beetle infestations within the hives increased by immigration from the immediate vicinity.

On 23rd March 2011 beetle numbers in the hives were deemed adequate (13- 41 per hive) and, based on experience from earlier years, likely to increase over the next few months. Each individually numbered hive was weighed on a mobile weighing platform supported by a pair of Ruddweigh™ load bars attached to a digital display. After weighing each hive was returned to its respective position within the apiary. At this time initial beetle counts were conducted. This entailed a systematic inspection of each hive (Figure 2).

Figure 2. The systematic inspection of individual hives.

The number of beetles was determined by opening the hives and counting the numbers of live adult beetles on the bottom boards, frames and lid. After smoking the hive entrance the lid was removed for inspection and placed upturned on the ground. The frames were smoked prior to their individual removal from the brood box. They were briefly inspected and placed into a spare hive box. The beetles remaining in the brood box were counted by drawing a 75mm wide metal spatula slowly across the bottom board and walls to move bees and disturb beetles that were harbouring within the hive box. Meanwhile the combination of smoke and light drove beetles from the frames in the second hive box onto the bottom board where they too were counted. The new hive box containing the frames was then placed back onto the original bottom board and the lid replaced.

Overwhelmingly, most beetles were found on the bottom board of the hives. On Day 0 beetle numbers were only low to moderate and we were confident that quite accurate counts were obtained without the need to remove and replace beetles during the inspection process. Hives were ranked in order of ascending beetle numbers, grouped in pairs and alternately allocated to either the APITHOR™ or ‘control’ treatment groups. A single APITHOR™ harbourage was placed on the bottom board of each ‘treatment’ hive (Figure 3). A harbourage containing an untreated cardboard insert was placed on the bottom board of each ‘control’ hive.

Figure 3. APITHOR™ installed on the bottom board of a hive.

Sixteen and thirty six days after harbourage placement the numbers of live beetles in the hives were recorded as before. At the same time the numbers of dead beetles seen in the hives were recorded and all dead beetles removed. The Day 16 live beetle count could not include any live beetles inside the harbourages and so is likely to have underestimated the live beetle count, at least in the 'controls'. Immediately prior to the Day 36 inspections the hives were re-weighed. During this inspection the number of frames of bees was also recorded. After the Day 36 inspections the harbourages were removed from the hives, placed into individual labelled sealable plastic bags and brought back to the laboratory. Here they were broken open, the cardboard peeled back and the number of live and dead beetles inside counted (Figure 4). The aggregate numbers of dead beetles removed during the two inspections together with the number dead inside the harbourages were recorded. These figures may not represent the total number of beetles killed by the treatments as bees may have removed some dead beetles from the hive.

Figure 4. Dead beetles inside a dismantled APITHOR™ small hive beetle harbourage.

Statistical analysis

Efficacy (reduction in the live beetle count) was calculated in two ways. Firstly, the absolute reduction in live beetles in the APITHOR™ treated hives was calculated based on comparison of the number of live beetles present in the hives at various times after placement of the harbourages with the numbers present pre-treatment:

$$\% \text{ reduction} = 100 \times ((T_0-T_1)/T_1)$$

Where T_0 is the aggregate pre-treatment live beetle count and T_1 is the aggregate live beetle count at Day 16 or Day 36.

In the second efficacy calculation allowance was made for changes in live beetle numbers in the control hives that reflected the naturally expanding population. As such, percentage reductions in the mean number of live beetles present in the hives at the Day 16 and Day 36 inspections were calculated using the formula recommended by Henderson and Tilton (1955) namely:

$$\% \text{ reduction} = 100 \times (1 - ((T_0/C_1) \times (C_0/T_1))$$

where C_0 and T_0 are the mean pre-treatment live beetle counts in the Control and Treated hives and C_1 and T_1 are the mean Day 16 or Day 36 live beetle counts in the control and APITHOR™ -treated hives respectively.

