

2011



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Bed Bugs Limited

Prepared by

David Cain

Evaluation of the tank trial
observations between the
passive bedbug monitor and
the clear view bedbug
monitor.

Contents

Summary3

Method3

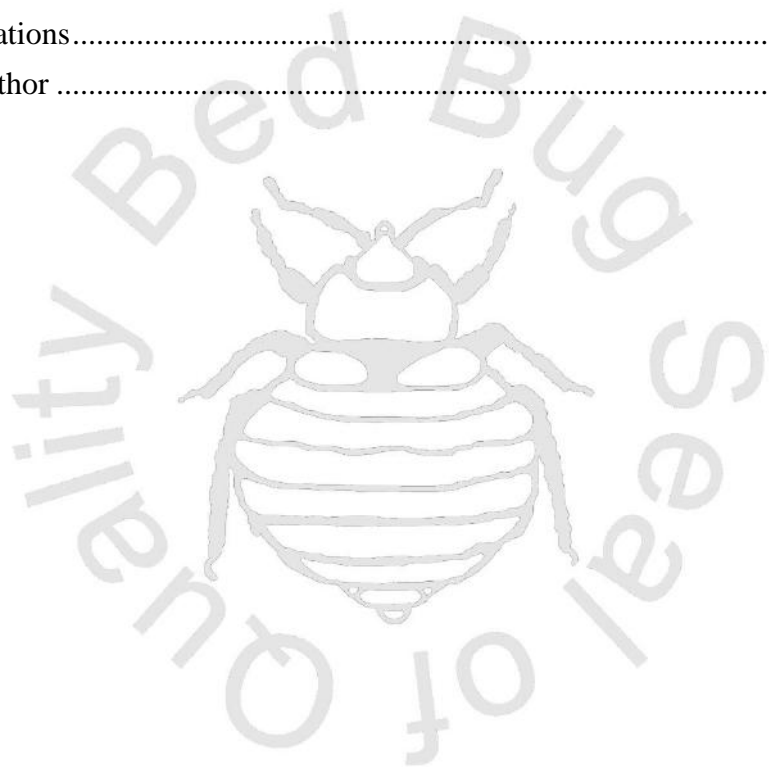
Data4

Results62

Conclusions65

Recommendations66

About the author66



Summary

Since the launch of the passive monitor in 2009 there have been a number of other concepts launched. Most are based on glue based attraction and aspects of chemical ecology. Although this would seem logical to many as a simple solution to bedbugs based on our field based observations over many years this pest is a lot more complex than this simple approach takes into account.

To evaluate the behaviour of bedbugs in a controlled environment given a choice between two monitors a colony of bedbugs was harvested from a hotel room in London. Approximately 75 live samples were collected which represented 3 different breeding generations in a room based on refugia modelling. Due to the room occupancy being high the samples were at various stages of feeding and to all intents and purposes would be as close to a wild population as we would gather.

The population was then observed over the following days to track their movements and the efficacy of the monitors being tested. The attractiveness of each product and the willingness of bedbugs given a free choice to explore or reside in the monitors could then be evaluated.

The ultimate end point for each product is when the first signs of bedbugs can be detected through inspection and how easily those signs can be confirmed.

Method

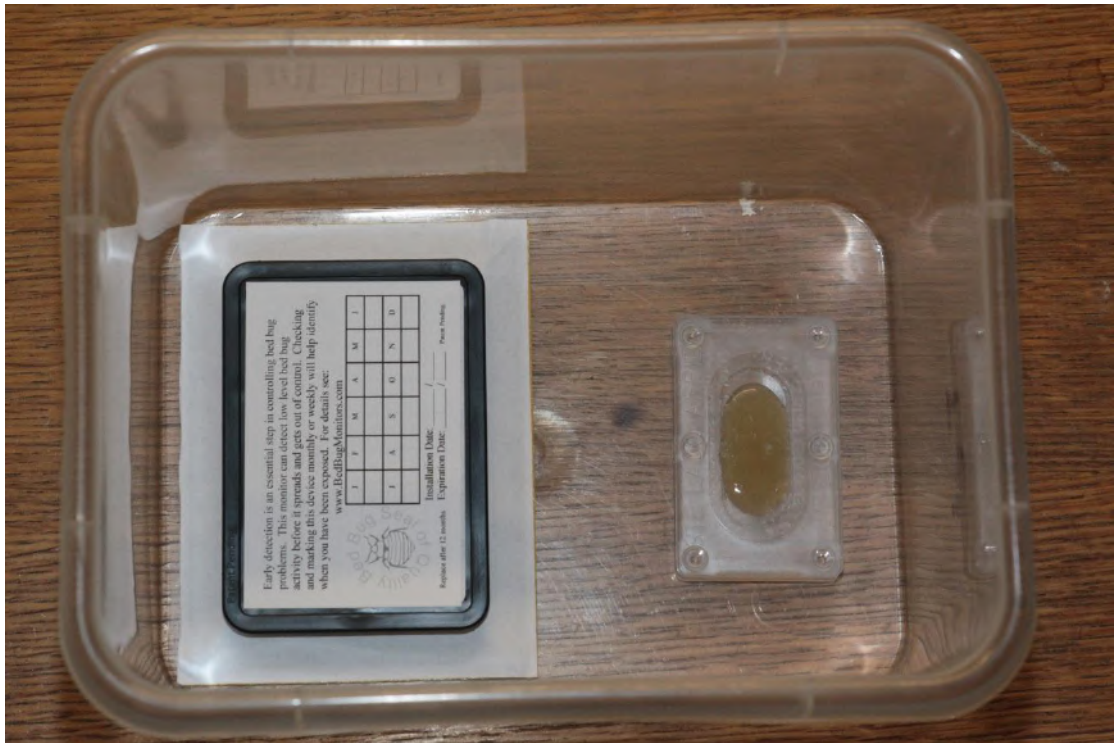
The clear view and passive bedbug monitors were placed in the area and allowed 20 minutes to acclimatise.

The entire population of bedbugs collected from a hotel room were released into a containment box between the two monitors by inverting the sample collection jar. This avoided any bias of introduction and gave both devices the same chance of working.

Images were taken of the test area at regular intervals and any specific, strong or regular behaviour patterns were observed in rapid frame photography. Each image was electronically time stamped to see the progression using a Canon EOS 5 D MKII camera fitted with a Cosima 1:1 lens.

The time stamp closest to the first confirmed signs of an infestation were noted as the first identification of bedbugs.

Data



IMG_0171 01/12/11 14:55 – tank set up



IMG_0173 01/12/11 14:56 - samples



| | |
|----------|--------------------------|
| IMG_0176 | 01/12/11 14:56 - Samples |
|----------|--------------------------|



| | |
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| IMG_0177 | 01/12/11 14:56 |
|----------|----------------|



