ABILITY OF TRAINED SCENT DETECTION DOGS TO DETECT GRAIN WEEVIL (Sitophilus granarius) IN WHEAT SAMPLES

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Introduction

Cereal grains are the major source of food for humans and domesticated animals. In many developing countries, overall post harvest losses of between 10–15% are fairly common. Grain weevils cause significant damage to harvested stored grains and may drastically decrease yields. They are hard to detect and usually all of the grain in an infested storage facility must be destroyed. In common with other grain boring species, its larval stage is concealed within the grain, feeding on the germ, only becoming apparent after pupation. Currently on farms, manual samples, traps, and probes have been used to determine the presence of insects. These methods are not efficient and are not widely available in the developing world.

The use of scent detection dogs for the monitoring of wood destroying insects and certain parasites of man is widespread and highly successful, however their role in stored product pest management has not been investigated.

Method

Samples of Grain Weevil (Sitophilus Granarius) were obtained from captive colonies.

The dogs ability to identify and discriminate the target scent was tested against a selection of distracting articles including uninfested wheat, empty vials, and samples of *Blattella germanica* and *Callosobruchus maculatus.*

Samples of adult grain weevils were presented in ventilated polycarbonate vials. Test samples of 1,3, 5,10 and 20 insects were presented to ascertain a minimal scent weight detectable by the detection dog.

Sterile wheat was exposed to a breading colony of grain weevils and grains inspected for visible eggs. Wheat showing an egg present on the grain were selected and incubated at 28oC for 21 days in 144 well culture plates to allow for larval development.

Samples of grain weevil infested gain were presented in ventilated polycarbonate vials. Test samples of 1, 10, 20, 50 and 100 infested grains per 100ml of wheat were presented to ascertain a minimal scent weight detectable by the detection dog.

All scent samples were presented in a concealment wall with over 600 possible concealment locations. The study dog was trained by a specialist scent detection dog trainer using a combined verbal and play reward system. The trainer acted as handler for the purpose of this study.

Results

Dogs were able to discriminate grain weevil samples from *Blattella germanica*, and *Callosobruchus maculatus*, with a 96% positive indication rate (correct indication behaviour from dog when target present) and 0% false positives (incorrect indication of when not present).

Presented Sample	Sitophilus Granarius	*Blattella germanica*	*Callosobruchus maculatus*
Number of replicates	25	25	25
Number of correct indications	24	0	0
Percentage accuracy	96%	100%	100%

Number of insects per sample	1	3	5	10	20
Number of replicates	25	25	25	25	25
Number of correct indications	23	25	25	25	25

A drop in accuracy was noted at single insect level however correct indications were given to 92% of concealments.

100% accuracy was achieved with concealments of 3 insects and above.

100% accuracy was achieved with samples containing 20 or more infested grains per 100mls of wheat. Below this level a reduction in a accuracy (false negative) was noted for samples containing 10 and 1 infested grains per 100mls of wheat achieving 96% and 92% respectively.

Number of infested grains per 100ml of wheat	1	10	20	50	100
Number of Replicates	25	25	25	25	25
Number of correct indications	23	24	25	25	25

Conclusions

Scent detection dogs can be trained to detect live grain weevil and infested grain at very low infestation levels.

Their ability to detect adult grain weevils at low levels and to discriminate the scent in the environment will make them a useful addition to pre harvest store preparations in rural environments. The focussed nature of a canine indication will allow localised remediation of any pockets of infestation within the store structure. Minimising consequential losses and chemical usage.

The test dog was able to discriminate between grain weevils and other insect pests such as German cockroach (*Blattella germanica*) and Bean beetle (*Callosobruchus maculatus.)* with a high degree of accuracy.

A dog would be able to check multiple samples at a central location in a detection session enabling small scale grain producers and subsistence farmers to collect samples from the top layer of their grain pile and send them for testing. This will be of most use in sub Saharan Africa where the infrastructure is already in place to support this system and small scale producers suffer extensive stored product damage.

The time input needed to develop dog used in this trial was 12 weeks. If trained properly, dogs can be used effectively to locate live grain weevil larvae in stored wheat crop prior to pupation. They could offer a fast and cost effective addition to integrated pest management programmes and subsequently reduce grain losses.

Further Research and Development

Over the coming years further testing and training will be undertaken to widen the range of stored product insects that can be detected using scent detection and how this can be developed into a field deliverable system.

Further development of a field training process to enable local resources to be trained to carry out sample testing.

It is intended that this training programme will be made available to humanitarian organisations to deploy throughout the developing world.

Background

The vast majority of hungry people live in developing regions, which saw a 42% reduction in the prevalence of undernourished people between 1990–92 and 2012–14. Despite this progress, about one in eight people, remain chronically undernourished in these regions. As the most populous region in the world, Asia is home to two out of three of the world's undernourished people and also suffers a high level of insect grain spoilage.

Children are the most visible victims of undernutrition. Black et. al. (2013) estimate that undernutrition caused foetal growth restriction, stunting, clinical wasting and is a cause of 3·1 million child deaths annually or 45% of all child deaths. In 2013, about half of all growth stunted children lived in Asia and over one third in Africa and approximately two thirds of all clinically wasted children lived in Asia and almost one third in Africa (UNICEF et al. 2014b)

The increase in mechanisation and urbanisation of these regions has had significant impact on these figures however the proportionate losses due to insect damage and spoilage are increasing. This is believed to be due to the move from subsistence farming to more centralised local stores for grain crop. under these conditions grain crops are pooled to keep them safer from vermin damage however when inoculated with grain boring insects has the potential to destroy the years food for an entire community.