FOUR CHEMICAL CONDITIONERS DO NOT IMPROVE CONDITION OF FOUR CONIFER SEEDINGS IN CALIFORNIA TEST

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From 1961 to 1964 the California Division of Forestry conducted studies to compare methods of maintaining four species of conifer seedlings in good physiological condition during storage and shipping.

Four commercial chemical plant conditioners and several packaging methods were compared. The preparations used were: Rutex 59, Rutex MCT 1019-1, Rutex W-3 (Foligard), and Shell 4901.[2] Packaging methods and materials included: Openend bundles wrapped in waterproof "Fibreen 200" Sisalkraft paper, polyethylene-coated kraft bags (fig. 1), and "Tufflex", a blotter-type paper with high moisture retention qualities.

Rutex 59 is a transparent sprayable liquid applied to plant roots to prevent desiccation. Rutex. MTC-1019-1 is similar to Rutex 59, but has lower pH. Rutex W-3 is also a sprayable liquid, but is designed as a transpiration inhibitor for foliar application. Shell 4901 is a hormone-type

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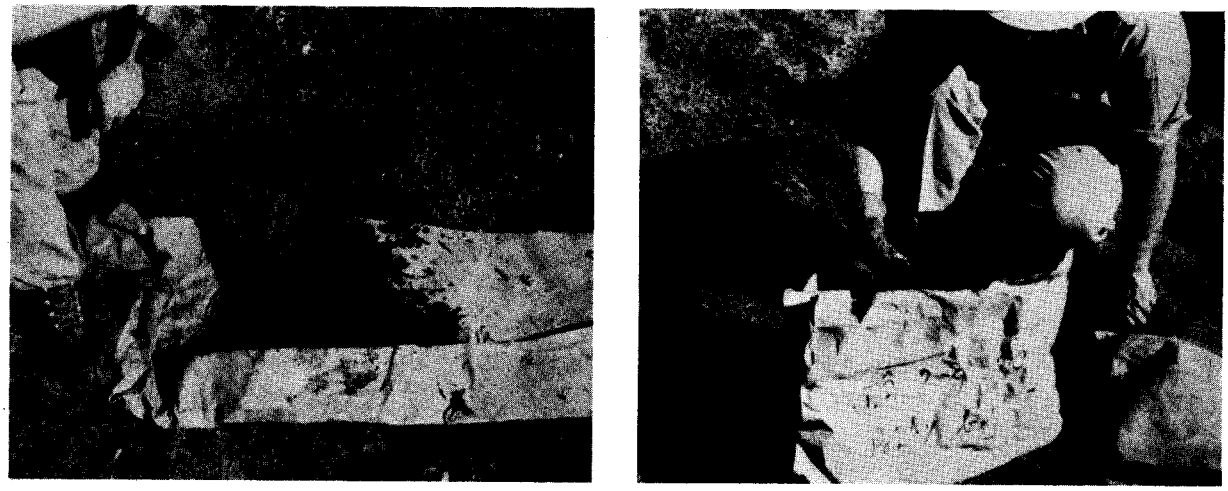
[2] The use of trade names for identity purposes does not imply endorsement or disapproval of the products by the Division of Forestry.



igure 1.—First-year survivals of 2–0 Jeffrey pine seedlings packed in moist shingle-toe wrapped in open-end Fibreen 200 Sisalkraft paper (*left*), and pack in polyethylene-lined kraft bag without shingle-toe (*right*), were almost identical (94 and 93 percent respectively), compared to 82 percent for controls. (*See table 3.*)

chemical designed to maintain plant cell turgidity.

The four seedling species tested were: Jeffrey pine, ponderosa pine, white fir, and Douglas-fir.

A number of trials with transpiration inhibitors and packaging materials have been made by forest nurserymen and researchers. Roy (1966) and Ursic (1963) found that Rutex root antidessicants did not improve survival materially. Seedlings treated with transpiration inhibitors also have shown little or no gain in survival (Fowells and Schubert, 1955; Jack, 1955; Maguire, 1952; Roy, 1966).

Polyethylene-coated kraft bags have been used satisfactorily for shipping trees and have the advantages of saving considerable weight (Duffield and Eide, 1959; Ursic, 1963). Mediums for retaining moisture around seedling roots were discussed by Eliason (1962). Bland (1962) reported that "Tufflex" was a satisfactory material for this purpose. "Seedling Pak", a wood fibre blanket, has been tested and is being used at a Minnesota industry nursery (Jankowski, 1966).

Tests conducted by Lanquist and Doll (1960) showed that seedlings could be stored satisfactorily over winter enclosed in polyethylene bags without moisture retaining medium.

Methods Used

Eight separate studies were made in the four-year testing period. These were conducted at the following nurseries and cooperative study areas:

Ben Lomond Nursery, Santa Cruz County, central California coast, elevation 2,700 ft.

