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# Caffeine as a killing and repellent agent for snails (*Acusta despecta*) and slugs (*Deroceras varians*) on horticultural plants

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Snails and slugs are members of the mollusk phylum. They are similar in biology and structure, except slugs lack the snail's external spiral shell. Snails and slugs feed on a variety of living plants, decaying plant matter, fruit, and flowers. They are among the most bothersome creatures on horticultural crops such as Chinese cabbage, cabbage, lettuce, ginseng, lily, and orchid (Kim et al., 1990; Kim, 1992; Sorensen, 1994). Several species of slugs and snails are frequently damaging horticultural plants agrochemicals, phorate, metaldehyde, and methiocarb, are being used to control snails and slugs in open fields and greenhouses. But those pesticides are hazardous to human beings and should not be used where children cannot be kept away from them because of toxicity. The high price of those chemicals is the other weak points. Farmers do not want to pay much money for the control of slugs and snails. Horticultural crop products should not be contaminated with agricultural compounds when harvested. We consume caffeine everyday by drinking coffee and considered caffeine as a generally safe compound, though it is not recommended for pregnant woman (Kwon et al., 1990). Caffeine has possibility as a candidate for the environmentally acceptable alternative toxicant. Recently, the control effect of caffeine, by-product of coffee industry, was reported against snails and slugs (Hollingsworth et al., 2002). Our results showed that some concentrations of caffeine solutions had killing or repelling effects on slugs and snails.

The effect of caffeine on snails was tested in no-choice and choice feeding tests. Each treatment had five snails and repeated three times. Leaves of Chinese cabbage and lettuce were dipped in caffeine solutions with different concentration, drip-dried and then placed in ventilated plastic containers, which were filled slightly with soils. In the no-choice tests over 24 h period, the areas of Chinese cabbage leaves fed by snails were reduced by 0, 0, 0, 8, and 48% for caffeine treatments of 2.0, 1.0, 0.5, 0.1, and 0% concentration, respectively (Fig. 1). In no-choice tests over 24 h period, the area of lettuce leaves fed by snails were reduced by 0, 0, 0, 5.8, and 32% for caffeine treat-

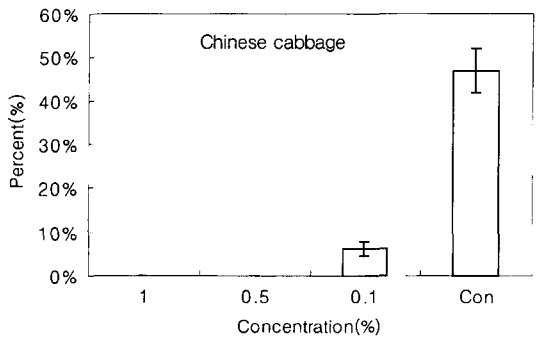


**Fig. 1.** Effect of caffeine treatments (1.0, 0.5, 0.1 and 0% from left to right) on the feeding of snails. Caffeine treatment causes snails to avoid the leafy parts of the Chinese cabbage.

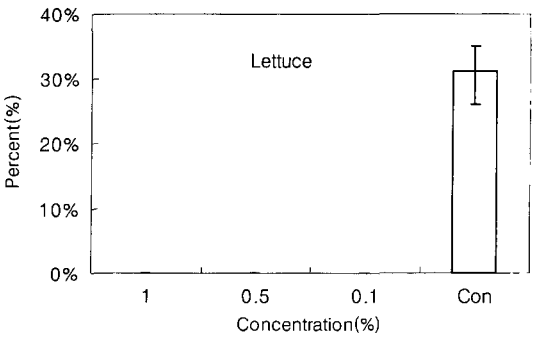


**Fig. 2.** Effect of caffeine treatments (1.0, 0.5, 0.1 and 0% from left to right) on the feeding of snails. Caffeine treatment causes snails to avoid feeding the leafy parts of the lettuce leaves.

