

Mist Applications of Sodium Silicate to Rose (*Rosa L. × 'Nearly Wild'*) Cuttings Decrease Leaflet Drop and Increase Rooting

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Leaf retention is an important consideration when rooting vegetative cuttings (Reuveni and Raviv, 1980). Softwood cuttings benefit from carbohydrates stored in leaves as well as from the auxins produced therein (Breen and Muraoka, 1974; Hartmann et al., 1990; Reuveni and Raviv, 1980). Therefore, methods that increase leaf retention on softwood cuttings have the potential to stimulate rooting.

Sodium silicate (SiO₂), at a concentration of about 4 mg/L⁻¹, has been injected into water pipes as a corrosion inhibitor for over 70 years (Anonymous, 1987; Armstrong et al., 1994). This results in the formation of a thin film of glass that lines the interior of pipes and prevents corrosion (Anonymous, 1987). Additions of sodium silicate to nutrient solutions affects disease resistance of plants (Belanger et al., 1995) and may enhance the leaf retention of cuttings by inhibiting fungal infection and development. In most research, silicon compounds are applied to plants by adding them to the nutrient solution contacting the root zone (Belanger et al., 1995). Other researchers have found that foliar application of silicon compounds may be superior to root zone application for disease control (Bowen et al., 1992; Menzies et al., 1992).

Rose (*Rosa L. × 'Nearly Wild'*) cuttings (~10 cm long, ~12 leaflets per cutting, new growth), which were mildly infected with black spot (*Diplocarpon rosae* Wolf.) (~3.6 infection sites per leaflet), were propagated in a greenhouse at the University of Minnesota in July and early August using intermittent mist. Cuttings were stuck one to a 9 × 7.5 × 7.5 cm propagation cell containing perlite and peat (3:1 by volume). Before placement into cells, cuttings were treated with 1000 mg/L⁻¹ IBA (Dip'n Grow, Astoria-Pacific Inc., Clackamas, OR). Sixteen trays, each containing 18 cuttings, were arranged into four blocks with four trays per block. Treatments within blocks consisted of trays arranged randomly and misted with tap water (control) or 50, 100, or 150 mg/L⁻¹ Si as sodium silicate. Sodium silicate was injected into the misting system by using a different Dosmatic Advantage fertilizer injection system (Dosmatic USA, Carrollton, Texas) for each treatment. Trays were separated by plastic sheets to prevent drift.

Mist was applied to cuttings for 6 s every 8 min. for 16 h per day. The number of new leaves produced, the number of leaflets lost, and the number of black spot infection sites >1mm in diameter per leaflet for each individual plant, were counted before treatments began and again after 6 weeks, when cuttings that developed at least one root initial over 2 cm long were considered to be successfully rooted. Significant differences between treatment means were calculated using Duncan's multiple range test (*P* 0.05). Significant differences in percentage of leaflets lost among treatments were calculated by transforming percentages to 2 × squareroot [arcsin(%/100)] (Sokal and Rohlf, 1995). All statistics were calculated using SPSS (SPSS Inc., 1997). Because of a nozzle failure, one of the trays treated with 100 mg/L⁻¹ Si was removed from statistical consideration.

All silicon treatments increased percentage rooting and 50 and 100 mg/L⁻¹ Si increased leaflet retention (Table 1). Greater leaflet retention probably increased available carbohydrates and leaf-produced auxins resulting in increased rooting (Breen and Muraoka, 1974; Hartmann et al., 1990; Reuveni and Raviv, 1980). The highest concentration of Si was not effective in reducing leaflet loss, perhaps because of a buildup of silicon on leaves and an increase in mist water pH. The pH of tap water stayed around 8.2 while additions of 150 mg/L⁻¹ Si increased it to 9.9.

Why 150 mg/L⁻¹ Si increased rooting is not known. The thin film of glass that forms on and around structures treated with sodium silicate may have reduced transpiration. Antitranspirants have increased rooting in other crops (Whitcomb et al., 1974).

New leaf emergence was greatest in cuttings receiving 50 and 100 mg/L⁻¹ Si (Table 1), indicating that these cuttings were healthier than cuttings of other treatments. Leaf initiation may have resulted from new or more rapid root formation, reduced fungal activity, decreased leaflet loss, or a combination of these factors. Additions of sodium silicate to mist systems for the purpose of promoting roots through leaf retention, or other means, has received little prior attention. Further investigations into possible modes of action and species that may benefit from these treatments are warranted.

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Table 1: Effects of misting rose cuttings with sodium silicate solutions on percentage rooting, percentage leaflets remaining, number of new leaves produced, and average number of black spots per leaflet after 6 weeks of treatment.

Silicon (mg/L ⁻¹)	Rooting (%)	Leaflets remaining (%)	New leaves produced	Black spots per leaflet
0	59.7 b ^z	16.3 c	1.8 b	18.0 a
50	88.7 a	32.6 a	2.9 a	15.3 ab
100	85.2 a	25.7 b	3.1 a	14.6 b
150	75.0 a	3.7 c	1.7 b	17.0 ab

^zMean separation within columns by Duncan's multiple range test, (*P*) \square 0.05, n=4.