IMG_0179 01/12/11 14:57



IMG_0180 01/12/11 14:57



IMG_0181 01/12/11 14:58



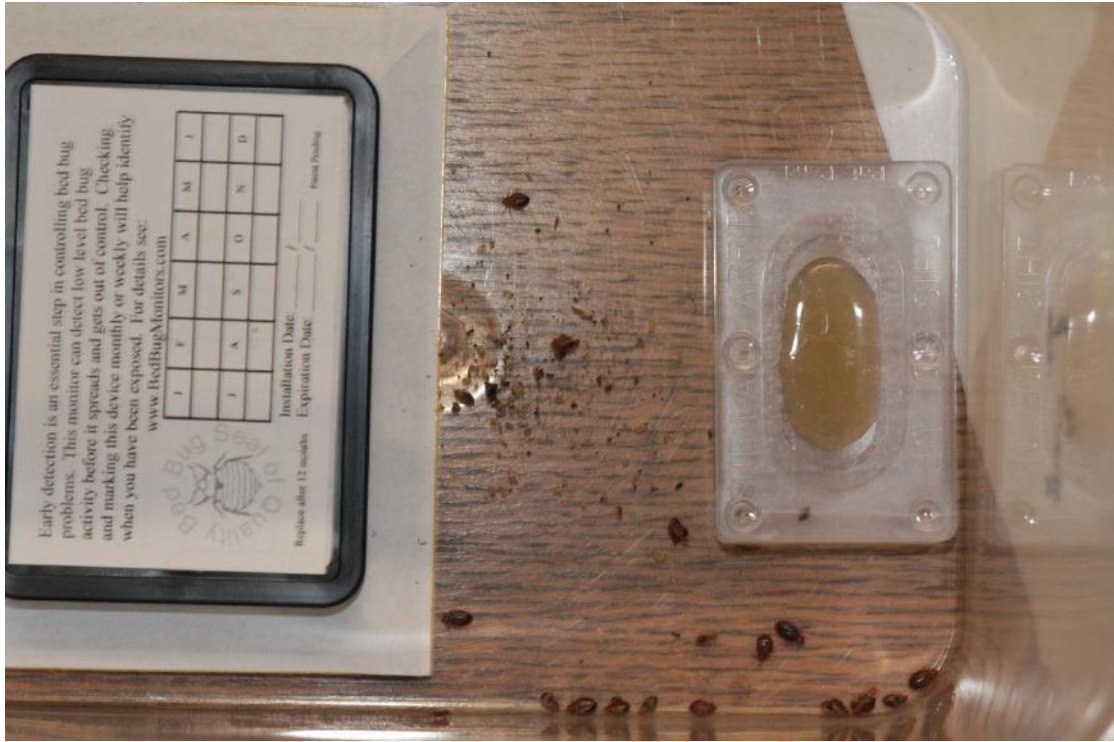
IMG_0182 01/12/11 14:58



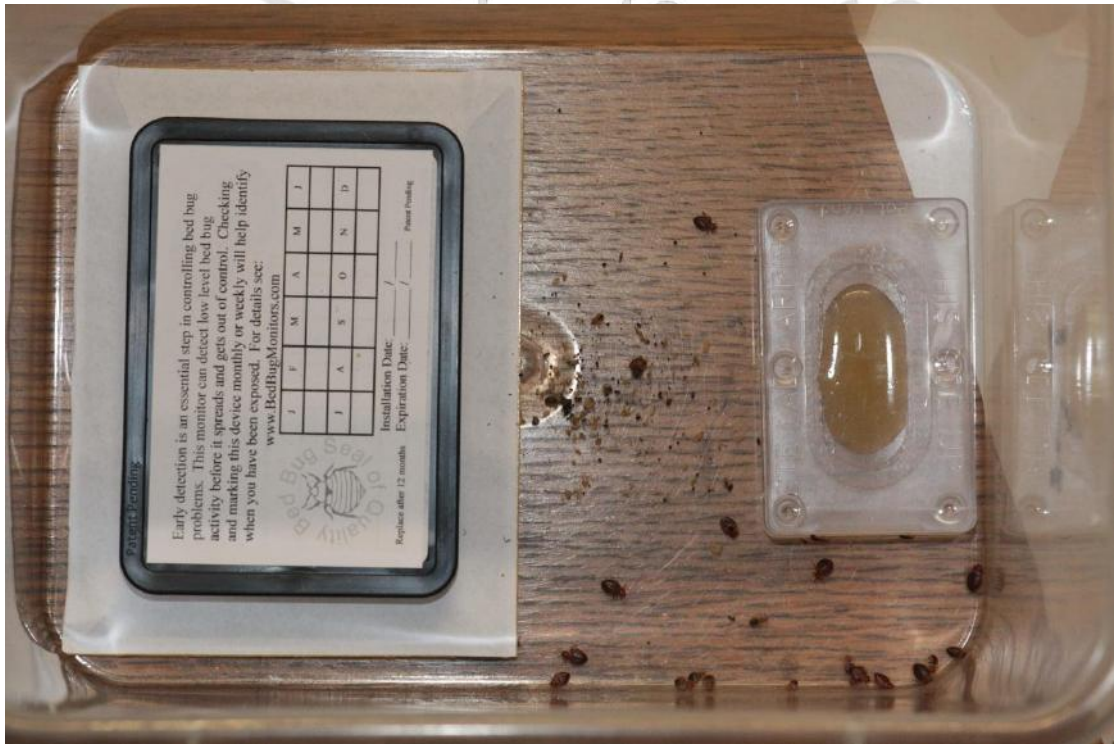
| | |
|----------|----------------|
| IMG_0183 | 01/12/11 14:58 |
|----------|----------------|



| | |
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| IMG_0184 | 01/12/11 14:58 |
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IMG_0185 01/12/11 14:58



IMG_0186 01/12/11 14:58



IMG_0187 01/12/11 14:58



IMG_0188 01/12/11 14:58



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| IMG_0189 | 01/12/11 14:58 |
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| IMG_0190 | 01/12/11 14:58 |
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IMG_0191 01/12/11 14:59



IMG_0192 01/12/11 14:59



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| IMG_0193 | 01/12/11 14:59 |
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| IMG_0194 | 01/12/11 14:59 |
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IMG_0195

01/12/11 14:59



IMG_0196

01/12/11 14:59



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| IMG_0197 | 01/12/11 14:59 |
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| IMG_0198 | 01/12/11 14:59 |
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IMG_0199 01/12/11 14:59



IMG_0200 01/12/11 14:59



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| IMG_0201 | 01/12/11 14:59 |
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| IMG_0202 | 01/12/11 14:59 |
|----------|----------------|



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| IMG_0203 | 01/12/11 14:59 |
|----------|----------------|



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| IMG_0204 | 01/12/11 14:59 |
|----------|----------------|



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|----------|----------------|
| IMG_0205 | 01/12/11 14:59 |
|----------|----------------|



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| IMG_0206 | 01/12/11 14:59 |
|----------|----------------|



IMG_0207 01/12/11 14:59



IMG_0208 01/12/11 14:59



IMG_0209 01/12/11 14:59



IMG_0210 01/12/11 14:59



| | |
|----------|----------------|
| IMG_0211 | 01/12/11 14:59 |
|----------|----------------|



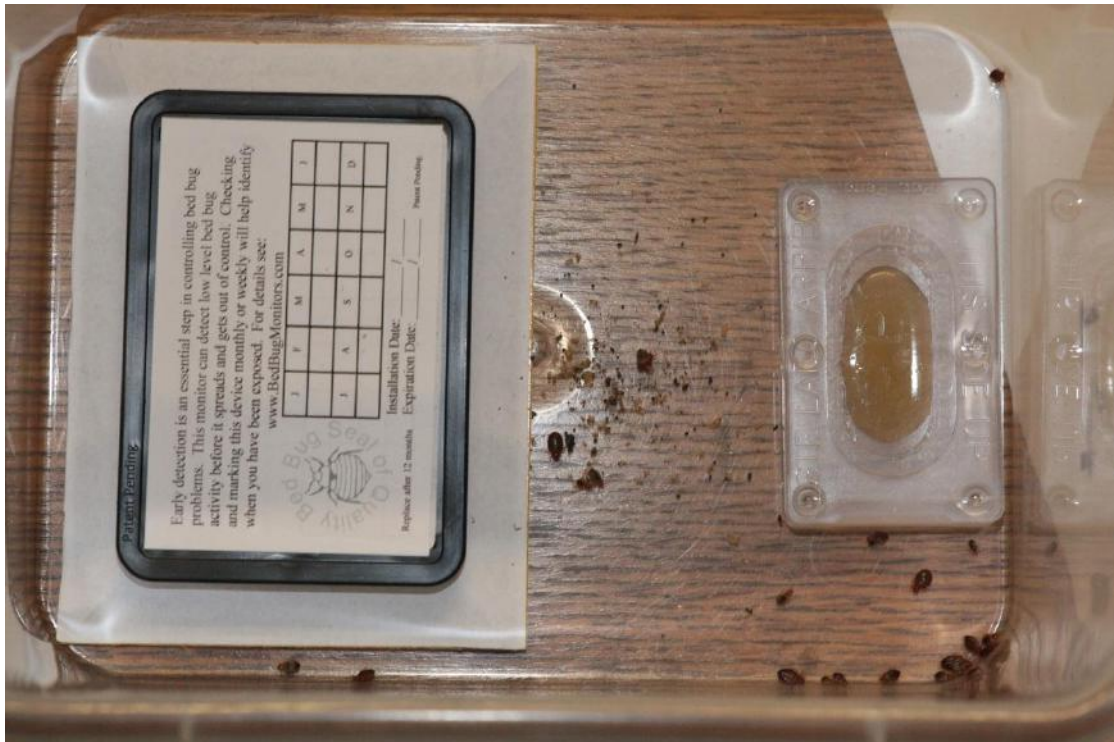
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| IMG_0212 | 01/12/11 14:59 |
|----------|----------------|



IMG_0213 01/12/11 14:59



IMG_0214 01/12/11 15:00



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|----------|----------------|
| IMG_0215 | 01/12/11 15:00 |
|----------|----------------|



| | |
|----------|----------------|
| IMG_0216 | 01/12/11 15:05 |
|----------|----------------|



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| IMG_0217 | 01/12/11 15:05 |
|----------|----------------|



| | |
|----------|----------------|
| IMG_0218 | 01/12/11 15:05 |
|----------|----------------|



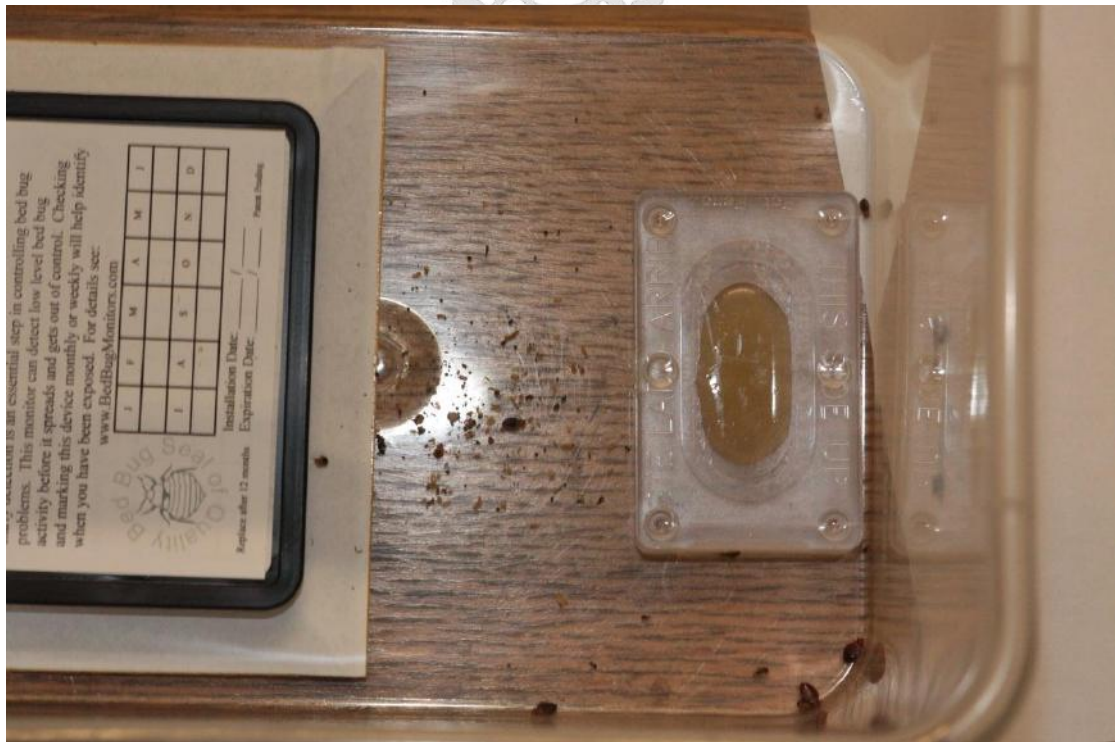
IMG_0219 01/12/11 15:05



IMG_0220 01/12/11 15:05



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| IMG_0221 | 01/12/11 15:05 |
|----------|----------------|