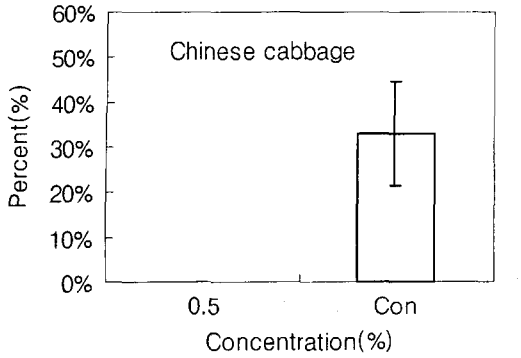


**Fig. 3.** Results are for a choice test for 24 h with 0.5% (left leaf) and 0% caffeine. Caffeine treatment causes snails to avoid the leafy parts of the Chinese cabbage.

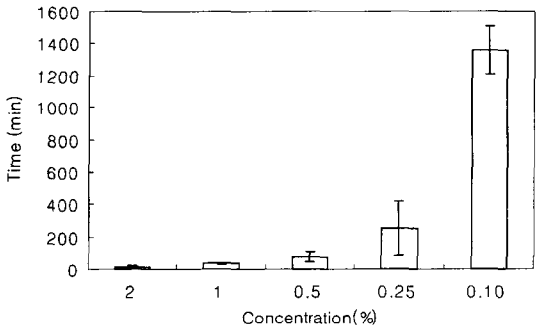


**Fig. 4.** Effect of caffeine on the snail (*Acuta despecta*). Mortality induced by higher doses of caffeine. Bars (left to right in each set): 2.0, 1.0, 0.5, 0.25, 0.1% solutions of caffeine. Error bars represent S.E. Y-axis is time (min) reaching to 100% morality.

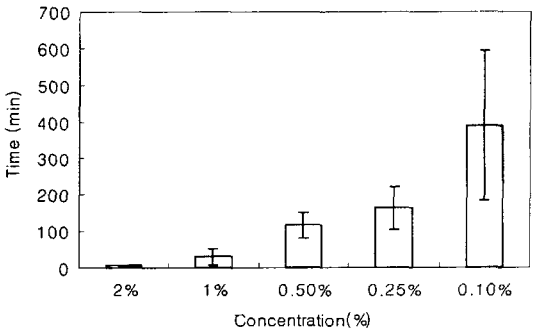


**Fig. 5.** Effect of caffeine on the slugs (*Deroceras varians*). Mortality induced by higher doses of caffeine. Bars (left to right in each set): 2.0, 1.0, 0.5, 0.25, 0.1% solutions of caffeine. Error bars represent S.E. Y-axis is time (min) reaching to 100% morality.

ments of 2.0, 1.0, 0.5, 0.1, and 0%, respectively (Fig. 2).

Similarly, in choice tests over 24 h period, consumed area of treated Chinese cabbage leaves was reduced by 0% and 30% for 0.5% caffeine concentration and control (Fig. 3). These results say that snails can recognize treated and untreated leaves with caffeine, and that caffeine, even as 0.5% concentration, has a significant effect on reducing feeding of the slugs.

The killing effect of caffeine on snails and slugs was tested. Each treatment had five snails or ten slugs and repeated three times. We dipped field slugs (*Deroceras varians*) and snails (*Acusta despecta*) in each concentration of caffeine for one minute, put in the containers with one ml caffeine solution or distilled water, and then measured the time to slugs and snails death. The concentrations of caffeine were 2.0, 1.0, 0.5, 0.1, and 0% (control). All snails and slugs were died within 24 h. No deaths were observed on snails and slugs, which were treated with water (Fig. 4 and 5). Caffeine is highly soluble in water, and 2% caffeine solution is more effective in reducing the presence of snails than 0.195% metaldehyde solution (Hollingsworth et al., 2002). Caffeine has potential as a killing or repellent agent against snails and slugs because of low price, toxicity, and solubility in water.

We dipped the leaves and stems of orchids, and found that 2% caffeine did not have damage on the foliage and flowers of orchids in preliminary experiments. But the green color of Chinese cabbage turned to whitish over 1% caffeine solution. Further research is necessary to reduce the effect of caffeine on changing the color of leafy parts of Chinese cabbage.

## References

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