Magalia Nursery, Butte County, northern Sierra Nevada, elevation 2,800 ft.

Winton Bear Clover Study, American Forest Products Corp., Amador County, central Sierra Nevada, elevation 4,500 ft.

Forest Creek Burn Study, American Forest Products Corp., Calaveras County, central Sierra Nevada, elevation 4,800 ft.

Each study treatment contained five replications of either 20, 25, or 30 seedings.

The "control" packing method for all studies was open-end bundles containing moist, well-aged cedar and redwood shingle-tow packed around seedling roots. To simulate shipping, packaged seedlings were transported by Division of Forestry truck from the Magalia Nursery to Davis, where they were held for seven days in an open shed.

TABLE 1.—*First-year survival of 2-0 Jeffrey pine seedlings packed in open-end bundles, shipped for 7 days, and planted near the Ben Lomond Nursery in March 1962*

Treatment	Survival
	Pct.
Control	82
Roots dipped in Rutex 59, no shingle-tow	84

TABLE 2.—*First-year survival of 1-0 ponderosa pine and white fir planted at the Magalia Nursery in May 1962, and second-year survival of 1-0 ponderosa pine, and 1-0 and 2-0 white fir planted in December 1961 on Winton Bear Clover and Forest Creek Burn Studies (all seedlings cold stored for 3 months)*

Treatment	Magalia		Winton bear clover	Forest creek burn	
	PP 1–0	WF 1–0	PP 1–0	WF 1–0 [1]	WF 2–0
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Stored stock					
Control	88.8	24.8	62.4	40.0	44.0[2]
Open-end bundles, roots dipped in Rutex MCT, no shingle-tow	52.8	6.4	52.8	44.0	46.7
Plus tops in Rutex W–3	87.2	8.0	43.2	38.7	72.0
Plus tops in Shell 4901	52.0	2.4	38.4	38.7	41.3
Fresh lifted stock untreated	86.4	32.0	[3]	[3]	[3]
LSD @ .01 level	25.4	—	—	—	—
LSD @ .05 level	—	22.3	24.1	n.s.	17.1

[1] Differences were not significant at the .05 level.

[2] Not included in analysis of variance because of extreme variations between treatment replications.

[3] Not tested.

Temperatures ranged from 35 to 60 degrees F. From there the trees were transported to the Ben Lomond Nursery and planted. For portions of tests incorporating storage, use was made of the nurseries' walk-in refrigerators which are maintained at 35 degrees F. Storage periods were 3 months.

Data for all studies but the one shown in table 1 were submitted to analysis of variance, and means were compared by least significant differences (LSD).

Results of the 1961 and 1962 studies are summarized in tables I and 2, 1963 studies in tables 3 and 4, and 1964 studies in figure 2.

The 1964 study using Douglas-fir stock was intended to be a single study, but because the Tufflex root wrap variable was omitted from the open-end

TABLE 3.—*First-year survival of 2-0 Jeffrey-pine seedlings shipped for seven days and planted near the Ben Lomond Nursery in February 1963*

Treatment	Survival [1]
	Pct.
Control	82
Open-end bundle, roots dipped in Rutex MCT, no shingle-tow	79
Poly-coated bags, no shingle-tow	93
Poly-coated bags with shingle-tow	94
Poly-coated bags, roots dipped in Rutex MCT, no shingle-tow	83

[1] LSD @ .05 level = 11.2%.

