assumed that this action would be very slow (5). Analyses of the plant material in this study showed no significant differences in N, P, K, Ca, Mg, Fe, Mn, or Zn levels from the boron treatments and thus are not included in this report.

Arcillite proved to be a very satisfactory growing medium for potato plant and tuber studies which require the removal of intact root systems and tubers for examination; however, it would not be good for mineral deficiency or toxicity investigations. For studies not involving nutrient levels, or where plants do not have to be extracted from the medium, mixing peat moss and/or vermiculite with arcillite at a 1:1 or 2:1 ratio (by volume) improved the water–and nutrient–holding capacity. The more constant water supply would be beneficial for rapid, steady growth and prevention of knobby or misshapen tubers.

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Silver Ion Increases Endogenous Ethylene in Sweet Potato Vine Cuttings[1]

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Additional index words. silver nitrate, *Ipomoea batatas*

Abstract. **Concentration of endogenous ethylene was higher in Ag^+-treated cuttings of sweet potato (*Ipomoea batatas* Lam.) than in the control or in cuttings subjected to 48°C for 2 minutes. When leaf tissue was dipped in 0, 125, 250, or 500 mg/liter Ag^+, endogenous ethylene was increased by the 250 and 500 mg/liter treatments. When equal concentrations of NO_3^- were applied to cuttings as KNO_3, $Ca(NO_3)_2$, or $AgNO_3$, only $AgNO_3$ increased the endogenous ethylene content.**

Silver ion (Ag^+) has been called an ethylene (C_2H_4) antagonist because it inhibits plant response to C_2H_4. Silver nitrate ($AgNO_3$) increases flower bud longevity (7, 8), promotes flower bud opening (1, 10), prevents abscission and senescence (2, 4), and blocks (2-chloroethyl)phosphonic acid (ethephon) action (8). Ag^+ controls growth retardation, stem swelling, and horizontal growth of etiolated peas (2) and C_2H_4-induced leaf epinasty of tomato plants (5). Ag^+ promotes maleness in gynoecious cucumber (5) and decreased C_2H_4 evolution while increasing respiration in ripening fruit (9, 13). Ag^+ treatment prevents C_2H_4 incorporation into tissue (3).

Endogenous C_2H_4 content increases after 2 hr when sweet potato slips are immersed in a 48° water bath for 1-2 min and root yields increase (12). Our purpose in this study was to determine the effect of Ag^+ on endogenous C_2H_4 concentration in sweet potato vine cuttings in comparison to hot water treatment.

'Jewel' sweet potato was selected for all experiments with uniform vines cut to about 30 cm in length. Leaves were removed from the lower 15 cm of the cuttings which were then randomly sorted into bundles of 32 for subsequent treatments.

Experiment 1. Vine cuttings were subjected to 1 of 4 treatments–deionized water, Ag^+, 48° water bath, or Ag^+ and 48° water bath in order to evaluate the effect of 250 mg/liter Ag^+ and immersion in a 48° water bath for 2 min on endogenous C_2H_4. Ag^+ was applied as $AgNO_3$ by dipping the apical 15 cm of the cuttings into the solution, while the hot water bath is currently applied to the basal portion of cuttings for scurf and black rot disease control as well as yield increase in the commercial production of sweet potatoes (12).

Each treatment was replicated twice and C_2H_4 was extracted 3, 6, 12, and 24 hr after treatment by a technique similar to that of Beyer and Morgan (6). Immediately prior to extracting C_2H_4, cuttings were cut in half to evaluate the response of leaf and stem tissue separately. Tissue was placed in large funnels fitted with serum caps. The funnels were then inverted, submerged, and filled with deionized water. A 150 mm Hg vacuum was applied to the tissue for 10 min in a vacuum chamber. Atmospheric pressure below 100 mm Hg may induce wound production of C_2H_4 or release bound C_2H_4 (6). The inverted funnels were returned to atmospheric pressure and 5 cc samples of extracted gas were removed from the tops of the funnels. Extracted gas samples were analyzed by gas chromatography using an activated alumina column and a flame ionization detector. C_2H_4 was identified by retention time and by absorption of C_2H_4 by saturate mercuric perchlorate solution (11).

Ag^+ applied to the apical 15 cm (leaf tissue) increased levels of endogenous C_2H_4 in comparison with the control in experiment 1 (Table 1). The amount of endogenous C_2H_4 recovered from $AgNO_3$ treated tissue was greatest 3 and 6 hr after treatment (Table 2). The persistence of Ag^+ in stimulating endogenous C_2H_4 is illustrated by the tissue extracted 12 and 24 hr after application of Ag^+. Stem tissue showed no response to the hot water bath.

Experiment 2. The effect of Ag^+ concentration on endogenous C_2H_4 was determined by dipping the apical 15 cm of vine cuttings into solutions containing 0, 125, 250, or 500 mg/liter Ag^+ applied as $AgNO_3$. Each treatment was replicated twice and the internal atmosphere was extracted 3 hrs after treatment and analyzed as noted above. Leaf and stem tissue were evaluated separately. In experiment 2, leaf tissue treated with 250 and 500 mg/liter Ag^+ contained greater amounts of endogenous C_2H_4 than stem and leaf tissue treated with 0 and 125 mg/liter Ag^+ (Table 1).