| | |
|----------|----------------|
| IMG_0222 | 01/12/11 15:05 |
|----------|----------------|



IMG_0223 01/12/11 15:06



IMG_0224 01/12/11 15:06



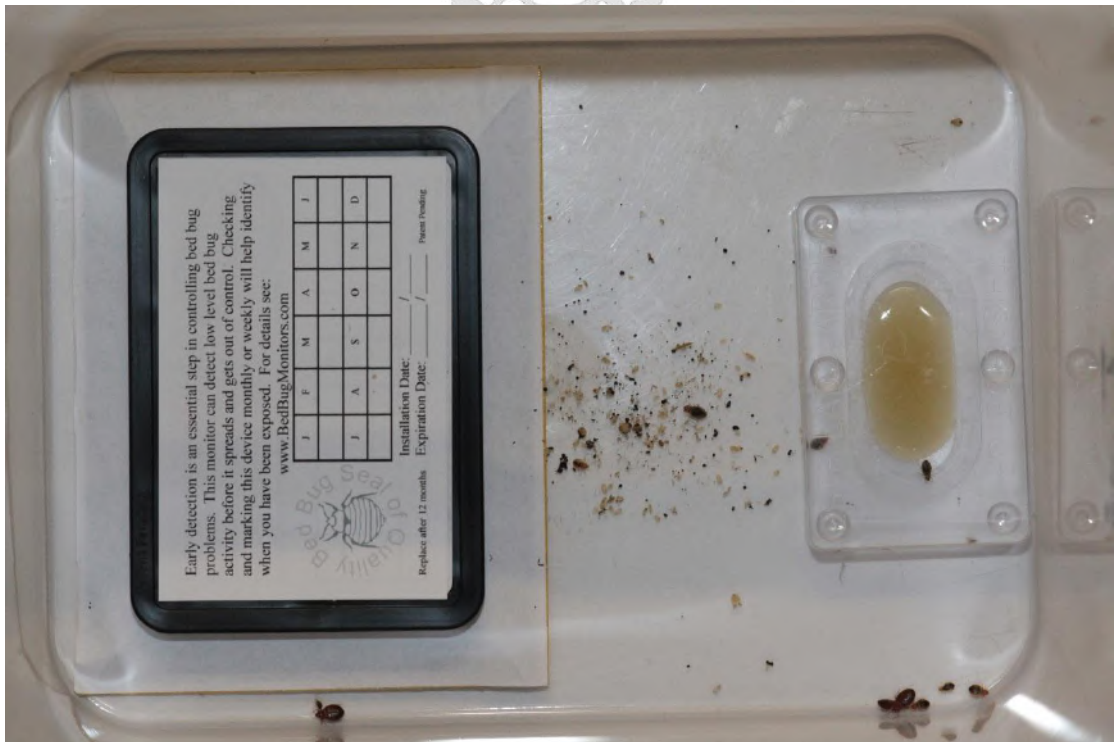
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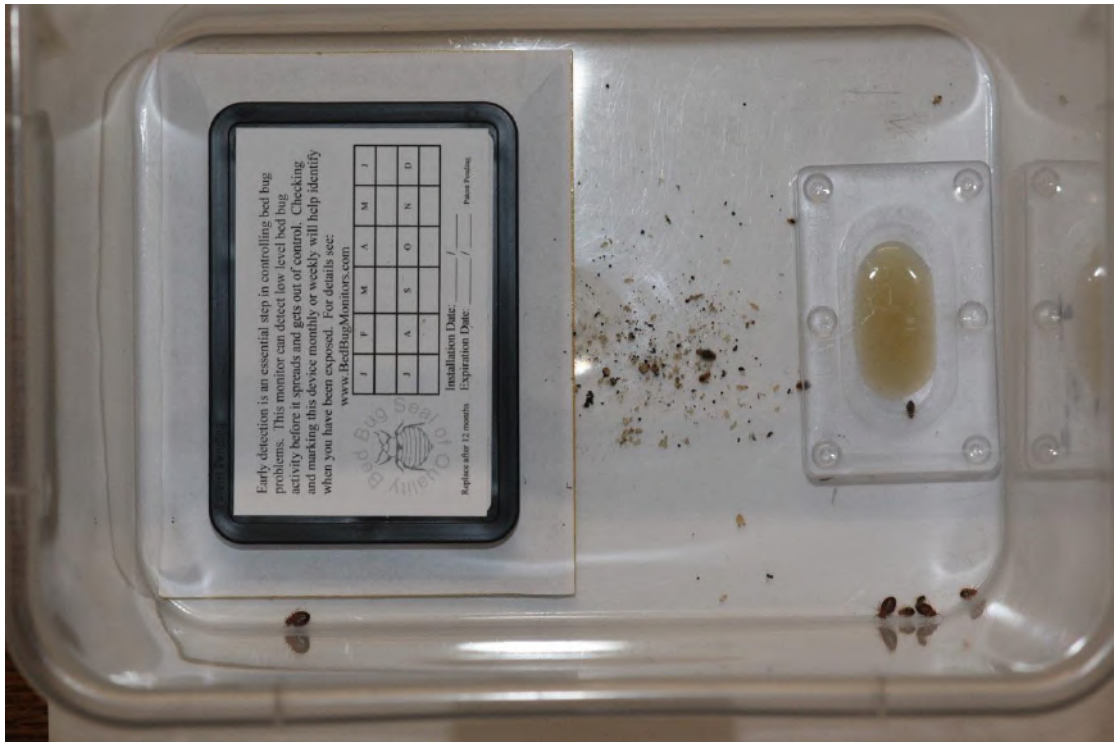
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|----------|----------------|
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| IMG_0227 | 01/12/11 15:06 |
|----------|----------------|



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| IMG_0228 | 01/12/11 15:06 |
|----------|----------------|



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|----------|----------------|
| IMG_0229 | 01/12/11 15:06 |
|----------|----------------|



| | |
|----------|----------------|
| IMG_0230 | 01/12/11 15:07 |
|----------|----------------|



IMG_0231 01/12/11 15:07



IMG_0232 01/12/11 15:07



| | |
|----------|----------------|
| IMG_0233 | 01/12/11 15:07 |
|----------|----------------|



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|----------|----------------|
| IMG_0234 | 01/12/11 15:07 |
|----------|----------------|



IMG_0235 01/12/11 15:08



IMG_0236 01/12/11 15:08



IMG_0237 01/12/11 15:08



IMG_0238 01/12/11 15:08



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| IMG_0239 | 01/12/11 15:08 |
|----------|----------------|



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| IMG_0240 | 01/12/11 15:08 |
|----------|----------------|



| | |
|----------|----------------|
| IMG_0241 | 01/12/11 15:08 |
|----------|----------------|



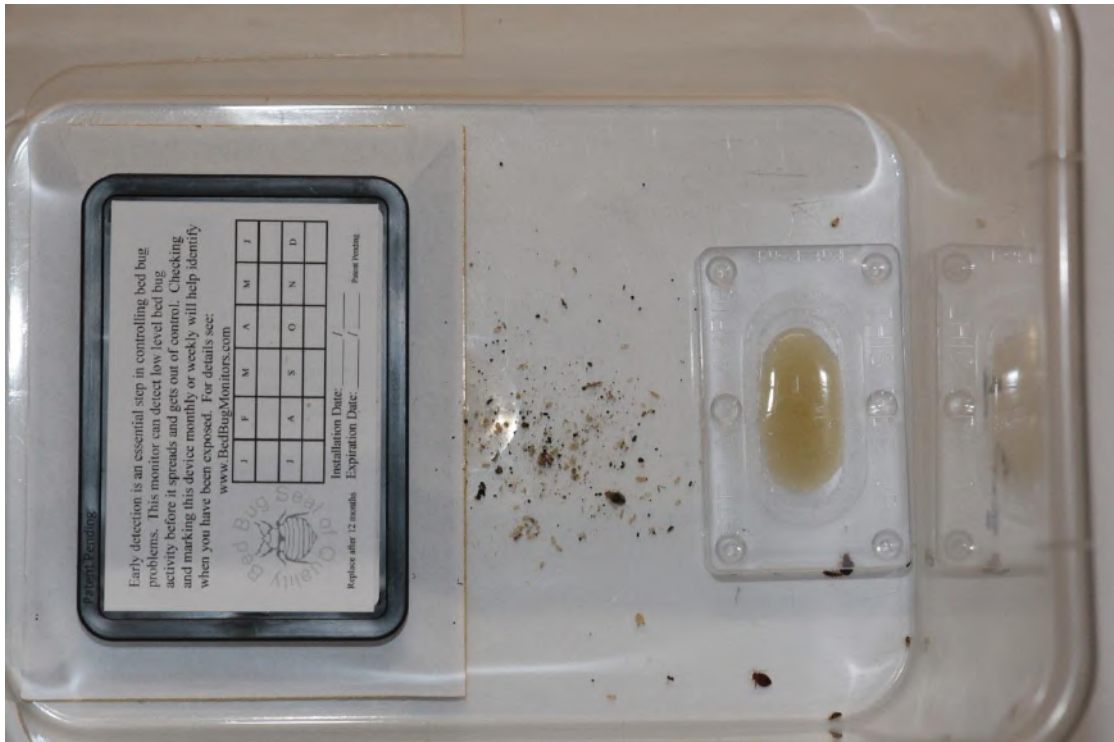
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|----------|----------------|



