POTENTIALS OF ANTITRANSPIRANTS IN PLANT PROPAGATION[1]

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Abstract. Under Florida conditions, film-forming antitranspirants increased rooting of *Podocarpus macrophylla* and *Juniperus chinensis* 'Hetzii' cuttings without mist as compared to conventional mist controls. However, in Oklahoma, antitranspirants were of no benefit to cuttings without mist. Cuttings treated with antitranspirants lost water at about the same rate as untreated controls under low humidity conditions; however, under high humidity, antitranspirants were beneficial. Under low humidity conditions coatings began to peel after 3 days but with high humidity they remained intact for several weeks. Cuttings treated with antitranspirants and placed under mist lost K at a rate similar to untreated controls. These data cast serious doubts on the benefits of these film-forming antitranspirants under low humidity conditions.

REVIEW OF LITERATURE

Increasing labor costs have stimulated many nurserymen to consider various production methods. Present propagation systems require considerable labor, handling, equipment and facilities. When cuttings are taken from the parent plant, water supply to the leaves is stopped, yet transpiration continues. Intermittent mist maintains a film of water over the leaf, thus reducing moisutre loss, but not without complications.

Tukey (11, 13) reported that every plant studied in his investigations of intermittent mist propagation lost nutrients by leaching. Tukey and Morgan (12) reported that young leaves lost approximately 3 to 10% of their N content within 24 hr. They also found that 80 to 90% K and 50 to 60% Ca were leached from mature leaves in 24 hr. Sorenson and Coorts (9) report less N, P, and K in plant tissue under mist, both at time of callus and root formation than was present initially. Sharpe (6) reported similar results and concluded these losses were dependent upon amount of mist used. About 95% of water loss by leaves occurs through stomata and only 5% through epidermis (3). Since greatest amounts of transpiration occurs through stomata, chemicals to reduce water loss must effectively control stomatal transpiration. Snyder (8) reported that antitranspirants were effective in reducing water loss and that effectiveness decreases with time. Smith, Chadwick and Reisch (7) applied two antitranspirants, Foli-Gard and Wilt-Pruf,

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to foliage of ornamental plants to determine effect on transpiration and winter injury. They reported transpiration was reduced approximately 10% from upper leaf surfaces and by 40% from lower leaf surfaces.

This research is based on the hypothesis that if antitranspirants could stop water loss from cuttings long enough, they could be rooted without mist and without the complication of leaching of nutrients (1, 2, 4).

MATERIALS AND METHODS

This work covers 9 experiments, 4 conducted at the Universtiy of Florida in Gainesville and 5 at Oklahoma State University, Stillwater. For brevity, only 5 will be summarized here.

Exp. 1 (Rooting of Cuttings - Florida). Three film-forming antitranspirants, each at 2 concentrations, 2 auxin levels, and 2 light intensities were used in factorial combination. Antitranspirants were Foli-Gard (an acrylic co-polymer), Vapor-Guard (a polyterpene), and Coating #30[1] (an experimental modified acrylic compound). Each antitranspirant was used at 5 and 25% concentrations, without auxin or with 1700 ppm auxin as a talc preparation (Rootone) and in full sun or under 50% saran shade.

Six-inch terminal cuttings of *Podocarpus macrophylla* and *Juniperus chinensis* 'Hetzii' were taken March 24 and were dipped in antitranspirants to the terminal two-thirds and excess liquid removed by vigorous shaking. Bases of cuttings to receive auxins were dipped in talc. Three cuttings were placed per 6-inch container with a medium of 1:1 builders sand and Canadian peat by volume and amended with dolomite, single superphosphate and Perk[2] at rates of 8, 5, and 1½ lb/cu yd, respectively.

A control under conventional mist compared 2 auxin levels, 0 and 1700 ppm to provide a standard. Cuttings were placed one per 2.5 inch plastic pot. Misting was 3 sec/min in a clear glass greenhouse.

Exp. 2 (Rooting of Cuttings - Oklahoma). Three film-forming antitranspirants plus a dry check and a mist check were treated with 5 auxin levels and 3 light intensities. Antitranspirants were Foli-Gard, Folicote (an emulsifiable wax) and Wilt-Pruf (a polyvinyl chloride). Auxin levels were 0, 8,000, 16,000, 30,000,

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[1] Dover Chemical Company, Wilmington, Delaware

[2] A micronutrient fertilizer manufactured by Kerr-McGee Corporation, Jacksonville, Florida.

and 45,000 ppm of IBA (Hormodin talc preparation) and light intensities of full sun, 33 and 62% shade.