Experiment 3. The effect of the source of NO_3^- was investigated by applying $AgNO_3$, KNO_3, $Ca(NO_3)_2$, or deionized water. The concentration of NO_3^- from each source was made equal to the concentration of NO_3^- in 250 mg/liter Ag^+ as $AgNO_3$ (14). Each treatment was replicated twice. Internal gases were extracted separately from leaf and stem tissue 3 hr after treatment and analyzed as noted above. KNO_3 and $Ca(NO_3)_2$ did not increase the concentration of endogenous C_2H_4 in treated tissue in experiment 3 (Table 1); only $AgNO_3$ was effective. In ex-

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Table 1. Effects of tissue, Ag^+ concentration, and source of NO_3^- on ethylene content of sweet potato tissue 3 hours after treatment.

Treatment	Concentration (mg/liter)	Ethylene content (μl/liter) Leaves	Stems	Mean
	Experiment 1			
Ag^+	0	0.45b	0.58a	0.52
	250	2.20a[z]	0.83a	1.51
	Experiment 2			
Ag^+	0	0.85b	0.68a	0.77
	125	0.83b	0.37a	0.60
	250	1.58a	0.58a	1.08
	500	1.71a	0.51a	1.11
	Experiment 3			
None	0	0.77b	0.93a	0.85
$AgNO_3$	(250)[y]	2.02a	0.75a	1.39
KNO_3	(250)	0.93b	0.88a	0.91
$Ca(NO_3)_2$	(250)	0.47b	0.61a	0.54

[z]Mean separation within columns and experiments by Duncan's multiple range test, 5% level.
[y]Concentration of NO_3^- was equal to the concentration of NO_3^- in 250 mg/liter Ag^+ applied as $AgNO_3$.

Table 2. Effect of tissue and time after treatment with a 2-minute, 48°C hot water dip or 250 mg/liter Ag^+ on endogenous C_2H_4 levels in sweet potato.

Tissue	Treatment	Ethylene content (μ/liter) Time after treatment 3hr	6hr	12hr	24hr	Mean
Leaves	none	0.74bcd	0.28d	0.54cd	0.44d	0.50
	Ag^+	3.65a[z]	1.85a	1.35abc	1.78a	2.16
	48°C, 2 min	0.25d	0.30d	0.39d	0.71bcd	0.41
	Ag^+ + 48°C	2.25a	3.35a	1.95a	1.45ab	2.25
Stems	none	0.24a	1.06a	0.55a	0.76a	0.65
	Ag^+	0.60a	1.04a	0.77a	1.22a	0.91
	48°C, 2 min	0.36a	0.46a	0.39a	0.83a	0.51
	Ag^+ + 48°C	0.56a	0.46a	0.81a	1.16a	0.75

[z]Mean separation within tissue and times by Duncan's multiple range test, 5% level.

periments 2 and 3 there were no differences in the amount of endogenous C_2H_4 recovered from treated vs. untreated stem tissue.

Paterson (12) reported that holding sweet potato plants in a 48° water bath stimulated C_2H_4 synthesis 2 hr after treatment, and that C_2H_4 content rapidly declined thereafter (12). C_2H_4 was evaluated 3 hr after treatment in experiment 1. This may account for the discrepancy between the current study and previously reported data.

The means by which Ag^+ stimulates C_2H_4 synthesis is not fully understood. Perhaps Ag^+ blocks the C_2H_4 activation site and thereby interfers with the feedback regulation of C_2H_4 production, accounting for stimulation of C_2H_4 synthesis. Alternatively, the stimulation may be a non-specific trauma induced by heavy metal toxicity.

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Effects of Soil Applications of Magnesium Sulfate and Dolomitic Limestone on Pimiento Pepper[1]

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Additional index words. Capsicum annum, zinc, pH

Abstract. **Plant weight of pimiento pepper (*Capsicum annum* L. cv Truhart Perfection) was more closely related to soil K and Mn levels than soil Mg in a greenhouse study. Plant Mg levels were increased significantly by $MgSO_4$ or dolomtic limestone additions. The sufficient-check soil produced significantly larger plants than the deficient-check or Mg-treated deficient soil.**

Magnesium deficiencies in pimiento pepper (3, 4, 5) are characterized by pale green leaf color followed by interveinal yellowing, leaf drop, small plants, and undersized fruit (1, 2, 6). Magnesium deficiencies generally occur in plants grown on acid, sandy soils in areas of high rainfall. Soils of the Coastal Plain Region of Georgia are of this type and precipitation is often greater than 100 cm/yr. Mg deficiency may be prevented by soil applications of magnesium sulfate (Epsom salts), dolomitic limestone of high Mg content, or foliar

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