| | |
|----------|----------------|
| IMG_0243 | 01/12/11 15:09 |
|----------|----------------|



| | |
|----------|----------------|
| IMG_0244 | 01/12/11 15:09 |
|----------|----------------|



| | |
|----------|----------------|
| IMG_0245 | 01/12/11 15:09 |
|----------|----------------|



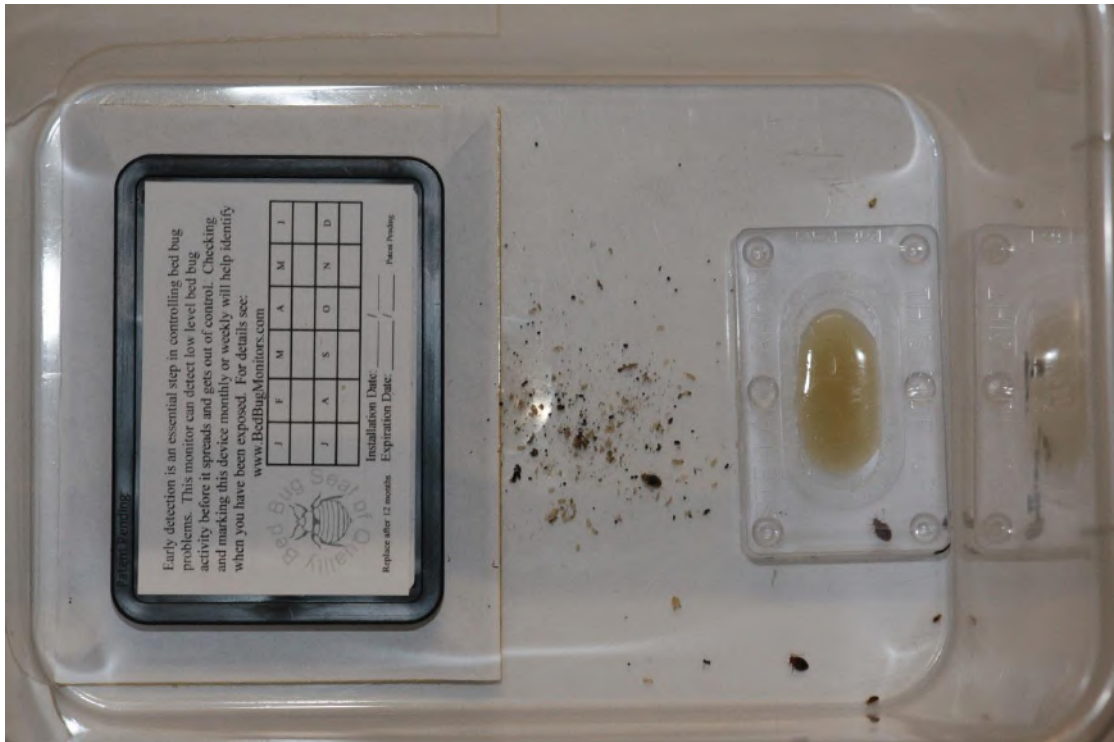
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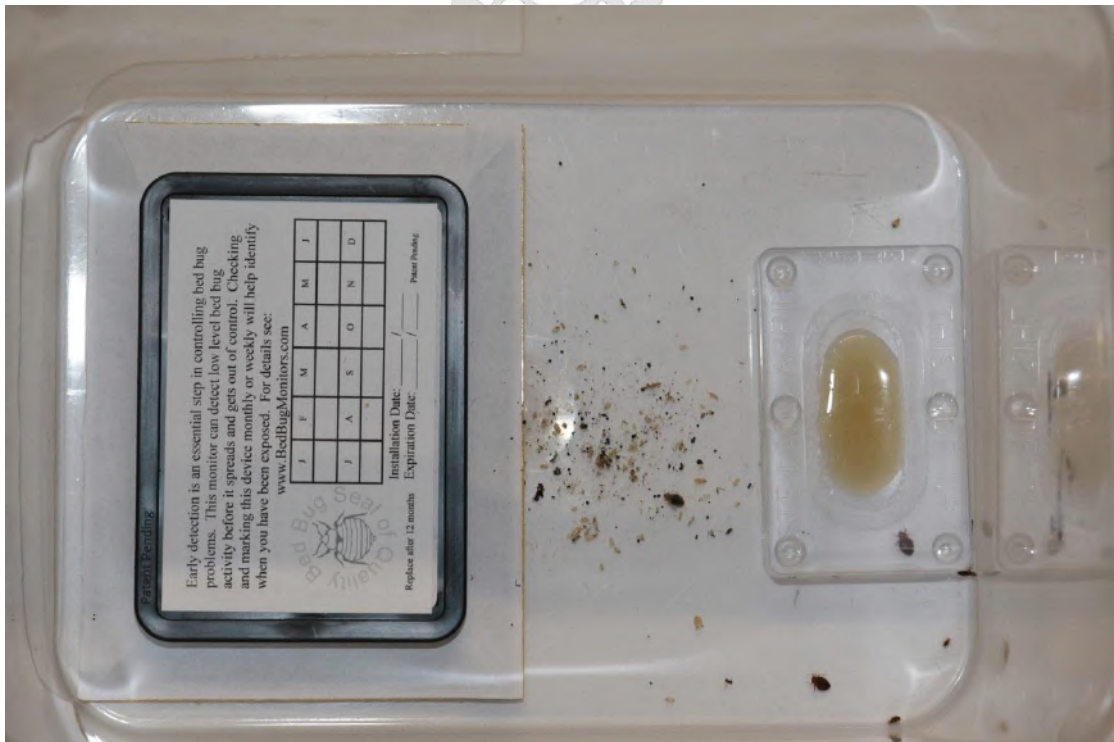
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|----------|----------------|
| IMG_0247 | 01/12/11 15:09 |
|----------|----------------|



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|----------|----------------|
| IMG_0248 | 01/12/11 15:09 |
|----------|----------------|



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| IMG_0249 | 01/12/11 15:09 |
|----------|----------------|



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| IMG_0250 | 01/12/11 15:09 |
|----------|----------------|



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| IMG_0251 | 01/12/11 15:09 |
|----------|----------------|



| | |
|----------|----------------|
| IMG_0252 | 01/12/11 15:09 |
|----------|----------------|



| | |
|----------|----------------|
| IMG_0253 | 01/12/11 15:09 |
|----------|----------------|



| | |
|----------|----------------|
| IMG_0254 | 01/12/11 15:09 |
|----------|----------------|



IMG_0255 01/12/11 15:09



IMG_0256 01/12/11 15:10



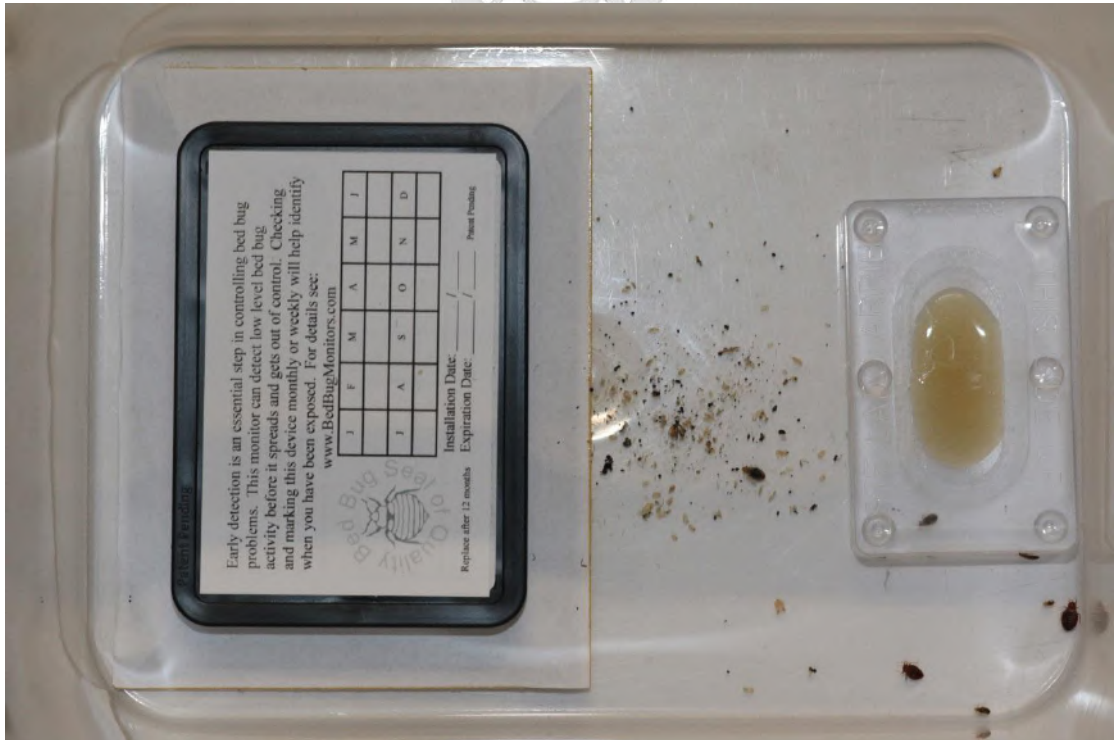
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|----------|----------------|



| | |
|----------|----------------|
| IMG_0258 | 01/12/11 15:10 |
|----------|----------------|



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| IMG_0259 | 01/12/11 15:10 |
|----------|----------------|



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|----------|----------------|
| IMG_0260 | 01/12/11 15:10 |
|----------|----------------|



| | |
|----------|----------------|
| IMG_0261 | 01/12/11 15:10 |
|----------|----------------|



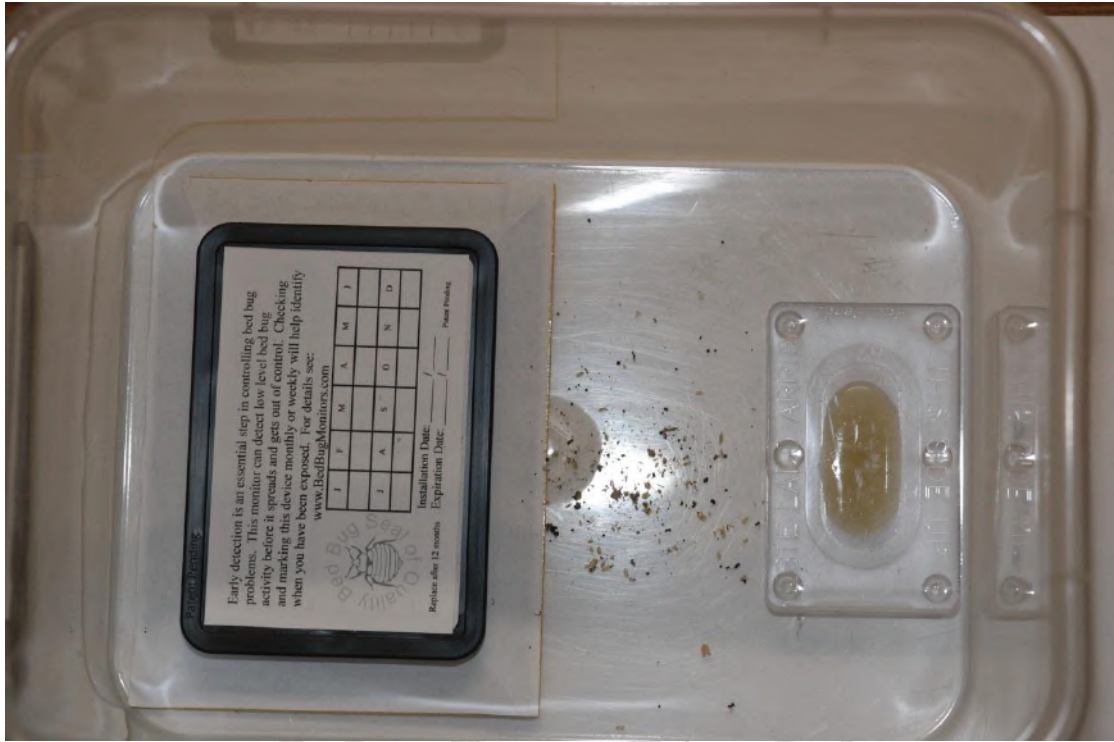
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|----------|----------------|
| IMG_0262 | 01/12/11 15:10 |
|----------|----------------|