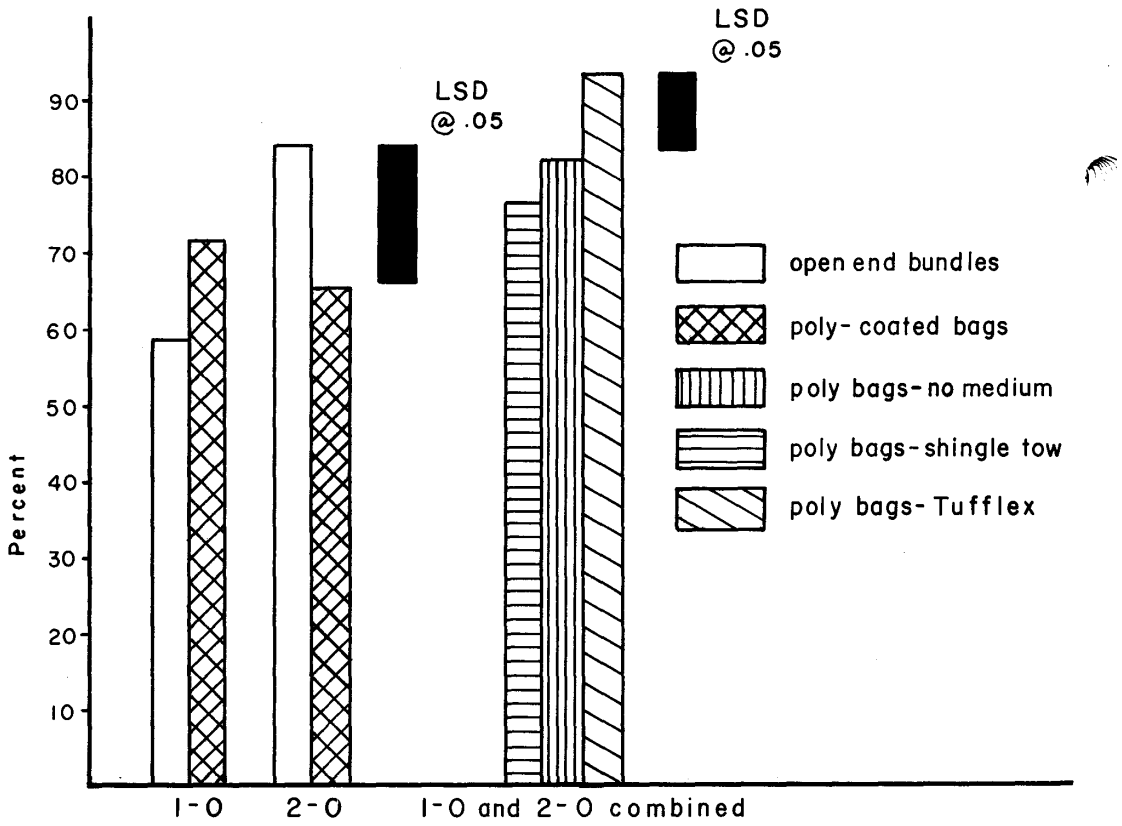


Figure 2.—First-year survival of 1–0 and 2–0 Douglas-fir seedlings shipped for 7 days and planted in April 1964 near the Ben Lomond Nursery, Calif.

TABLE 4.—*First-year survival of 3-months cold stored 1-0 seedlings packed in open-end bundles, and fresh lifted 1-0 seedlings planted near the Magalia Nursery, June 10, 1963*

Treatment	Ponderosa pine [1]	White fir [2]
	Pct.	*Pct.*
Control	72	3
Roots dipped in Rutex MCT, no shingle-tow	75	0
Tops dipped in Rutex W–3 no shingle-tow	73	6
Freshly lifted, no treatment	22	0

[1] LSD @ .01 level = 30.7%.

[2] Survival was not sufficient for statistical analysis.

bundles, the study was separated into two parts for the purpose of statistical analysis (fig. 2). The first part was analyzed as a factorial experiment comparing 1-0 vs. 2-0 age classes, Rutex root dip vs. shingletow, and packaging in open-end bundles vs. poly coated bags. There was no difference between the Rutex and shingle-tow treatments so they do not appear in figure 2. The second part of the study compared moisture holding mediums in poly-coated bags.

Discussion and Conclusions

The following conclusions from this series of studies over a four-year period should assist nurserymen in packaging techniques:

1. There was no advantage to treating seedlings with the Shell 4901 or Rutex materials under conditions of the tests:

   a. Shell 4901 in several of the tests decreased survival significantly.

   b. Rutex 59 in several tests also decreased survival. However, in one test (table 2), 2-0 white fir treated with a combination of Rutex MCT and Rutex W-3 survived better than the other treatments. This treatment bears further investigation on 1-0 and 2-0 white fir.

   c. Jeffrey pine 2-0, with roots dipped in Rutex 59 and packed in an open-end bundle without a packing medium, planted after seven days shipping, survived as well as the control packed with shingle-tow.

2. The poly-coated kraft bags improved survival significantly only in one of two studies (table 3 and fig. 2). However, in the one showing no improvement, other variables may have confounded results. One replication in one study varied considerably from the other four, for no discernible reason.

Survival of 2-0 Douglas-fir shipped in polycoated bags (fig. 2), was signigficantly less than in open-end bundles. Interaction of age and packaging method in this study was highly significant. This perhaps indicates that when Douglas-fir seedlings are shipped for seven days, open-end bundles are less satisfactory than poly-coated bags for 1-0, but more satisfactory than bags for 2-0.

3. Survival of 1-0 and 2-0 Douglas-fir seedlings packed in poly-coated bags and open-end bundles showed no significant age class differences.

4. White fir survived poorly, indicating we need to know more about handling this species.

5. Jeffrey pine survived well in most treatments. Because of this hardiness the species is no longer used in reforestation studies where survival is being tested.

6. TufHex, used as a moisture-retaining medium around roots of Douglas-fir seedlings packed in poly-coated bags, was significantly superior to shingle-tow and no medium.

7. As might be expected, the physiological condition of 1-0 ponderosa pine and white fir was not suitable for lifting from the Magalia Nursery as late as June 10 (table 4). Survival of freshly lifted seedlings, even though planted immediately from the seed beds, was very poor.

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