not work at these low temperatures but we have been using a method for several years that is very good, on at least the red rhododendrons that I grow. It is 1 lb Terraclor (75% WP) and 2 lbs. Captan (50% WP) in 100 gallons water sprayed on the plants once before they are covered and then about once a month during the covered period or as needed.

This really works but I would caution you not to use it on young growth or at elevated temperatures, such as you would have in a greenhouse. Try it on a small scale first. It appears that the Captan kills most of the organism present and then they do not seem to reform on a surface that has Terraclor on it.

The only thing I am sure of is that we would not recognize today what we will be doing in the field of winter protection five years from now. The structures we are using now can yield about $40,000 gross crop return per year per acre covered and I expect this figure to double in five years, due to better quality crops.

I always enjoy attending the Western Region Plant Propagators' Meeting, as the people here are so very friendly.

LITERATURE CITED

1. Flint, Harrison, 1967. Winter storage of young nursery stock. *Proc. Inter. Plant Prop. Soc.* 17:344—350.

MODERATOR McNEILEN: Thank you, Dick. Now Dr. Douglas Phillips, U.S.D.A. plant pathologist from Fresno, California will discuss control of geranium rust through heat treatment. Dr. Phillips:

HOT-WATER TREATMENT OF GERANIUM CUTTINGS

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Postharvest, hot-air or hot-water treatment of geranium cuttings offers a high or eradicative level of control of geranium rust incited by *Puccinia pelargonii-zonalis* Doidge with only slight injury to the cuttings, (Grouet, 1965) (Phillips and McCain, 1972). Our initial work indicated that hot-water treatment at 122° F for 90 seconds also gave some control of other cutting-borne pathogens that are im-

portant during shipping. We, therefore, undertook a study to evaluate the effects of hot-water on cuttings of 4 different varieties of geranium, *Pelargonium hortorum* Bailey (P. *zonale* Ait. probably x *P. inquinans).*

Trimmed, uncallused cuttings, freshly harvested from fields in San Diego County, California were treated in water at 122° F for 90 seconds, then cooled in air or in cool chlorinated water (50 ppm C10). Control cuttings were not treated. Following treatment, cuttings were packed in fiberboard shipping boxes and held 2—4 days at room temperature before they were evaluated for disease.

In the first test, hot-water treated and untreated cuttings of the varieties Coral Seas and Electra were placed in the shipping boxes with or without a polyethylene wrapping. Table 1 shows that 67% of the non-wrapped, hot-water treated cuttings were in sound condition after 4 days, whereas only 48% of the untreated, unwrapped cuttings were sound. Wrapping markedly increased losses in both lots. The incidence of stem-end rot incited by *Botrytis* sp. was much reduced by the hot-water treatment.

In the second test, with 500 relatively "soft" cuttings of the varieties Cardinal and Apple Blossom, lots of 50 each, treated and non-treated cuttings were put into kraft paper sacks and packed into shipping boxes. Evaluation of these cuttings after 2 days indicated 30—40% injury to the small expanding leaves at the shoot tip (Table 2). However, the overall condition of the treated cuttings was good. Hot water controlled stem-end rot and produced a clean, unwilted cutting, whereas most of the untreated cuttings were wilted.

In addition to this evaluation, 300 cuttings of each variety in the second test were shipped by air to Ohio State University. Twenty-four hours after treatment, the heated and non-heated cuttings were judged to be in good condition. Cuttings from this air shipment, planted in a greenhouse, grew and developed normally.

It is not now known whether the hot-water treatment will affect vascular pathogens of geranium. The treatment does not raise the internal temperature of the cuttings sufficiently to kill these pathogens. Tests now underway indicate the bacterium, *Xanthomonas pelargonii* is not killed by the hot water, and chlorination of the hot water may be necessary to prevent the pathogen from being disseminated during the treatment. Injury might limit the use of hot water in some cases, but field-grown cuttings appear to be quite tolerant of the treatment. These tests indicate that hot-water treatment of geranium cuttings controls stem-end rot during shipping and may improve the overall quality of the cuttings, in addition to controlling geranium rust.

Table 1. Effects of hot-water treatment and polyethylene wraps on Coral Seas and Electra geranium cuttings, after 4 days at room temperature.

Variety	Heat treatment	Wrapping	Uninjured	Stem-end rot
			percent	percent
Electra	+	—	66.7 a[1 2]	7.2 a
	—	—	48.2 ab	24.1 ab
	+	+	35.7 b	41.3 b
	—	+	31.2 b	56.3 b
Coral Seas	+	—	67.2 a	2.7 a
	—	—	35.7 ab	22.7 c
	+	+	68.2 b	9.7 a
	—	+	16.5 b	69.0 b

[1]Each datum represents the mean of 4 replications of 25 cuttings

[2]Data in each block not followed by the same letter differ at a confidence level of 95 percent.

Table 2. Stem-end rot and injury of Cardinal and Apple Blossom geranium cuttings treated in hot water and held 48 hours at room temperature.

Variety	Treatment	Stem-end rot	Injury[1]
		percent	percent
Cardinal	heated	0[2]	29
Cardinal	not heated	19	0
Apple Blossom	heated	0	43
Apple Blossom	not heated	20	0

[1]Injury limited to small expanding leaves at shoot tip

[2]Each datum represents 100 cuttings.

LITERATURE CITED

1. Grouet, D. 1965. La rouille du Pelargonium zonala. Traitement par thermotherapie. *Epiphyties* 16:315-331.
2. Phillips, D. J. and A. H. McCain. 1972. Hot-water therapy for geranium rust control. *Phytopathology*. In press.

Wednesday Evening Session

MODERATOR VAN VEEN: Tonight we have a panel discussion on teaching techniques in plant propagation. Howard Brown will be the lead-off man. Howard:

TEACHING TECHNIQUES IN PROPAGATION

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In preparing for this presentation I tried to consider how teaching propagation in our department would differ from that done at the other institutions represented on this panel. There is probably little difference in how we handle seeds, cuttings, buds or grafts but there may be a big difference in how we motivate the students. While the technique that I will describe works well for our vocationally oriented, suburban campus, I am not necessarily recommending it for all colleges.

At Cal Poly our students in Ornamental Horticulture operate a commercial nursery and flower shop as part of their educational experience. It gives them an opportunity to propagate plants, grow them on, and market them while participating in the profits from the crops that they grow. Many of our alumni claim that production and management experience gained through our Agricultural Enterprise Program was the most valuable experience that they received in college. I know, too, that the dollar incentive is much stronger for many students than would be a mere course grade.

We encourage capable students to start an enterprise project during their sophomore or junior years. Oftentimes they will be in partnership with a student who has grown a crop previously. This gives them the benefit of the experience of a person who has been