Toxicity of Oleander Derived Compost

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When the Integrated Waste Management Act of 1989 was passed, California landfills were required to divert recyclable wastes from disposal. This brought new and strong markets for sales of yardwastes and composts to California landscape industries. Landscapers are challenged with providing customers with organic products that are weed and pathogen free, horticulturally suitable for plant growth and "safe" to people and animals. Although much research has been done on metals content of sludge composts, there is little known about possible effects of growing plants in composts or yardwastes containing poisonous plant materials.

Oleander (*Nerium oleander*) is a native of the Mediterranean region, it is now widely cultivated in the United States, especially California. The shrub is attractive, long-lived, drought tolerant and pollution tolerant. Its use in California landscapes, especially along freeways, has been extensive. Oleandrin, the toxic principle in Oleander is a cardiac glycoside which when ingested in small quantities (0.005% animal weight in horse), will cause death (Kingsbury, 1966). All plant parts, green or dry, are purported to be toxic to animals and humans. Anecdotal and some verified reports of human deaths are on record. Although a death (self inflicted) of a California woman was reported in 1982, a California Department of Food and Agriculture study found no deaths from Oleander in California during a 20 year period (Fuller and McClintock, 1986). Despite lack of recent human fatalities, animals are frequently poisoned each year and inquiries to poison control centers concerning toxicity and ingestion of oleander are frequent (Lampe and McCann, 1985).

Oleander glycoside molecules rely on specific orientation of an unsaturated lactone ring and a hydroxyl group for cardio-activity (Kingsbury, 1966). An associated sugar portion of the molecule may be important in solubility or activity. The size, complexity and susceptibility of the molecule to microbial attack during the composting process suggest that oleandrin will not persist long in soil. Although the size, complexity and instability of oleandrin make transport into crops unlikely, there have been no studies to validate these assumptions (Downer and Craigmill, 1995).

Oleandrin detection is difficult when precision is necessary. Precise analytical methods are necessary to avoid feeding studies with test animals (which are problematic due to animal rights issues. Thin layer chromatographic techniques give "ball park" estimates for tissue concentration (Galey et al., 1996). Yet, precise, repeatable measurements have been difficult. Assay by high performance liquid chromatography (HPLC) requires an extraction procedure which gives high yield of the target molecule. Refinement of the HPLC assay is perhaps the best way to track oleander toxicity.

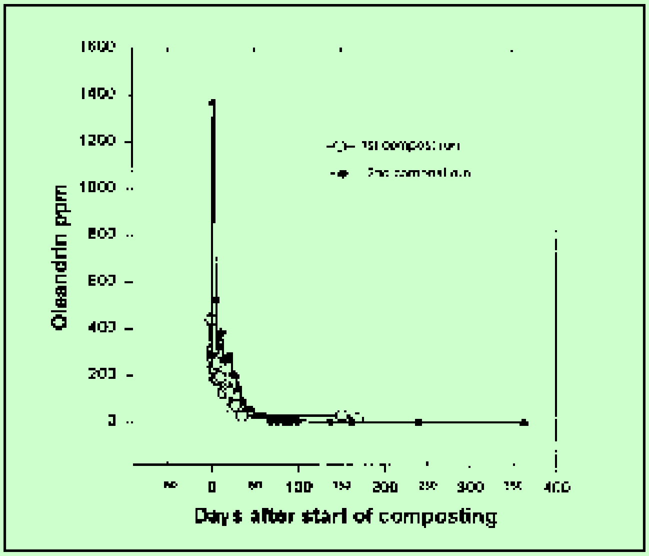
Methods

Oleandrin Degradation: Compost Study.

Oleander (*Nerium oleander*) clippings of stems, leaves and flowers were shredded with a commercial shredder grinder to make a pile of at least $1m^3$. The compost pile was covered with a polyethylene tarp to retard moisture loss. Additional water (approximately 25L) was added initially. No nitrogen or other fertilizer materials were added to the compost pile. The pile rapidly heated to over 65^oC. Compost samples were collected at the time of shredding (fresh) and on regular intervals, until the compost stabilized. The compost pile was maintained as an aerobic pile with turning after each sample collection. Two samples were obtained from the center of the pile prior to turning. Samples were collected and stored frozen (-20^oC) and mailed in batches to University of California, Davis. The average of each sample pair was used to plot oleandrin concentration over time.