Six-inch terminal cuttings of *Juniperus scopulorum* 'Blue Heaven' and *J.c.* 'Hetzii' were taken December 1 and treated as in Exp. 1. Cuttings were placed one per 3.5 inch square plastic containers. All treated cuttings were placed on wire benches in a clear plastic greenhouse where humidity was maintained between 65 and 80% by wetting walls and floor several times daily. Peat and perlite rooting medium was directly watered as needed. Control cuttings in the mist propagation were stuck at the same time and received the same auxin and light intensity treatments.

Exp. 3 (Leaching of nutrients - Oklahoma). Foli-Gard, Folicote and Wilt-Pruf were applied to *J.c.* 'Hetzii' cuttings at 0, 10, or 20% concentration. Tissue analysis of the complete cutting was determined after 0, 2, 4, 6, or 8 weeks of misting. Mist, medium and container conditions were as in Exp. 2.

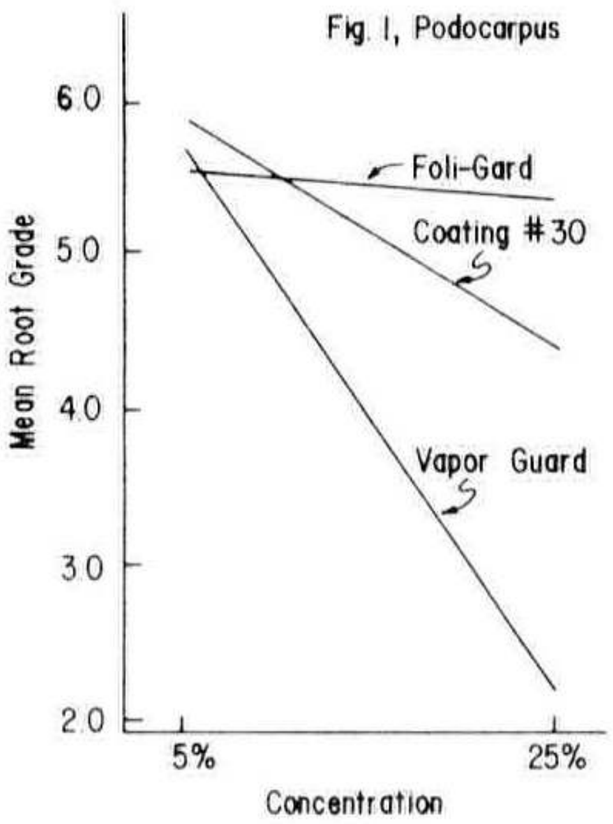
Exp. 4 (Effects on water loss - Oklahoma). Foli-Gard, Folicote and Wilt-Pruf were applied to *J.c.* 'Hetzii' and *Ligustrum japonicum* cuttings at 0, 10, and 20% concentrations. Cuttings were dipped entirely, allowed to dry 1 hr on an open laboratory table and weighed. Subsequent weights were taken every 48 hr and percent moisture loss determined. Relative humidity in the laboratory ranged from 60 to 65%.

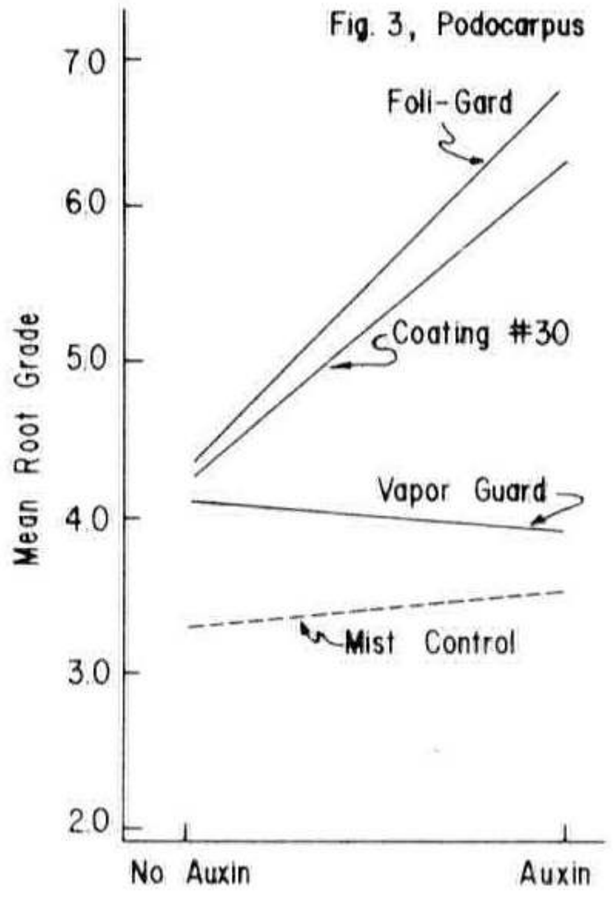
Exp. 5 (Percent water loss at high and low humidity - Oklahoma). Treatments were the same as in Exp. 4. Following treatment, cuttings were placed on an open laboratory table at 60-65% humidity or in chambers at 90 to 95% humidity. After 4 days, percent water loss from cuttings as affected by treatments was determined.