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|----------|----------------|
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|----------|----------------|



| | |
|----------|----------------|
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|----------|----------------|



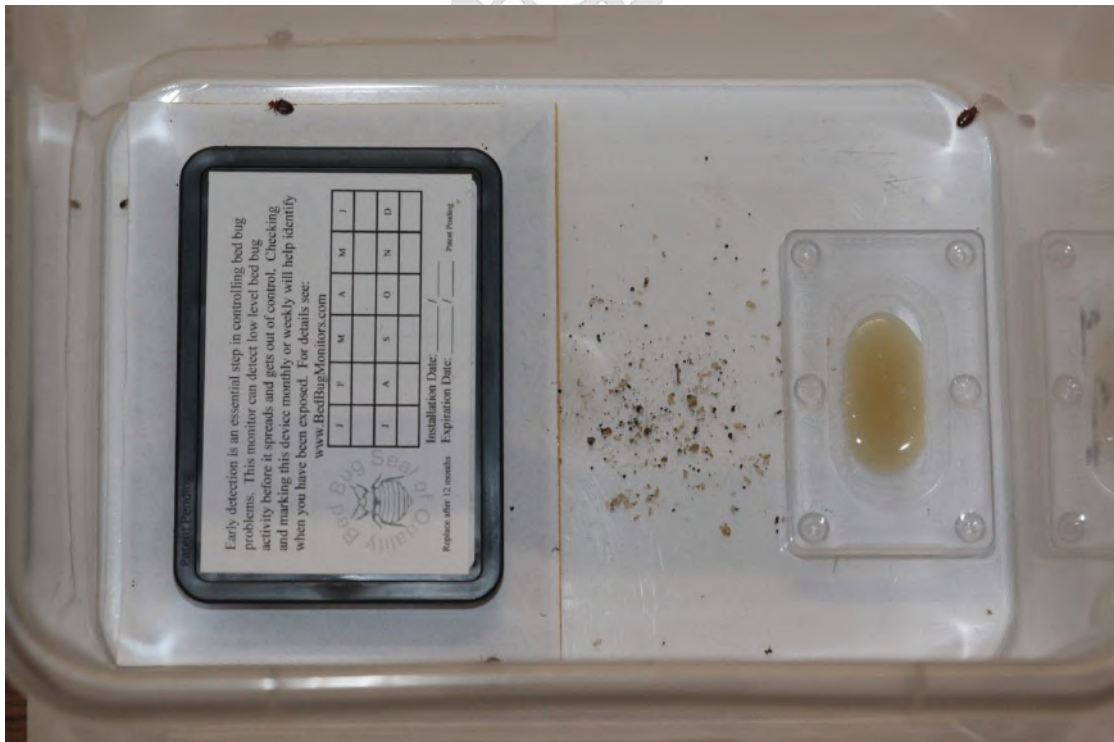
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|----------|----------------|



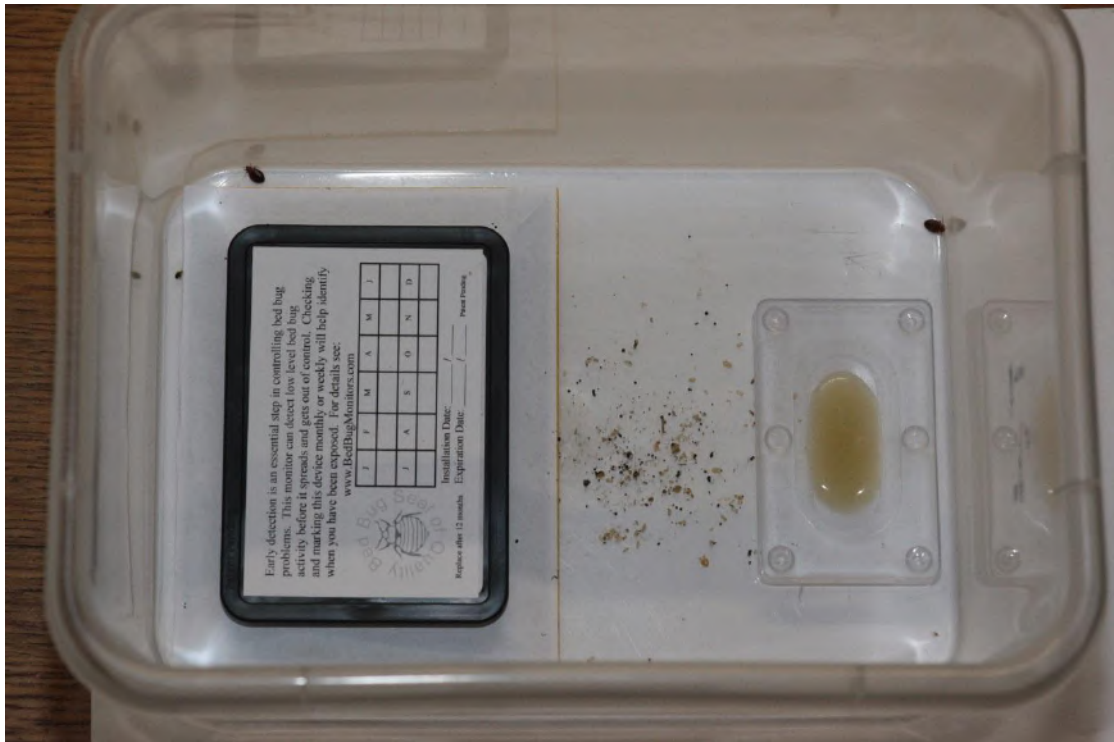
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|----------|----------------|



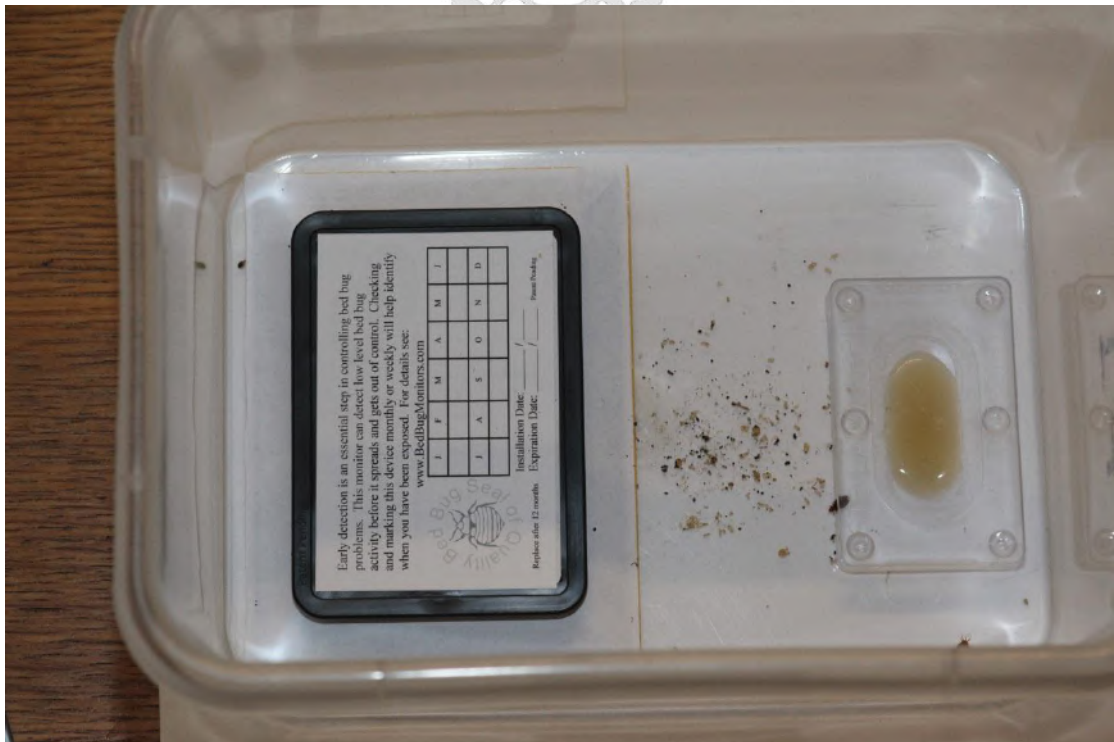
| | |
|----------|----------------|
| IMG_0267 | 02/12/11 17:04 |
|----------|----------------|



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|----------|----------------|
| IMG_0268 | 02/12/11 00:06 |
|----------|----------------|