Changes in hive weights were analysed using the Student' t-test. Changes to the number of frames of bees in the treatments were analysed using a generalised linear model with errors assumed to follow a multinomial distribution. Beetle counts (live and dead) were analysed using a generalised linear mixed model with errors assumed to follow Poisson distributions.

Results:

On Day 0 low to moderate beetle numbers (mean approximately 25 beetles) were recorded in each hive (Table 1) with no significant difference ($P>0.05$) in beetle numbers in hives assigned to the control or APITHOR™ treatments. During the trial interval beetle numbers in the control hives increased by approximately 20% indicating an expanding beetle population. At the Day 16 assessment the mean number of live beetles in the control hives was 31 (range 18-47) and probably underestimated the true number as it is very likely that some beetles were harbouring inside the untreated (control) harbourages. At the same time two live

beetles were found in only one of the APITHOR™ treated hives. The remaining fourteen treated hives contained no live beetles (>99% reduction). At the Day 36 assessment the mean number of live beetles in the control hives was similar to that recorded on Day 16 but had dropped to zero in the APITHOR™ treated hives (100% reduction). The reductions in live beetle counts in the APITHOR™ treated hives was highly significant ($P<0.001$).

The reduction in live beetles in the APITHOR™ treated hives was reflected in the numbers of dead beetles removed from the hives or retrieved from the harbourages at the completion of the trial. Some beetles died outside the harbourage and bees may have removed some of these from the hives. It is impossible to estimate how many dead beetles may have been lost in this way but generally it can be said that the number of dead beetles retrieved in the treated hives rarely matched the pre-treatment live beetle counts. Therefore the numbers of dead beetles recorded in Table 1 do not match the Day 0 live beetle counts. Nevertheless, there was a highly significant ($P<0.001$) difference in the number of dead beetles recovered from the APITHOR™ treated hives compared to the controls (Table 1).

Mean hive weights and the mean number of frames of bees increased in both the control and APITHOR™ treated hives (Table 1) with no significant differences ($P>0.05$) evident between the two treatments. Hive weight largely reflected the amount of honey laid down during the trial interval though there was, on average a modest 0.3 - 0.4 frame increase in bee numbers.

Discussion:

In the field efficacy trials the pre-treatment live beetle counts represented the starting populations in each hive. There was no way of accurately measuring the number of beetle migrating into or out of the hives but it has been shown that beetles entering hives usually stay (N. Annand, unpublished data). Similarly it was not possible to accurately measure the number of beetles killed by the treatment. This was evident by the disparity in the number of beetles recorded in the APITHOR™ treated hives on Day 0 and the total number of dead beetles recorded throughout the trial interval (Table 1). This is because some beetles die outside

the harbourage and are removed by the bees. At the first (Day 16 after placement of APITHOR™) assessment of live beetle numbers in the hives, greater than 99% control had been achieved with fourteen of the fifteen hives containing no live beetles. At the final (Day 36) assessment no live beetles (100% control) were observed in any of the treated hives.

With this level of effectiveness bee keepers should feel confident that deployment of APITHOR™ harbourages in their bee colonies as directed on the label will control small hive beetle.

REFERENCES

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Table 1. Comparison of changes live beetle counts, dead beetle counts, mean hive weight increase and mean number of frames of bees in 'control' and APITHOR™-treated hives.

Treatment	Mean hive weight (kg) Day 0	Mean hive weight (kg) Day 36	Mean net increase in hive weight (kg)	Mean no. frames Day 0	Mean no. frames Day 36	Mean total dead beetle count	Mean live beetle count Day 0	Mean live beetle count Day 16	Mean live beetle count Day 36
Control	18.56	24.61	6.053	6.07	6.47	1.6	25.93	31.33	31.53
APITHOR™	19.29	24.73	5.44	5.87	6.20	14	23.33	0.13	0
p-value	0.352	0.89	0.139	0.500	0.356	<0.001	0.151	<0.001	<0.001

APPENDIX 1.

Original records of field efficacy trial results.