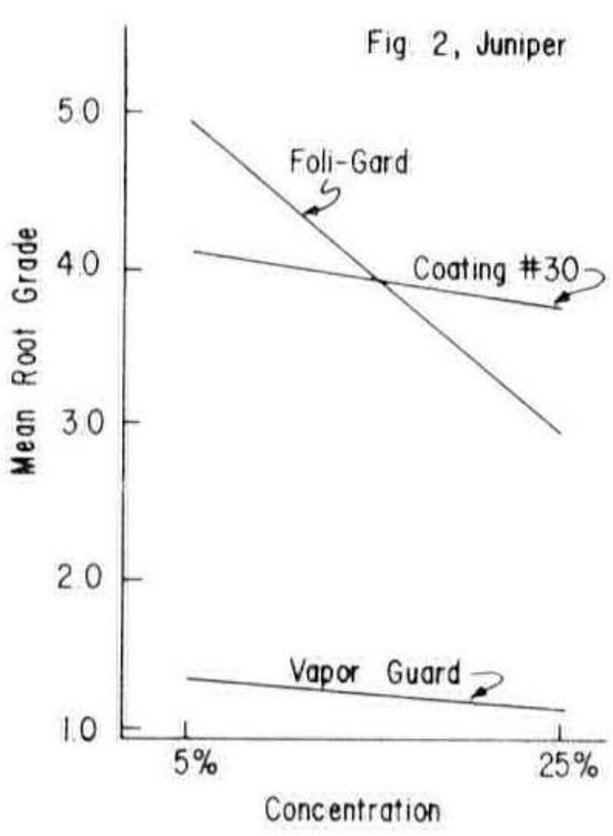
RESULTS

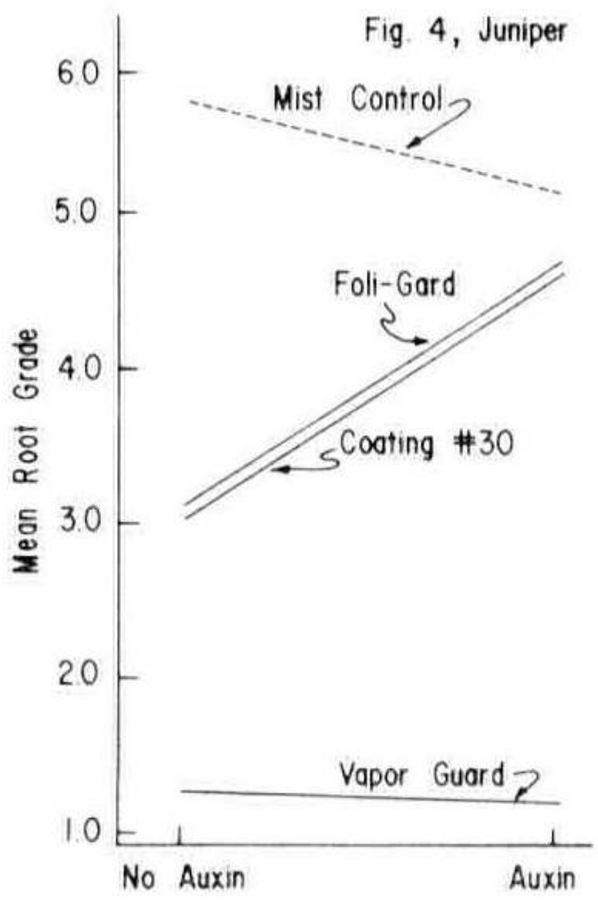
Exp. 1 (Florida). As concentration of antitranspirant increased from 5 to 25%, root grades generally decreased. At 5%, podocarpus rooted about the same for all chemicals; however, Coating #30 and Vapor Guard decreased root grade when increased to 25% (Fig. 1). On the other hand, juniper cuttings were very sensitive to Vapor Guard and both Foli-Gard and Coating #30 decreased rooting with increased concentration (Fig. 2).