IMG_0269 02/12/11 00:06



IMG_0270 02/12/11 00:06



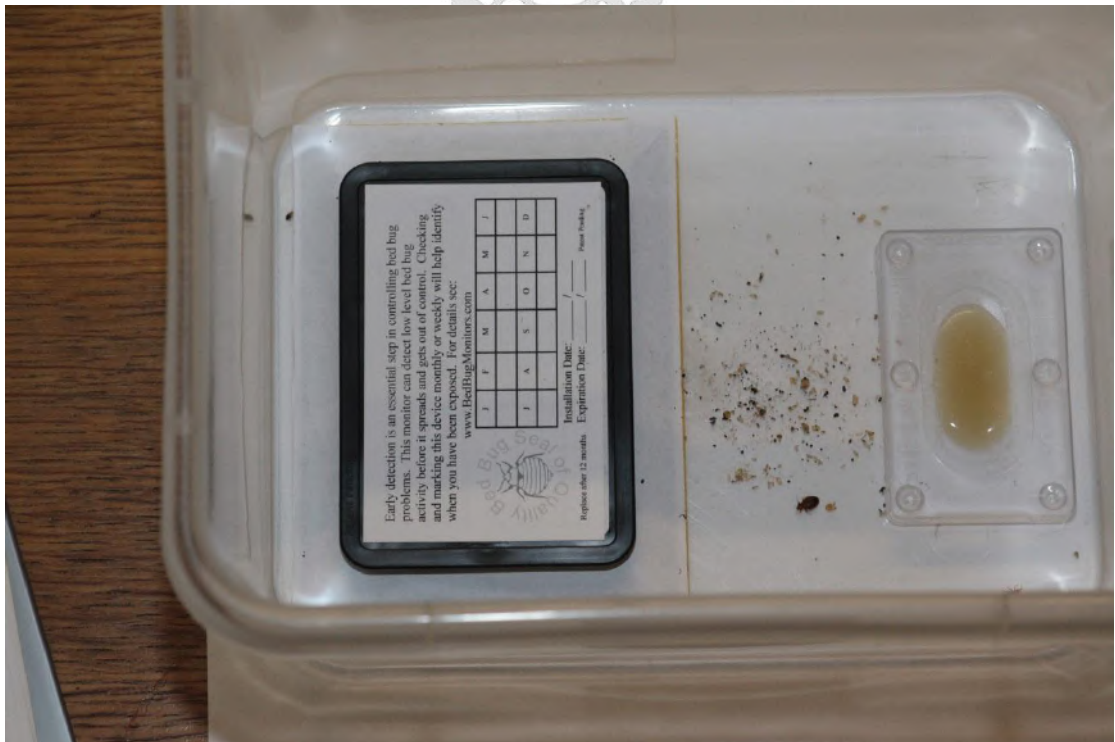
| | |
|----------|----------------|
| IMG_0271 | 02/12/11 00:50 |
|----------|----------------|



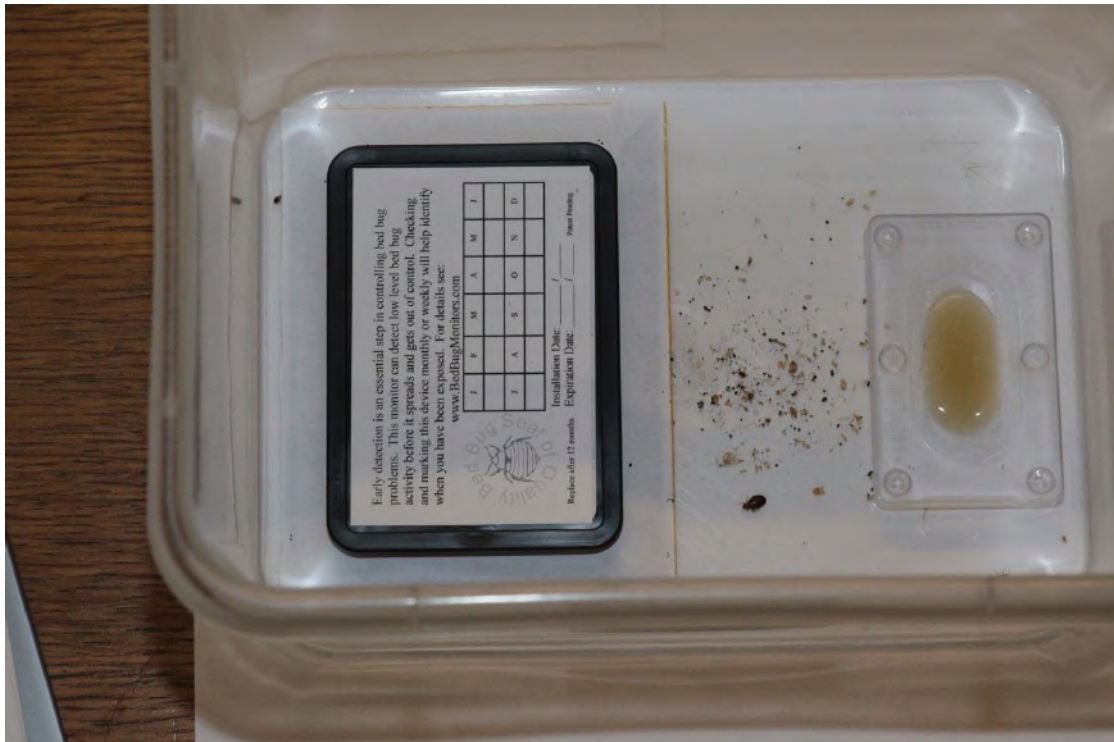
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|----------|----------------|
| IMG_0272 | 02/12/11 00:50 |
|----------|----------------|



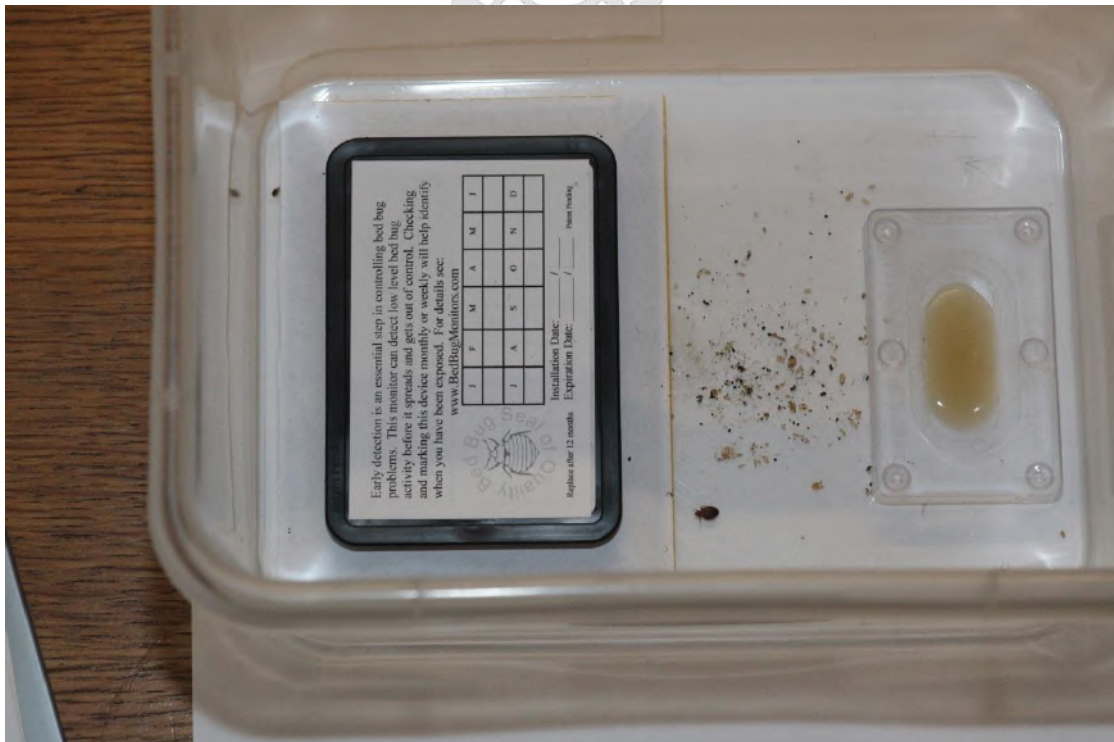
| | |
|----------|----------------|
| IMG_0273 | 02/12/11 00:50 |
|----------|----------------|



| | |
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| IMG_0274 | 02/12/11 00:50 |
|----------|----------------|



IMG_0275 02/12/11 00:50



IMG_0276 02/12/11 00:50



| | |
|----------|----------------|
| IMG_0277 | 02/12/11 00:50 |
|----------|----------------|



| | |
|----------|----------------|
| IMG_0278 | 02/12/11 00:50 |
|----------|----------------|



IMG_0279 02/12/11 00:50



IMG_0280 02/12/11 09:11



| | |
|----------|----------------|
| IMG_0281 | 02/12/11 09:11 |
|----------|----------------|



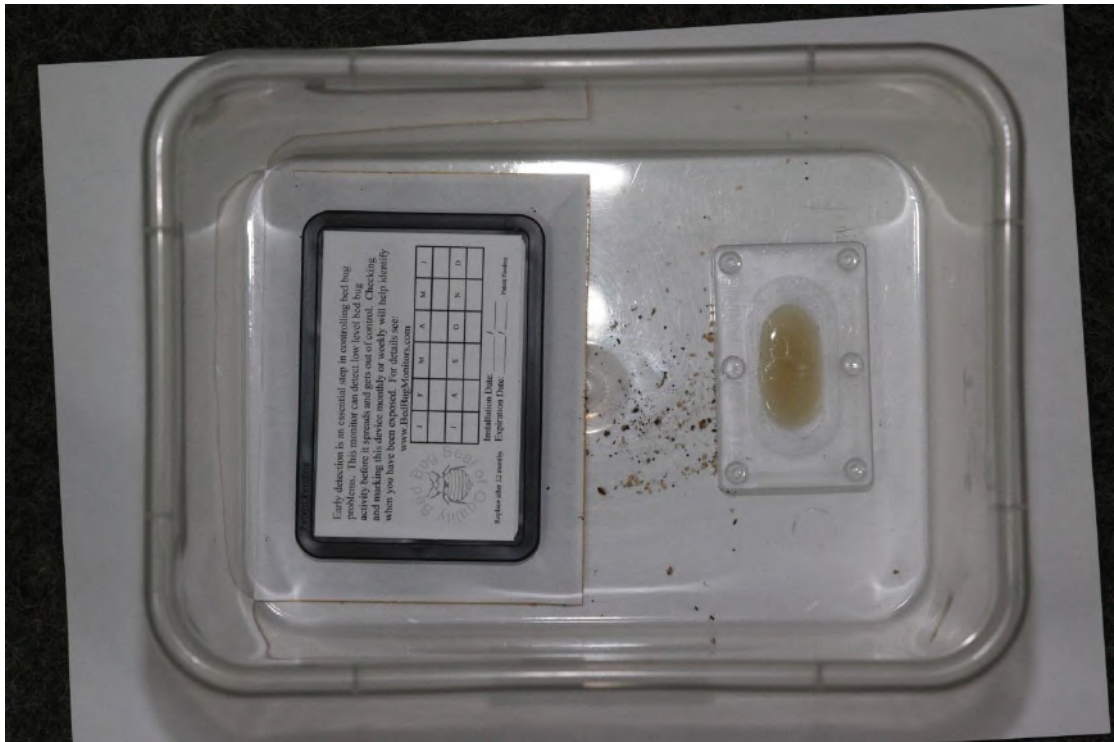
| | |
|----------|----------------|
| IMG_0282 | 04/12/11 12:02 |
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IMG_0283 05/12/11 02:00