A. Control hives

2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 118	CONTROL / APITHOR NOTES:		
Initial hive weight (date) 15.4 (23/3/11)	6 frames	Final hive weight (date)	21.2
Initial live beetle count (date) 17 (23/3/11)	~~21 + 1~~ 8/4/11	Initial dead beetle count 0	
2nd live beetle count (date) (8/4/11)	21 + 1 = 22	2nd dead beetle count 0	
3rd live beetle count (date) (23/4/11)	15 x 2 = 17	3rd dead beetle count 0	FINAL 5 frames
In harbourage live beetle count 9 8 tea	TOTAL LIVE BEETLE 17 + 8 = 25 9 tea	In harbourage dead beetle count 1 0 tea	
Total dead beetle count	1		

2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 139	CONTROL / ~~APITHOR~~ NOTES:		
Initial hive weight (date) 19.4 (21/3/11)	7 Frames	Final hive weight (date)	25.6
Initial live beetle count (date) 31 (23/3/11)		Initial dead beetle count 0	
2nd live beetle count (date) (8/4/11)	43 + 3 = 46	2nd dead beetle count 0	
3rd live beetle count (date) (28/4/11)	30 X 1 = 31	3rd dead beetle count 0	
In harbourage live beetle count ~~10~~ 18 EGGS	TOTAL active = 31 + ~~EGGS~~ 18 = ~~50~~ 49 EGGS	In harbourage dead beetle count 1	
Total dead beetle count	1		

FINAL. 7 + frames dead bees

2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 154	CONTROL / ~~APITHOR~~ NOTES:		
Initial hive weight (date) 20.8 (23/3/11)	7 frames	Final hive weight (date)	26.8
Initial live beetle count (date) 20 (23/3/11)		Initial dead beetle count 0	
2nd live beetle count (date) (5/4/11)	25 + 0 = 25	2nd dead beetle count 0	possible drone layer
3rd live beetle count (date) (25/4/11)	19 + 1 = 20	3rd dead beetle count 0	FINAL 7# frames 5# & grubs
In harbourage live beetle count	~~TOTAL LIVE~~ 20 + 1 = 21	In harbourage dead beetle count 0	
Total dead beetle count	0		

2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 121	CONTROL / ~~APITHOR~~ NOTES:		
Initial hive weight (date) 21.4 (27/1/11)	7 Frames	Final hive weight (date)	27.6
Initial live beetle count (date) 40 (27/1/11)	1	Initial dead beetle count 0	
2nd live beetle count (date) (8/4/11)	46 + 1 = 47	2nd dead beetle count 0	
3rd live beetle count (date) (8/4/11)	29 + 1 = 30	3rd dead beetle count 0	
In harbourage live beetle count 8	TOTAL LIVE 30 + 8 = 38	In harbourage dead beetle count 2	
Total dead beetle count	2		

FINAL
7 frames
good
brood.

2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 131	CONTROL / APITHOR NOTES:		
Initial hive weight (date) 15.4 (23/3/11)	4 Frames	Final hive weight (date)	21.0
Initial live beetle count (date) 20 (23/3/11)		Initial dead beetle count 0	
2nd live beetle count (date) (5/4/11)	17+1 = 18	2nd dead beetle count 0	
3rd live beetle count (date) (28/4/11)	17+0 = 17	3rd dead beetle count 0	FINAL 5 frames
In harbourage live beetle count 8	TOTAL LIVE = 17+8 = 25	In harbourage dead beetle count 0	
Total dead beetle count	0		

2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 147	CONTROL / ~~APITHOR~~ NOTES:		
Initial hive weight (date) 17 4 (23/3/11)	6 Frame	Final hive weight (date)	24.6
Initial live beetle count (date) 25 (23/3/11)		Initial dead beetle count 0	
2nd live beetle count (date) (5/4/11)	26 + 0 = 26	2nd dead beetle count 0	
3rd live beetle count (date) (28/4/11)	23 + 0 = 23	3rd dead beetle count 0	FINAL 7frame
In harbourage live beetle count 7	TOTAL LIVE = 23 + 7 = 30	In harbourage dead beetle count 1	
Total dead beetle count	1		

