

One thing leads to another

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I was talking to a farming friend for quite a time on a recent SANTFA bus trip about the pros and of the cons of using caffeine as a snail control agent. He sensed both my excitement and frustration and at the end said, ‘one thing always leads to another’.

He was right, and for me in the context of snail control, that ‘another’ is uscharin.

SANTFA’s search for alternative snail control methods has unearthed several prospective treatments including caffeine and uscharin, a toxic chemical found in the milky latex of *Calotropis procera*, a plant native to the semi-arid tropics of Africa (Figure 1).

In 2012 SANTFA will continue to explore the effectiveness of synthetic caffeine as a potential in-season snail bait and pre-harvest windrow-cleaner for canola.

We will also pursue the potential of uscharin.

In the *Journal of Chemical Ecology*, Hamdy et al¹ describes uscharin as the most potent molluscicidal compound tested against land snails (Table 1).

Uscharin was measured by Hamdy to be hundreds of times more toxic to *Theba pisana* (the common white round snail), than conventional chemical actives including metaldehyde and methiocarb.

The most interesting prospect from the toxicity trial was uscharin’s potency as a foliar spray. Existing industry molluscicides are not particularly effective when applied as a foliar spray and are more often than not formulated as oral baits.

Exciting data published by Kushwaha and Singh² in 2010 build on Hamdy’s findings. These researchers have shown that

sub-lethal doses of uscharin can disrupt the reproductive cycle of the water snail, *Lymnaea acuminata* (Table 2).

Kushwaha and Singh’s data clearly show that sub-lethal concentrations of uscharin had a significant adverse effect on the water snail’s fecundity (the rate at which eggs are laid). In addition, the reduced number of eggs that were laid by the snails exposed to sub-lethal levels of uscharin did not hatch as readily as the eggs laid by untreated snails. Exposure to uscharin extended the time it took for eggs to hatch and substantially reduced the percentage of eggs that did eventually hatch. The survival rate of snail hatchlings was also significantly lower in the presence of sub-lethal levels of uscharin.

The overall effect of reducing the snail’s egg-laying rate, the hatchability of the eggs and the survival of the hatchlings is just the type of outcome needed to get back on top of exploding snail populations.

The prospect of being able to develop a robust foliar spray that kills snails on contact and disrupts the life cycle of the survivors has motivated SANTFA to explore this potential control method.

Unlike caffeine, uscharin is not commercially synthesised in factories and, at this stage, harvesting *C. procera* plants and performing solvent extraction of the chemical is the only means of obtaining satisfactory quantities of uscharin.

Seiber et al³ have studied the concentrations of uscharin in various parts of *C. procera*. They found that uscharin concentration was very high – from 16% to 35% – in the milky latex found in the ‘fruit’ (Figure 2).

Table 1: Efficacy of uscharin and sprayable molluscides against *T. pisana* snails in laboratory tests

Toxicant	Conc. (%)	Mortality (%)
Untreated Control	0	4
Uscharin A	0.0017	20
Uscharin B	0.0027	50
Uscharin C	0.0033	60
Uscharin D	0.0066	80
Uscharin E	0.0083	10
Slug-N-Snail Spray (metaldehyde)	0.5000	10
Mesurool 75 WP (methiocarb)	0.9600	32

ADAPTED FROM: **USCHARIN, THE MOST POTENT MOLLUSCICIDAL COMPOUND TESTED AGAINST LAND SNAILS** HAMDY I. ET.AL., *JOURNAL OF CHEMICAL ECOLOGY*, VOL 20, NO. 1, 1994. ENVIRONMENTAL CHEMISTRY AND TOXICOLOGY LABORATORY, DEPARTMENT OF CHEMISTRY, TEXAS SOUTHERN UNIVERSITY. HOUSTON, TEXAS, 77004.

