Leaf Abscission in *Radermachera sinica* in Response to Ethylene and Silver Thiosulfate

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Radermachera sinica L. is a deciduous tree native to southeastern Asia (Liu, 1972), having opposite bipinnate leaves with numerous green leaflets. Although *R. sinica* plants generally perform well in most indoor environments, rapid and near complete defoliation has occurred during shipping and retail distribution, possibly due to exposure to ethylene (Marousky and Harbaugh, 1979, 1982; Reid, 1985). Silver thiosulfate (STS) has been used to prevent ethylene-induced injuries (Reid et al., 1980; Reid, 1985). Our study determined the effect of ethylene on leaf drop and the protection offered by the application of STS to *R. sinica*.

Twenty-eight *R. sinica* seedlings grown in 1.5-liter pots, and which received a single, foliar application of daminozide at 2500 mg-liter⁻¹, were separated at random into seven groups and sprayed to runoff with 0, 0.125, 0.25, 0.375, 0.5, 1.0, or 4.0 mM STS prepared as described, by Reid et al. (1980). Maximum photosynthetic photon flux (PPF) was 420 $\mu\text{mol}\cdot\text{s}^{-1}\cdot\text{m}^{-2}$. Air temperature at the time of STS application was 30C. Plants were evaluated for STS foliar injury on the uppermost pair of fully expanded leaves after 7 days.

To determine ethylene sensitivity, one pair of STS-treated leaves was taken below the youngest, fully expanded leaves. Only plants receiving STS treatments of 0 (control) or 0.125 mM were used to screen for sensitivity to ethylene-induced leaf abscission. Petioles with a full complement of leaflets were placed in individual flasks containing distilled water. Four flasks containing leaves from each STS treatment were placed in each of two Plexiglass chambers (0.21 m³) maintained at 25 $\pm$ 1C under continuous light providing a PPF of 15 $\mu\text{mol}\cdot\text{s}^{-1}\cdot\text{m}^{-2}$ from cool-white fluorescent tubes. Sufficient ethylene was injected into chambers to give concentrations of 0.5 and 2.0 ml-liter⁻¹. Flasks containing leaves were removed from the chambers after 24 hr of exposure and placed on a laboratory bench. Leaves were examined at 2-hr inter-

vals beginning 22 hr after the ethylene treatment.

The application of 4.0 mM STS caused severe injury to all leaves, and treated plants became unsalable (Table 1). Leaves receiving STS between 0.375 and 1.0 mM showed various degrees of phytotoxicity, resulting in unmarketable plants. Although 0.25 mM STS induced some necrosis, plants were still salable due to the small number and size of lesions. No phytotoxicity was observed on plants treated with 0.125 mM STS.

Leaves unprotected with STS and exposed to 2.0 ml ethylene/liter lost all leaflets within 22 hr, with abscission occurring in most of the petioles and rachises (Fig. 1). Similar leaves exposed to 0.5 ml ethylene/liter for 24 hr exhibited no abscission during the 24-hr exposure to ethylene. However, leaf abscission had initiated within 4 hr following removal from the chamber and was complete within 30 hr. Also, the degree of response to ethylene at 0.5 ml-liter⁻¹ was less severe, as evidenced by the intact petioles and rachises (Fig. 1). All leaflets on the STS-treated leaves at both ethylene concentrations remained intact during the next 30 days. Both types of experiments were repeated several times and results were consistent.

Ethylene-induced leaf abscission in *R. sinica* occurred at lower concentrations of ethylene and more rapidly than reported for other foliage plants (Marousky and Harbaugh, 1982; Reid, 1985). Although appli-

cation of 4 mM STS may be safe on ornamental such as *Brassia actinophylla* (Reid, 1985), much lower concentrations are required to avoid injury in *R. sinica*. Foliar application of STS at 0.125 mM to *R. sinica* seems to provide excellent protection against injury from ethylene-contaminated environments encountered within commercial shipping and handling channels.

Table 1. Degree of leaf injury 7 days following foliar application of silver thiosulfate (STS) at various concentrations. Air temperature at the time of STS application was 30C.

STS concn (mM)	Leaflets with lesions ^a (%)	Plant grade (1-5) ^b
0 (control)	0 $\pm$ 0	5.0 $\pm$ 0
0.125	0 $\pm$ 0	5.0 $\pm$ 0
0.250	30 $\pm$ 5	4.0 $\pm$ 0
0.375	48 $\pm$ 9	3.5 $\pm$ 0.6
0.500	56 $\pm$ 6	2.5 $\pm$ 0.6
1.0	75 $\pm$ 8	1.3 $\pm$ 0.3
4.0	100 $\pm$ 0	1.0 $\pm$ 0

^aMeans are the average of eight replicates $\pm$ SE of the mean.

^b5 = No foliar injury; 4 = slight injury, but salable; 3 = moderate injury, salability doubtful; 2 = unmarketable; 1 = severe injury.

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Fig. 1. Leaves of *Radermachera sinica* without STS application 6 hr after completion of a 24-hr treatment with 2 (right) or 0.5 (middle) ml ethylene/liter. The leaf on the left received a foliar spray of STS at 0.125 mM before exposure to 2 ml ethylene/liter for 24 hr.

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