2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 128	CONTROL / ~~APITHOR~~ NOTES:		
Initial hive weight (date) 19.0 (23/3/11)	6 Frames	Final hive weight (date)	26.4
Initial live beetle count (date) 4 26 (23/3/11)		Initial dead beetle count 0	
2nd live beetle count (date) (8/4/11)	18 + 1 = 19	2nd dead beetle count 0	
3rd live beetle count (date) 28/4/11	30 + 0 = 30	3rd dead beetle count 0	FINAL 7 frames
In harbourage live beetle count 4	TOTAL LIVE = 30+4 = 34	In harbourage dead beetle count 2	
Total dead beetle count	2		

2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 125	CONTROL / ~~APITHOR~~ NOTES:		
Initial hive weight (date) 20·4 (23/3/11)	6 Frames	Final hive weight (date)	26·2
Initial live beetle count (date) 23 (23/4/11)		Initial dead beetle count 0	
2nd live beetle count (date) (8/4/11)	32 + 1 = 33	2nd dead beetle count 1	
3rd live beetle count (date) (25/4/11)	23 x 1 = 24	3rd dead beetle count 0	FINAL 7 frames
In harbourage live beetle count 6	TOTAL LIVE 24 + 6 = 30	In harbourage dead beetle count 1	
Total dead beetle count	2		

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2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 123 ~~Apithor~~ EFF CL	CONTROL / ~~APITHOR~~ NOTES:		
Initial hive weight (date) 18.2 (23/3/11)	6 Frames	Final hive weight (date)	23.2
Initial live beetle count (date) 13 (23/3/11)		Initial dead beetle count 0	
2nd live beetle count (date) (8/4/11)	18+0 = 18	2nd dead beetle count 0	larvae out
3rd live beetle count (date) (28/4/11	20+0 = 20	3rd dead beetle count 0	FINAL 7 frames
In harbourage live beetle count 5	TOTAL LIVE = 20+5 = 25	In harbourage dead beetle count 3	
Total dead beetle count	3		

2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 112	CONTROL / APITHOR NOTES:		
Initial hive weight (date) 20.4 (23/3/11)	6 frames	Final hive weight (date)	26.8
Initial live beetle count (date) 23 (23/3/11)	~~23~~ EEGG 8/4/11 G	Initial dead beetle count 0	
2nd live beetle count (date) (5/4/11)	23	2nd dead beetle count 0	
3rd live beetle count (date) (28/4/11)	24 + 1 = 25	3rd dead beetle count 0	FINAL 7+ frames
In harbourage live beetle count 4	TOTAL LIVE = 25+4 = 29	In harbourage dead beetle count 4 Ø EEGG	
Total dead beetle count	~~Ø~~ EE GG 4		

2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 144	CONTROL / APITHOR NOTES:		
Initial hive weight (date) 19.4 (23/3/11)	~~87~~ from Effie	Final hive weight (date)	25.8
Initial live beetle count (date) 29 (23/3/11)		Initial dead beetle count 0	
2nd live beetle count (date) (6/4/11)	60 x	2nd dead beetle count 0	
3rd live beetle count (date)	30+3= 33	3rd dead beetle count 0	
In harbourage live beetle count 11	TOTAL LIVES 33 + 11 = 44	In harbourage dead beetle count 3	
Total dead beetle count	3		

FINAL 7 + from dead bees in front

2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 135	CONTROL / APITHOR NOTES:		
Initial hive weight (date) 19.4 (23/3/11)	6 frames	Final hive weight (date)	25.6
Initial live beetle count (date) 31 (23/3/11)		Initial dead beetle count 0	
2nd live beetle count (date) (8/4/11)	34	2nd dead beetle count 0	larvae under
3rd live beetle count (date)	29 x 2 = 31 >	3rd dead beetle count 0	FINAL Hive
In harbourage live beetle count 12	TOTAL LIVE = 31 + 12 = 43	In harbourage dead beetle count 1	
Total dead beetle count	1		

