Recent research from Hawaii reveals caffeine could be used as a novel slug killer. **Tom Allen-Stevens** talks to the lead scientist, Dr Robert Hollingsworth

A slug of caffeine

How did you discover that caffeine kills slugs?
A colleague tested a wide variety of toxicants against the coqui frog that is an important pest in Hawaii. When he treated potted plants infested with frogs with caffeine, he noted that slugs came out of the treated pots and died.

What exactly does it do to the slugs, and how is its action different from metaldehyde and methiocarb?
We don't know how caffeine is working. Scientific studies of mollusc neurons indicate that caffeine exposure increases the duration of nerve action potentials. I'm not a physiologist, but I think this means that the nerve fires for longer than normal.

Methiocarb is a nerve poison. It causes loss of muscle control. The mode of action of metaldehyde is debated among scientists. One mode of action is that it acts as an irritant, causing excess mucus production and consequent water loss. Death from desiccation can occur, while it also has a toxicant action at higher doses.

What dose is required?
All of the slugs came out of the soil-containing pots when we treated at 2% strength. However, caffeine acted as a feeding deterrent at 0.1% in our laboratory trials.

Two percent caffeine is 40x the strength of your average cup of coffee. How will it affect non-target species?
Non-target studies are just beginning in Hawaii, associated with the frog control programme. My guess, based on some observations, is that caffeine has relatively low potential as a contact poison for most insects because they have a waxy epicuticle, or outside layer on the exoskeleton. This repels water and caffeine is very water soluble.

Slugs and snails absorb water from their food and from the environment. This increases their relative exposure to caffeine when caffeine is being used as a contact poison.

Caffeine may affect earthworms, however. I didn't study this, but noted one or two dead earthworms in soil that was brought into the lab and saturated with 2% caffeine.

Has any work looked into how much caffeine is taken up by the plant, how that might affect the taste and whether there are any residues that could be carried through to the consumer?
I wouldn't expect it to be particularly good at penetrating leaf tissues, which generally have a protective waxy layer. After spraying plants and after drying, a white residue — caffeine crystals — is left on the plant. This can be removed by washing with water.

Taste and residue investigations have not yet been carried out, but caffeine is classified as a GRAS (Generally Recognized As Safe) compound by the US Food and Drug Agency (FDA). It is added to cola-type drinks at 0.02%. Some studies even suggest that its consumption is beneficial for certain groups of people, as a mood enhancer leading to better health.

There could be operator exposure issues, however. The caffeine being used was derived from food-grade caffeine — essentially 100% pure. Pure caffeine is not available to the general public, and in its pure form is quite dangerous.

Is it harmless to the plant?
Lots of work needs to be done with formulations. For example, 2% caffeine is phytotoxic to lettuce, cabbage, bromeliads and ferns. However, plants with thick, tough leaves, such as orchids, are apparently not affected.

Would caffeine need to go through pesticide registration processes?
Yes, it definitely needs to go through registration process to assure its environmental safety when used as directed. Currently there are no caffeine-containing molluscicides labelled for use, so it would not be legal to use caffeine as a pesticide.

It has, however, been approved on an emergency basis by the US Environmental Protection Agency for use against coqui frogs in Hawaii. Concentrations up to 2% are allowed in certain areas under certain conditions.

Is it expensive and would it ever be commercialised?
The food-grade caffeine that was purchased from Asia cost about $8.00/kg of pure powder. It was purchased in 25kg drums. So if you were using it at 2% in an agricultural setting, the cost would be considerable. Maybe as a feeding deterrent, at 0.1%, there would be more potential for commercialisation.

I don't think registration costs would be prohibitive. There is already an extremely large body of knowledge on human toxicology.

A caffeine-containing product might be particularly useful in drip-irrigated agriculture, where rain would not wash residues off leaves. Caffeine might also be good for disinfesting potted plants that are to be exported, since slugs tend to exit treated pots. After disinfesting, the caffeine could be removed by drenching the soil.

Metaldehyde, for all of its many benefits, doesn't have this effect. It stops slugs and snails in their tracks, and if they happen to be down in the pot, that's where they'll stay.