Oleandrin Assay. Oleandrin was extracted from samples of compost and vegetable tissues with methylene chloride. Impurities were removed from the crude extract by charcoal solid phase extraction. Samples were derivitized with 1-naphthoyl chloride and quantified by HPLC with a fluorescence detector. These methods are fully outlined in Tor and others 1996.

Plant Uptake Study. Two vegetables: lettuce and tomato, were field grown in an Ojai very fine sandy loam (thermic fine-loamy, mixed Mollic Haploxeralfs) soil. Lettuce (*Lactuca* sativa 'Ruby') transplants were placed in one of three treatments. Treatments were: 1 untreated—no oleander; 2 oleander mulch 7.5cm thick or; 3. oleander (7.5cm thick layer), incorporated to 15cm depth. Oleander was incorporated with a rototiller. Oleander treatments were freshly shredded



Disappearance of oleandrin from compost (Fig. 1)

Oleandrin levels in vegetables grown in oleander mulches and amendments. The method detection limit is 0.05 ppm of oleandrin. The reported value is an average of four values, three of which were 0. (Table 1)

Oleandrin Concentration (ppm)		
Treatment	**Lettuce**	**Tomato**
Untreated	Not detected	Not detected
Mulched	.05	Not detected
Incorporated	Not detected	Not detected

oleander as described above. Treatments were applied over 0.5m wide rows. Tomatoes (*Lycopersicon esculentum* 'Beef master') were treated and planted in the same manner. Treatments were arranged in randomized complete block design with four replications. Irrigation was applied through drip tubing as required to promote good growth (approx. every 3-5 days during the growing period). No fertilizers were applied. Lettuce plants were harvested, washed and dried prior to shipment to Davis. Tomato fruit were washed, frozen then shipped.

Results

Fresh leaves and stems of oleander contained up to 1500ppm. Oleandrin concentration falls rapidly after the onset of aerobic composting (Figure 1). Decay of the glycoside is rapid for about 50 days after which it s rate of decomposition is much reduced. After 300 days, it was undetectable in compost.

Two vegetable crops were studied for potential uptake of oleandrin. Growth measurements were not taken however, lettuce grew rapidly, reaching maturity in less than 60days. Except for a single sample, no oleandrin was detected in any lettuce plants (Table 1). Tomatoes required longer to grow and produce a crop. Tomatoes growing in soil with incorporated oleander showed symptoms of nitrogen deficiency early in the test, but recovered, yielding a sufficient crop by the time of harvest. After approximately 90 days, tomatoes were harvested, frozen and analyzed for oleandrin. The fruit were determined to be "clean". Fruit from the same vines were subsequently eaten without harm.

Conclusions

Composting is an effective method means of destroying one of the toxic glycosides in oleander. The composting process causes a rapid decline in oleandrin concentration and eventually its complete disappearance from the compost. It is hard to determine what a "safe" level of oleandrin would be for compost, because compost is not consumed by people. Livestock may nibble fresh leaves of mulches, but would probably avoid composted materials. After fifty days, the level of oleandrin in compost falls to less than 10% of its original concentration in the feedstock. It would be most unlikely to cause harm if ingested, because a high volume of compost would be required to consume a toxic dose.

It appears from our growth studies that oleandrin is not transported into plants. The detection limit of the HPLC assay is very low at 0.01 to 0.05ppm. In all but one case, no oleandrin could be detected in the two vegetables we grew in oleander treated soil. In a single sample 0.2ppm oleandrin was detected, this was from lettuce growing in oleander mulched soil. Residue of chopped oleander may have been carried with the lettuce during harvest , dried, and ground with the sample. We did not wash lettuce or tomatoes before analysis so that we could have a "worst case" scenario. It appears from these preliminary studies that oleander mulches or amendments pose no threat to consumers of lettuce or tomato cultivated in the presence of oleander. It is advised however, that fresh vegetables should be washed before consumption to remove any particles of mulch that may be retained during harvest.

Further work is necessary to examine other kinds of plants used as food, especially root crops. We would also like to examine oleandrin persistence in soil and oleandrin concentrations at different times of the year.

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