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2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 117	CONTROL / ~~APITHOR~~ NOTES:		
Initial hive weight (date) 16.4 (23/3/11)	7 Frames	Final hive weight (date)	21.0
Initial live beetle count (date) 29 (23/3/11)		Initial dead beetle count 0	
2nd live beetle count (date) (5/4/11)	38+3 = 41	2nd dead beetle count 0	+live larvae
3rd live beetle count (date)	28 +2 = 30	3rd dead beetle count 1	
In harbourage live beetle count 4	TOTAL LIVE 30 + 4 = 34	In harbourage dead beetle count 1	
Total dead beetle count	2		

FINAL 5 frames pretty brood dead bees

2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 120	**CONTROL / APITHOR** NOTES:		
Initial hive weight (date) 18.6 (21/3/11)	5 frames	Final hive weight (date)	23.8
Initial live beetle count (date) 35 (23/3/11)		Initial dead beetle count 0	
2nd live beetle count (date) (6/4/11)	26 + 0 = 26	2nd dead beetle count 0	
3rd live beetle count (date) (28/4/11)	20 + 1 = 21	3rd dead beetle count 0	FINAL 6 frames
In harbourage live beetle count 12	TOTAL LIVE = 21 + 12 = 33	In harbourage dead beetle count 1	
Total dead beetle count			

2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 129	CONTROL / ~~APITHOR~~ NOTES:		
Initial hive weight (date) 16.8 (23/3/11)	5 Frames	Final hive weight (date)	23.6
Initial live beetle count (date) 27 (23/3/11)	?	Initial dead beetle count 0	
2nd live beetle count (date) (5/4/11)	31 x 1 = 32	2nd dead beetle count 0	
3rd live beetle count (date) (28/4/11)	19 + 3 = 22	3rd dead beetle count 0	
In harbourage live beetle count 8	TOTAL LIVE = 22 + 8 = 30	In harbourage dead beetle count 1	
Total dead beetle count	1		

FINAL
6 frames
good brood
1 SHB larva

A. APITHOR™- treated hives

2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 133	~~CONTROL~~ / APITHOR NOTES:		
Initial hive weight (date) 18.2 (23/3/11)	6 Frames	Final hive weight (date)	24.2
Initial live beetle count (date) EGGS ~~25~~ 27 (23/3/11)		Initial dead beetle count 0	
2nd live beetle count (date) (8/4/11)	0	2nd dead beetle count EGGS 8/4/11 3	
3rd live beetle count (date) (28/4/11)	0 x 0 = 0	3rd dead beetle count 0	
In harbourage live beetle count 0	TOTAL LIVE = 0 + 0 = 0	In harbourage dead beetle count 5	
Total dead beetle count	8		

FINAL 7 frames

2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 141	~~CONTROL~~ / **APITHOR** NOTES:		
Initial hive weight (date) 21.0 (23/3/11)	7 frames	Final hive weight (date)	28.4
Initial live beetle count (date) ~~2~~ 22 (23/3/11)		Initial dead beetle count 0	
2nd live beetle count (date) (8/4/11)	0+0=0	2nd dead beetle count 5	
3rd live beetle count (date) (28/4/11)	0+0=0	3rd dead beetle count 0	
In harbourage live beetle count 0	TOTAL LIVE= 0+0=0	In harbourage dead beetle count 11	
Total dead beetle count	16		

FINAL 7 frames

2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 148	~~CONTROL~~ / APITHOR NOTES:		
Initial hive weight (date) 18.6 (23/3/11)	6 frame	Final hive weight (date)	23.8
Initial live beetle count (date) ~~16~~ 17 (23/3/11)		Initial dead beetle count 0	
2nd live beetle count (date) (6/4/11)	0 + 0 = 0	2nd dead beetle count 0	
3rd live beetle count (date) (28/4/11)	0 + 0 = 0	3rd dead beetle count 0	
In harbourage live beetle count 0	TOTAL LIVE = 0 + 0 = 0	In harbourage dead beetle count 11	
Total dead beetle count	11		