Podocarpus cuttings treated with Foli-Gard or Coating #30 rooted much better when treated with auxin, whereas the mist control and Vapor Guard treatments were not affected by auxin level (Fig. 3). Auxin applications had no effect on the rooting of junipers in the mist; however, Foli-Gard and Coating #30 treatments responded to auxin applications (Fig. 4).









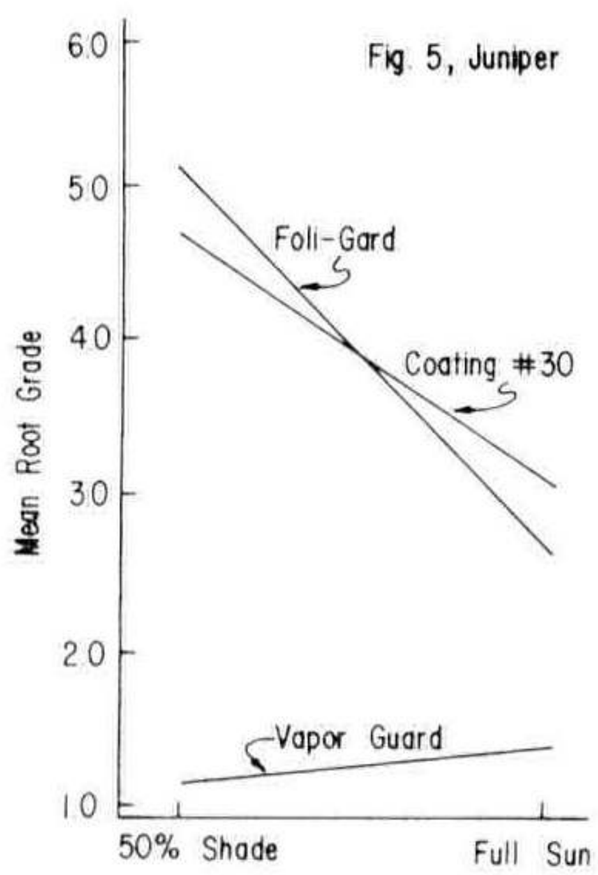


Fig. 1. Effects of 3 antitranspirants each at 2 concentrations on the rooting of podocarpus cuttings. **Fig. 2.** Effects of 3 antitranspirants each at 2 concentrations on the rooting of juniper cuttings. **Fig. 3.** Effects of 3 antitranspirants on the rooting of podocarpus cuttings with and without auxin as compared to a mist control. **Fig. 4.** Effects of 3 antitranspirants on the rooting of juniper cuttings with and without auxin as compared to a mist control. **Fig. 5.** Effects of 3 antitranspirants on rooting of juniper cuttings in full sun or 50% shade.

Light intensity had no effect on rooting of podocarpus. Juniper cuttings rooted much better in 50% shade than in full sun with Foli-Gard and Coating #30 (Fig. 5). When all treatment combinations are considered, four are significantly better than the mist control for rooting podocarpus: Coating #30 at 5% in shade with auxin; Foli-Gard at 5 or 25% in shade with auxin; and Vapor Guard at 5% in shade with auxin (Table 1). Only Foli-Gard at 5% in shade with auxin significantly increased the rooting of junipers over mist controls.

Table 1. Root grade of juniper and podocarpus cuttings rooted with antitranspirants or under mist (1 = no roots; 10 = best roots).

Antitranspirant	Concentration (Percent)	Auxin Applied	Podocarpus Full Sun	Podocarpus 50% Shade	Juniper Full Sun	Juniper 50% Shade
			Root Grade			
Coating #30	5	yes	5.8	8.4**	3.7	5.6
Coating #30	5	no	5.3	4.6	3.1	4.3
Coating #30	25	yes	6.1	4.9	4.4	6.1
Coating #30	25	no	3.0	4.0	1.4	3.5
Foli-Gard	5	yes	6.4*	7.0**	3.6	8.8**
Foli-Gard	5	no	4.9	4.2	2.4	5.5
Foli-Gard	25	yes	6.7*	7.0**	2.9	4.5
Foli-Gard	25	no	4.4	3.8	2.0	2.5
Vapor Guard	5	yes	5.8	7.2**	1.6	1.0
Vapor Guard	5	no	5.5	6.2	1.2	1.8
Vapor Guard	25	yes	1.8	2.2	1.6	1.0
Vapor Guard	25	no	2.6	2.8	1.6	1.0
Control (conventional mist system and 2¼" pots)				yes	3.8	5.1
				no	3.4	5.8