Table 2: Effect of uscharin on fecundity, hatchability and survival of the snail *Lymnaea acuminata*

Toxicant: 24hr exposure	Fecundity: (eggs / day for 20 snails)	Hatchability % (days)	Hatchling survival % (LC50 for 48hrs)
Control (Nil)	191	100 [7-9]	100
20% LC50	83	55 [9-12]	49
60% LC50	49	39 [12-13]	15

ADAPTED FROM: **EFFECT OF USCHARIN ON THE REPRODUCTION OF THE SNAIL *LYMNAEA ACUMINATA*** KUSHWAHA AND SINGH, *WORLD JOURNAL OF ZOOLOGY* 5 (1): 15-19, 2010 ISSN 1817-3098, 2010. DEPARTMENT OF ZOOLOGY, DDU GORAKHPUR UNIVERSITY, GORAKHPUR-273009, UTTAR PRADESH, INDIA.



FIGURE 1. CALOTROPIS PROCERA ENJOYS A SEMI-ARID TROPIC ENVIRONMENT AND HAS BECOME A SIGNIFICANT WEED IN MANY COUNTRIES.



FIGURE 2. AN OPENED FRUIT OF *C. PROCERA* SHOWING THE SEED SURROUNDED BY FINE HAIRS. USCHARIN IS CONCENTRATED IN THE MILKY LATEX FOUND IN THESE FRUITS.

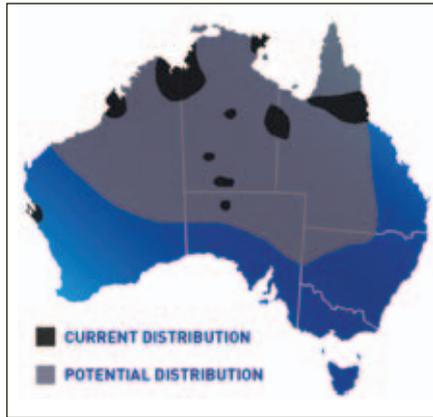


FIGURE 3 (LEFT). THE DISTRIBUTION OF *C. PROCERA* IN AUSTRALIA.

Uscharin content in the leaves was measured at only 1% to 5%.

Seiber's paper contains description of a chemical extraction method to extract and isolate quite pure uscharin.

C. procera prefers sandy soils and a hot, dry, tropical climate and has a notorious history as a weed in many parts of the world. In Australia it is widespread over the tropical savannas of Queensland, the Northern Territory and Western Australia (Figure 3), and is a declared (noxious) weed in WA and NT, so landholders are

required to control it.

SANTFA is seeking to determine whether the extraction of uscharin could become a viable component in a weed management program for *C. Procera*.

REFERENCES:

- 1 **USCHARIN, THE MOST POTENT MOLLUSCICIDAL COMPOUND TESTED AGAINST LAND SNAILS.**
HAMDY I. ET.AL. , JOURNAL OF CHEMICAL ECOLOGY, VOL 20, NO. 1, 1994
ENVIRONMENTAL CHEMISTRY AND TOXICOLOGY LABORATORY, DEPARTMENT OF CHEMISTRY, TEXAS SOUTHERN UNIVERSITY. HOUSTON, TEXAS, 77004.
- 2 **EFFECT OF USCHARIN ON THE REPRODUCTION OF THE SNAIL LYMNAEA ACUMINATA**
KUSHWAHA AND SINGH, WORLD JOURNAL OF ZOOLOGY 5 (1): 15-19, 2010 ISSN 1817-3098, 2010.
DEPARTMENT OF ZOOLOGY, DDU GORAKHPUR UNIVERSITY, GORAKHPUR-273009, UTTAR PRADESH, INDIA.
- 3 **CARDENOLIDES IN THE LATEX AND LEAVES OF SEVEN ASCLEPIAS SPECIES AND CALOTROPIS PROCERA**
JAMES N. SEIBER, CAROLYNJ. NELSON* AND S. MARK LEE DEPARTMENT OF ENVIRONMENTAL TOXICOLOGY, UNIVERSITY OF CALIFORNIA, DAVIS, CA 95616, USA.



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