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2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 127	~~CONTROL~~ / APITHOR NOTES:		
Initial hive weight (date) 17.6 (23/3/11)	S Francis	Final hive weight (date)	22.6
Initial live beetle count (date) ~~32~~ 41 (23/3/11)		Initial dead beetle count 0	
2nd live beetle count (date) (8/4/11)	0	2nd dead beetle count 0	
3rd live beetle count (date) (28/4/11)	0 x 0 = 0	3rd dead beetle count 0	FINAL
In harbourage live beetle count 0	TOTAL LIVE 0+0=0	In harbourage dead beetle count 24	
Total dead beetle count	24		

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2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 136	~~CONTROL~~ / APITHOR NOTES:		
Initial hive weight (date) 20.4 (23/3/11)	6 F frames	Final hive weight (date)	27.0
Initial live beetle count (date) 17 17 (23/3/11)		Initial dead beetle count 0	
2nd live beetle count (date) (5/4/11)	0	2nd dead beetle count 4	
3rd live beetle count (date) (25/4/11)	0 + 0 = 0	3rd dead beetle count 0	
In harbourage live beetle count 0	TOTAL LIVE = 0+0=0	In harbourage dead beetle count 4	
Total dead beetle count	8		

finish 6 frames

2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 138	~~CONTROL~~ / APITHOR NOTES:		
Initial hive weight (date) 16.4 (23/3/11)	5 Frames	Final hive weight (date)	21.0
Initial live beetle count (date) 25 26 (23/3/11)		Initial dead beetle count 0	
2nd live beetle count (date) (8/4/11)	0	2nd dead beetle count 7	
3rd live beetle count (date) (28/4/11)	0 + 0 = 0	3rd dead beetle count 0	
In harbourage live beetle count 0	TOTAL LIVE = 0+0=0	In harbourage dead beetle count 22	
Total dead beetle count	29		

REMOVE 5 FRAMES

2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 145	~~CONTROL~~ / APITHOR NOTES:		
Initial hive weight (date) 27.0 (23/3/11)	7 frames	Final hive weight (date)	268
Initial live beetle count (date) 16 18 (23/3/11)		Initial dead beetle count 0	
2nd live beetle count (date) (5/4/11)	0 x 0 = 0	2nd dead beetle count 3	
3rd live beetle count (date) (28/4/11)	0 x 0 = 0	3rd dead beetle count 0	
In harbourage live beetle count 0	TOTAL LIVE 0+0=0	In harbourage dead beetle count 12	
Total dead beetle count	15		

Brood 7 frames in upper brood

2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 122	~~CONTROL~~ / APITHOR NOTES:		
Initial hive weight (date) 18.0 (23/3/11)	5 frames	Final hive weight (date)	22.6
Initial live beetle count (date) 28 (23/3/11)		Initial dead beetle count 0	
2nd live beetle count (date) (8/4/11)	0	2nd dead beetle count 6	few were stuck leave under
3rd live beetle count (date) (28/4/11)	0 + 0 = 0	3rd dead beetle count 0	from 6 frames
In harbourage live beetle count 0	TOTAL LIVE = 0+0=0	In harbourage dead beetle count 8	
Total dead beetle count	14		

APITHOR Efficacy Version 1 16th March 2011 Approved by Garry Levot

2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 126	~~CONTROL~~ / APITHOR NOTES:		
Initial hive weight (date) 21.2 (23/3/11)	6 Frames 6	Final hive weight (date)	24.8
Initial live beetle count (date) 20 (23/3/11)		Initial dead beetle count 0	
2nd live beetle count (date) (8/4/11)	0	2nd dead beetle count 0	
3rd live beetle count (date) 28/4/11	0 +0 = 0	3rd dead beetle count 0	
In harbourage live beetle count 0	TOTAL LIVE = 0+0-0	In harbourage dead beetle count 2	
Total dead beetle count	2		