IMG_0284 05/12/11 00:04



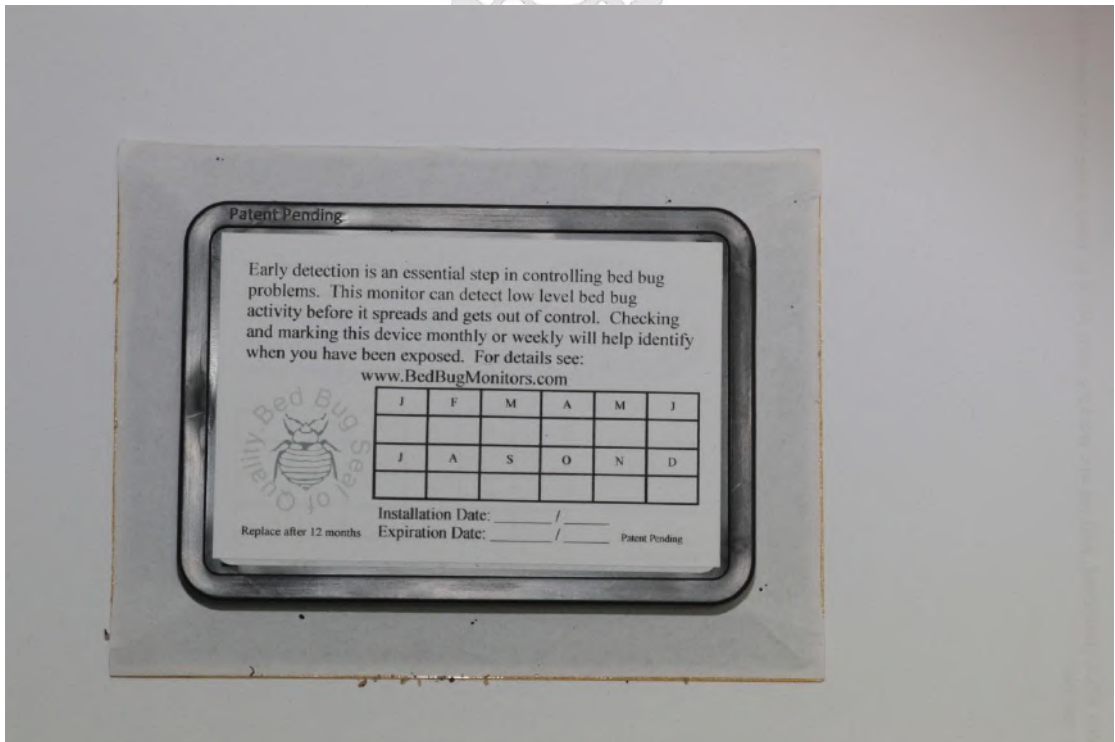
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|----------|----------------|



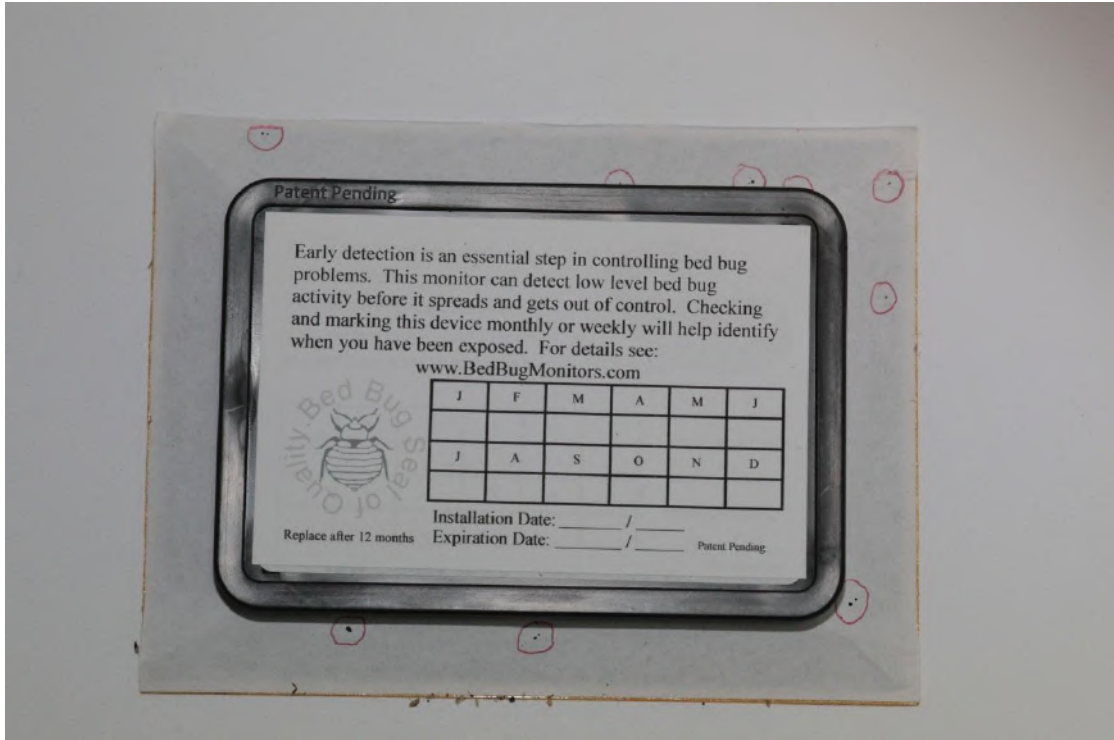
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|----------|----------------|



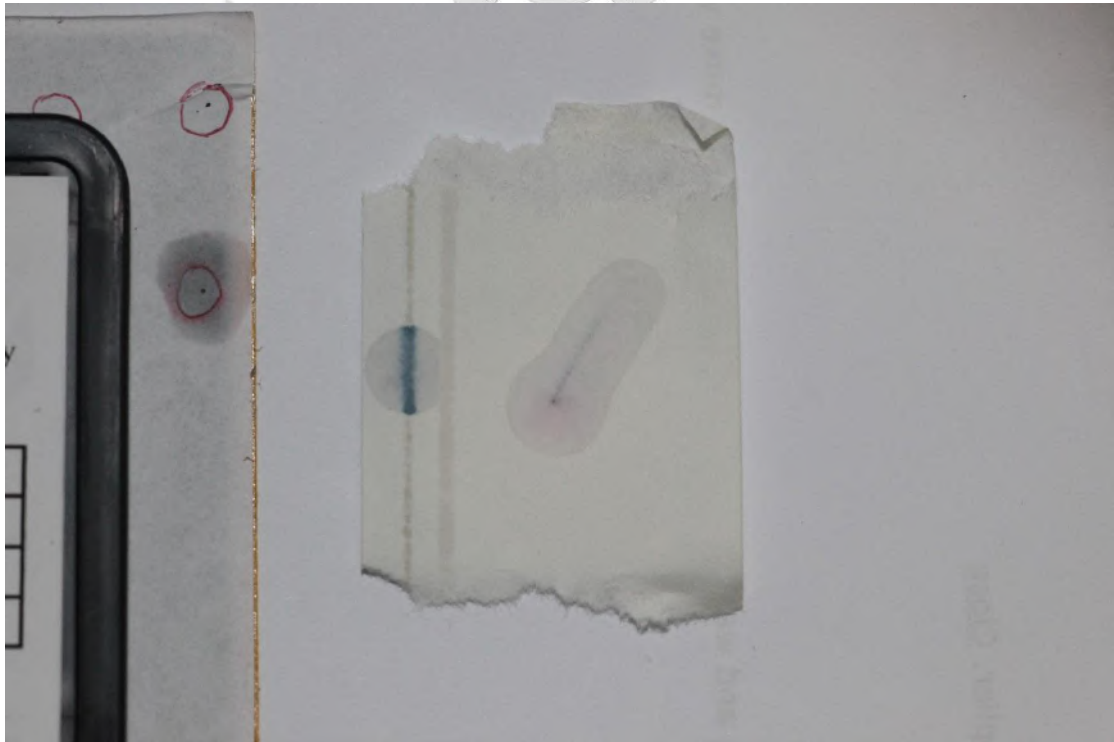
| | |
|----------|----------------|
| IMG_0287 | 10/12/11 17:59 |
|----------|----------------|



| | |
|----------|----------------|
| IMG_0288 | 10/12/11 18:08 |
|----------|----------------|



IMG_0289 10/12/11 18:08



IMG_0290 10/12/11 18:11

Results

The results have been summarised in the table below:

| Image | Date/Time | Passive | Clearview |
|----------|----------------|---------|-----------|
| IMG_0171 | 01/12/11 14:55 | n/a | n/a |
| IMG_0173 | 01/12/11 14:56 | n/a | n/a |
| IMG_0176 | 01/12/11 14:56 | n/a | n/a |
| IMG_0177 | 01/12/11 14:57 | n/a | n/a |
| IMG_0179 | 01/12/11 14:57 | 0 | 0 |
| IMG_0180 | 01/12/11 14:57 | 0 | 0 |
| IMG_0181 | 01/12/11 14:58 | 0 | 0 |
| IMG_0182 | 01/12/11 14:58 | 0 | 0 |
| IMG_0183 | 01/12/11 14:58 | 0 | 0 |
| IMG_0184 | 01/12/11 14:58 | 0 | 0 |
| IMG_0185 | 01/12/11 14:58 | 0 | 0 |
| IMG_0186 | 01/12/11 14:58 | 0 | 0 |
| IMG_0187 | 01/12/11 14:58 | 0 | 0 |
| IMG_0188 | 01/12/11 14:58 | 0 | 0 |
| IMG_0189 | 01/12/11 14:58 | 0 | 0 |
| IMG_0190 | 01/12/11 14:58 | 0 | 0 |
| IMG_0191 | 01/12/11 14:59 | 0 | 0 |
| IMG_0192 | 01/12/11 14:59 | 0 | 0 |
| IMG_0193 | 01/12/11 14:59 | 0 | 0 |
| IMG_0194 | 01/12/11 14:59 | 0 | 0 |
| IMG_0195 | 01/12/11 14:59 | 0 | 0 |
| IMG_0196 | 01/12/11 14:59 | 0 | 0 |
| IMG_0197 | 01/12/11 14:59 | 0 | 0 |
| IMG_0198 | 01/12/11 14:59 | 0 | 0 |
| IMG_0199 | 01/12/11 14:59 | 0 | 0 |
| IMG_0200 | 01/12/11 14:59 | 0 | 0 |
| IMG_0201 | 01/12/11 14:59 | 0 | 0 |
| IMG_0202 | 01/12/11 14:59 | 0 | 0 |
| IMG_0203 | 01/12/11 14:59 | 0 | 0 |
| IMG_0204 | 01/12/11 14:59 | 0 | 0 |
| IMG_0205 | 01/12/11 14:59 | 0 | 0 |
| IMG_0206 | 01/12/11 14:59 | 0 | 0 |
| IMG_0207 | 01/12/11 14:59 | 0 | 0 |
| IMG_0208 | 01/12/11 14:59 | 0 | 0 |
| IMG_0209 | 01/12/11 14:59 | 0 | 0 |
| IMG_0210 | 01/12/11 14:59 | 0 | 0 |
| IMG_0211 | 01/12/11 14:59 | 0 | 0 |
| IMG_0212 | 01/12/11 14:59 | 0 | 0 |
| IMG_0213 | 01/12/11 14:59 | 0 | 0 |
| IMG_0214 | 01/12/11 15:00 | 0 | 0 |
| IMG_0215 | 01/12/11 15:00 | 0 | 0 |
| IMG_0216 | 01/12/11 15:05 | 2 | 0 |
| IMG_0217 | 01/12/11 15:05 | 2 | 0 |