* Significant at 5% level or
** Significant at 1% level based on Dunnet's test (control vs. other treatments)

Exp. 2 (Oklahoma). None of the antitranspirant-treated cuttings at any auxin level or light intensity of either species rooted satisfactorily. Control cuttings in the mist rooted best with full sun. 'Hetzii' juniper rooted 100% at all auxin levels. *J.s.* 'Blue Heaven' rooted 60% at 16,000 ppm auxin.

Exp. 3 (Oklahoma). Antitranspirants had no effect on leaching loss of N, K, Ca or Mg from cuttings. Potassium tissue levels decreased with time in the mist.

Exp. 4 (Oklahoma). Weight of antitranspirant-treated 'Hetzii' juniper and ligustrum cuttings decreased 23 to 24% in 48 hr. Untreated controls decreased 25 to 26% during the same period. After 6 days, all cuttings, regardless of coatings, had decreased in weight by 44 to 46%.

Exp. 5 (Oklahoma). With high humidity, ligustrum cuttings retained from 7% (20% Folicote) to 18% (20% Foli-Gard) more moisture than the untreated controls for the 4 day period. However, with low humidity, ligustrum cuttings retain 8% more moisture than the control when treated with 10% Folicote but lost 23% more moisture than the control when treated with 10% Wilt-Pruf. On the other hand, 'Hetzii' juniper cuttings lost about equal quantities of water with or without antitranspirants in high humidity, whereas in low humidity, a 3 to 16% decrease in water loss was obtained with the antitranspirants.

DISCUSSION

When comparing the results of these experiments, the dorminant question is: "Why the difference between the Florida and Oklahoma results?" In Florida, the relative humidity did not drop below 85% during the various experiments. In Oklahoma, even though considerable effort was made to maintain a high humidity, it remained between 65 and 80%. The mositure stress was, therefore, much higher in Oklahoma. Podocarpus is not hardy in Oklahoma; therefore, only the juniper portion of the study was continued here. In addition, since only Foli-Gard had proven beneficial to junipers, two new chemicals were added to the study. In all cases, antitranspirants failed to aid rooting of juniper cuttings under Oklahoma conditions (Exp. 2). It was found that treated and untreated cuttings lost water at about the same rate (Exp. 4). Close study under the microscope showed that under the low humidity conditions of Oklahoma, all antitranspirants at all rates began to break and peel from the leaf surface after about 3 days. On the other hand, when these same chemicals were placed in high humidity conditions, the protective film remained intact for several weeks (Exp. 5). These data suggest that little, if any, benefit is derived from using these antitranspirants under low humidity conditions. However, with high humidity, some worthwhile benefit may be derived.

Antitranspirants had no effect on preventing leaching of nutrients from cuttings under mist (Exp. 3). The fate of the coating under these conditions could not be determined and results did not warrant further study.

Under Florida conditions (Exp. 1), the practice of using antitranspirants as a substitute for mist appears very promising. *Podocarpus macrophylla* is grown primarily from seed due to the difficulty of rooting cuttings of superior plants. However, cuttings rooted extremely well with 4 of the treatment combinations, far superior to the mist controls. This may have been due to the preventing of nutrient leaching or other factors. Only one treatment combination was superior to mist for rooting 'Hetzii' junipers. It is of interest that for both species reported here and others tested in Florida, but not mentioned in this paper, rooting was best in shade. This is in agreement with Thames (1) who attributed the failure of wax emulsions on loblolly pine to heat being trapped inside the coatings by the greenhouse effect. It is also challenging in that auxin had little influence on rooting of either species in mist but when antitranspirants coated the leaves, considerable benefit resulted. This suggests a change in metabolism inside the leaf following restriction of gas exchange.

In areas where the relative humidity remains high for much of the year, this technique deserves further study, particularly with

hard-to-root species. The development of new coatings and varied response by different species could prove most beneficial.

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CHARLIE PARKERSON: Thank you, Carl; now I know why my trials with your method failed. Our next paper has to do with hormone concentrations and will be presented by Dave Ruppert.