Final 6 frames v. good brood

2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 111	~~CONTROL~~ L / APITHOR NOTES:		
Initial hive weight (date) 18.8 (23/3/11)	7 frames	Final hive weight (date)	26.8
Initial live beetle count (date) 31 (23/3/11)		Initial dead beetle count 0	
2nd live beetle count (date) (8/4/11)	0+0=0	2nd dead beetle count 5	
3rd live beetle count (date) (28/4/11)	0+0=0	3rd dead beetle count 0	
In harbourage live beetle count 0	TOTAL LIVE 0+0	In harbourage dead beetle count 9	
Total dead beetle count	14		

FINAL 7+ frames

2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 113	~~CONTROL~~ / APITHOR NOTES:		
Initial hive weight (date) 19.6 (23/3/11)	5 Frames	Final hive weight (date)	26.2
Initial live beetle count (date) ~~28~~ 34 23/3/11		Initial dead beetle count 0	
2nd live beetle count (date) (6/4/11)	0+0 = 0	2nd dead beetle count 7	green cell Chalkbrood bees Quiet no brood
3rd live beetle count (date) (28/4/11)	0+0 = 0	3rd dead beetle count 0	FINAL 7 frames 5HB larvae under harbourage
In harbourage live beetle count 0	TOTAL LIVE = 0+0 = 0	In harbourage dead beetle count 13	
Total dead beetle count	20		

2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 115	~~CONTROL~~ / APITHOR NOTES:		
Initial hive weight (date) 18·6 (23/3/11)	7 Frames	Final hive weight (date)	24.8
Initial live beetle count (date) (23/3/11) 16		Initial dead beetle count 0	
2nd live beetle count (date) (8/4/11)	0	2nd dead beetle count 0	
3rd live beetle count (date) (26/4/11)	0+0 = 0	3rd dead beetle count 1+1=2	FINAL 6 Frames
In harbourage live beetle count 0	FINAL LIVE = 0+0=0	In harbourage dead beetle count 18	
Total dead beetle count	20		

APITHOR Efficacy Version 1 16th March 2011 Approved by Garry Levot

2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 140	~~CONTROL~~ L / APITHOR NOTES:		
Initial hive weight (date) 160 (23/3/11)	4 Frames Ftn	Final hive weight (date)	20.6
Initial live beetle count (date) 13 (23/3/11)		Initial dead beetle count 0	
2nd live beetle count (date) (5/4/11)	0	2nd dead beetle count 0	
3rd live beetle count (date) (28/4/11)	0 X 0 = 0	3rd dead beetle count 0	
In harbourage live beetle count 0	TOTAL LIVE = 0 + 0 = 0	In harbourage dead beetle count 4	
Total dead beetle count	4		

FINAL 4 5 frames RECD

2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 124 x	~~CONTROL~~ / APITHOR NOTES:		
Initial hive weight (date) ~~20~~ 25.0 (23/3/11)	6 frames	Final hive weight (date)	28.2
Initial live beetle count (date) 21 (23/3/11)		Initial dead beetle count 0	
2nd live beetle count (date) (8/4/11)	0 x 0 = 0	2nd dead beetle count 1	
3rd live beetle count (date) (28/4/11)	0 x 0 = 0	3rd dead beetle count 0	
In harbourage live beetle count 0	TOTAL LIVE = 0 + 0 = 0	In harbourage dead beetle count 9	
Total dead beetle count	10		

FINAL 7 frames

2011 SMALL HIVE BEETLE EFFICACY TRIAL

HIVE NUMBER: 143	~~CONTROL~~ / APITHOR NOTES:		
Initial hive weight (date) 18.2 (27/3/11)	6 frames	Final hive weight (date)	23.2
Initial live beetle count (date) 19 (27/V11)		Initial dead beetle count 0	
2nd live beetle count (date) (8/4/11)	1 x1 = 2	2nd dead beetle count 0	
3rd live beetle count (date) 28/4/11	0 x0 = 0	3rd dead beetle count 0	
In harbourage live beetle count 0	TOTAL LIVE = 0 + 0 = 0	In harbourage dead beetle count 15	
Total dead beetle count	15		

FINAL 5 frames EE & chalkbrood