| Image | Date/Time | Passive | Clearview |
|----------|----------------|---------|-----------|
| IMG_0218 | 01/12/11 15:05 | 2 | 0 |
| IMG_0219 | 01/12/11 15:05 | 2 | 0 |
| IMG_0220 | 01/12/11 15:05 | 2 | 0 |
| IMG_0221 | 01/12/11 15:05 | 2 | 0 |
| IMG_0222 | 01/12/11 15:05 | 2 | 0 |
| IMG_0223 | 01/12/11 15:06 | 2 | 0 |
| IMG_0224 | 01/12/11 15:06 | 2 | 0 |
| IMG_0225 | 01/12/11 15:06 | 2 | 0 |
| IMG_0226 | 01/12/11 15:06 | 2 | 0 |
| IMG_0227 | 01/12/11 15:06 | 2 | 0 |
| IMG_0228 | 01/12/11 15:06 | 2 | 0 |
| IMG_0229 | 01/12/11 15:06 | 2 | 0 |
| IMG_0230 | 01/12/11 15:07 | 2 | 0 |
| IMG_0231 | 01/12/11 15:07 | 2 | 0 |
| IMG_0232 | 01/12/11 15:07 | 2 | 0 |
| IMG_0233 | 01/12/11 15:07 | 2 | 0 |
| IMG_0234 | 01/12/11 15:07 | 2 | 0 |
| IMG_0235 | 01/12/11 15:08 | 2 | 0 |
| IMG_0236 | 01/12/11 15:08 | 2 | 0 |
| IMG_0237 | 01/12/11 15:08 | 2 | 0 |
| IMG_0238 | 01/12/11 15:08 | 2 | 0 |
| IMG_0239 | 01/12/11 15:08 | 2 | 0 |
| IMG_0240 | 01/12/11 15:08 | 2 | 0 |
| IMG_0241 | 01/12/11 15:08 | 2 | 0 |
| IMG_0242 | 01/12/11 15:08 | 2 | 0 |
| IMG_0243 | 01/12/11 15:09 | 2 | 0 |
| IMG_0244 | 01/12/11 15:09 | 2 | 0 |
| IMG_0245 | 01/12/11 15:09 | 2 | 0 |
| IMG_0246 | 01/12/11 15:09 | 2 | 0 |
| IMG_0247 | 01/12/11 15:09 | 2 | 0 |
| IMG_0248 | 01/12/11 15:09 | 2 | 0 |
| IMG_0249 | 01/12/11 15:09 | 2 | 0 |
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| IMG_0252 | 01/12/11 15:09 | 2 | 0 |
| IMG_0253 | 01/12/11 15:09 | 2 | 0 |
| IMG_0254 | 01/12/11 15:09 | 2 | 0 |
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| IMG_0258 | 01/12/11 15:10 | 2 | 0 |
| IMG_0259 | 01/12/11 15:10 | 2 | 0 |
| IMG_0260 | 01/12/11 15:10 | 2 | 0 |
| IMG_0261 | 01/12/11 15:10 | 2 | 0 |
| IMG_0262 | 01/12/11 15:10 | 2 | 0 |
| IMG_0263 | 01/12/11 15:10 | 2 | 0 |
| IMG_0264 | 01/12/11 15:18 | 2 | 0 |

| Image | Date/Time | Passive | Clearview |
|----------|----------------|---------|-----------|
| IMG_0265 | 01/12/11 15:35 | 2 | 0 |
| IMG_0266 | 01/12/11 15:55 | 2 | 0 |
| IMG_0267 | 02/12/11 17:04 | 7 | 0 |
| IMG_0268 | 02/12/11 00:06 | 7 | 0 |
| IMG_0269 | 02/12/11 00:06 | 7 | 0 |
| IMG_0270 | 02/12/11 00:06 | 7 | 0 |
| IMG_0271 | 02/12/11 00:50 | 7 | 0 |
| IMG_0272 | 02/12/11 00:50 | 7 | 0 |
| IMG_0273 | 02/12/11 00:50 | 7 | 0 |
| IMG_0274 | 02/12/11 00:50 | 7 | 0 |
| IMG_0275 | 02/12/11 00:50 | 7 | 0 |
| IMG_0276 | 02/12/11 00:50 | 7 | 0 |
| IMG_0277 | 02/12/11 00:50 | 7 | 0 |
| IMG_0278 | 02/12/11 00:50 | 7 | 0 |
| IMG_0279 | 02/12/11 00:50 | 8 | 0 |
| IMG_0280 | 02/12/11 09:11 | 8 | 0 |
| IMG_0281 | 02/12/11 09:11 | 8 | 0 |
| IMG_0282 | 04/12/11 12:02 | 8 | 0 |
| IMG_0283 | 05/12/11 02:00 | 8 | 0 |
| IMG_0284 | 05/12/11 00:04 | 8 | 0 |
| IMG_0285 | 06/12/11 00:04 | 8 | 0 |
| IMG_0286 | 10/12/11 09:42 | 9 | 0 |
| IMG_0287 | 10/12/11 17:59 | n/a | 0 |
| IMG_0288 | 10/12/11 18:08 | 9 | n/a |
| IMG_0289 | 10/12/11 18:08 | 9 | n/a |
| IMG_0290 | 10/12/11 18:11 | n/a | n/a |

IMG_0290 illustrates a colour changing faecal trace confirmation kit that we have been evaluating for a third party company. Using a simple reagent swab test you can confirm faecal traces either on the passive detection skirt or from other materials. To date despite extensive destruction testing we have not managed to get this kit to fail.

The colour change on the left of the paper illustrates that the test reagents are working correctly which we feel is an essential part in any diagnostic test for the signs of bedbugs as stressed and anxious consumers always want to be able to confirm that the test is both accurate and working correctly. In our minds a test that is not conclusive and does not have this level of QC assurance should not be considered professional and should certainly not be placed in the hands of consumers.

Conclusions

The passive monitor showed signs of bedbug activity after just 8 minutes in the tank trial. Interestingly enough this was on the far left side of the monitor illustrating that any release location bias could not affect the result.

After just 21 minutes by IMG_0264 15:18 the majority of bedbugs had sought refuge in the passive monitor. Although they continued to search the tank they only did so in small numbers.

Even after 10 days the clearview monitor had failed to retain a single bedbug for detection and must therefore be considered a failure in terms of this test.

A number of the bedbugs that investigated the clearview monitor appeared to become stuck in the glue, in all cases this only lasted a few minutes and there appeared to be an extended period where no bedbugs ventured close to the device.

The number of visible faecal traces continued to increase on the detection skirt of the passive monitor illustrating that defecation occurs as a behavioural response to the monitor and not just as a post feeding / return to refugia response.

Although there are no extensive repetitions of this test we feel that the results are so clear that replications are simply not necessary as there is clearly a preference expressed between the two monitors in terms of bedbug behaviour.

The faecal trace indicator system shows great promise as both a professional and consumer product and should be on the market in January 2012 offering consumers a rapid cost effective way to confirm bedbugs based on faecal traces within 30 seconds with the added advantage of a built in QC test to ensure that the reagents in the kit are working. The risk of cross contamination with this system is also a lot lower than other detection technologies offering consumer confidence rather than a nagging doubt that the test may have failed or been inconclusive.

Recommendations

This study further highlights the need for independent testing of all bedbug related products free from the supply chain and influences of inventors.

Although in this case that would exclude us from testing our own product we are confident enough in the results we have observed over the last 4 years and have only had 2 failed detection in some 10,000 field placements offering a detection accuracy greater than 99.99%.

We will continue to test consumer products and services to ensure that they are capable of delivering the claims they have made, to date less than 10% of the products and services tested have passed our assessment and yet 100% of them remain on sale to the public. In the long run this will erode consumer confidence in pest control services and as such we call upon all interested parties to support the need for independent testing.

About the author

David Cain has been on a tireless quest to take on bedbugs since first exposed to them in 2002 when he finished a career in science and business to pursue a different direction in life. Having qualified as a molecular biologist from Nottingham and Leicester Universities in the UK he worked in various laboratory and technical roles until eventually working for investment banks and venture capitalists assessing the value and investment risks of scientific based business models.

In 2005 Bed-Bugs.co.uk was started as the world first dedicated extermination firm working exclusively on bedbugs since the demise of Tiffin & Son who operated between 1650 and the 1930's.

Passionate about bedbugs and how the industry is developing on a global basis he spends an excessive amount of time trying to help people and keep the information in the public domain accurate and helpful.

In 2011 he was awarded two patents GB2463953 and GB2470307 in the field of bedbug detection which encompass both the product and methods of passive bedbug monitoring. These patents are now being progressed through the PCT and have been granted foundation patent status in recognition of the unique teaching they offer in terms of bedbug biology and behaviour.