Packing Methods Studied for Australian Toon and Slash Pine Plantings

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The Hawaii Division of Forestry packs seedlings intended for shipment in sphagnum moss and plastic. Large amounts of moss have been harvested from the mountain swamps and frequent dry spells make regrowth slow. Because moss is expensive to obtain and the supply is dwindling, an alternative packing method is needed.

Kraft-polyethylene (K-P) bags offer some advantages over moss and plastic packing. They can be transported in open trucks provided the weather is not unusually warm. They are dry, and easy to label, carry, and store. Partially emptied bags can be closed to protect the seedlings (1). The need for heeling-in-provided the bags are kept in a shady cool place-may be eliminated.

Seedlings packed in K-P bags have been successfully planted for several species including four conifers: slash pine (2), Douglas-fir (3), ponderosa pine (3), and loblolly pine (4, 5). We know of no reports of seedlings of hardwood species being successfully planted from bags.

This article discusses some results of planting slash pine *(Pinus elliottii)* and Australian toon *(Toona australis)* seedlings packed in K-P bags and in sphagnum moss and plastic.

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Methods

Typical State Tree Nursery stock of Australian toon and slash pine seedlings were used in our study. The 360 seedlings of each species were randomly divided into six groups of 60 seedlings each. Two groups of each species were packed using one of three methods : (1) Sphagnum and clear plastic (control) ; (2) K-P bags without moss; and (3) K-P bags with a handful of wet moss. Seedlings were planted on nursery and field sites.

Australian Toon

Australian toon seedlings were planted in the Division's nursery in Hilo and on the Waiakea Forest Reserve-both on the island of Hawaii. The nursery site is 40 feet in elevation, and has about 140 inches of rain annually. The imported soil is about 6 inches deep over coral rockfill. The field site is at 2,860 feet elevation. Annual rainfall varies widely, averaging about 200 inches. Aspect is northeast. Slope varies from 1 to 35 percent. The soil type is Kiloa extremely stony, mucky silt loam.

Slash Pine

The slash pine seedlings were planted at the University of Hawaii Experiment Station nursery and on the Puu Ka Pele Forest Reserveboth on the island of Kauai. The nursery site is about 400 feet elevation and has about 65 inches of rain annually. The soil is a silt loam. The Forest Reserve is about 2,900 feet elevation with annual rainfall averaging 45 inches. Aspect is southwest. Slopes are about 10 percent. The soil type is Mahana silt loam.

The Experiment

The experimental design was identical at the four sites. Each site consisted of four blocks, with three row-plots within each block. In each row-plot, 15 trees packed by the same method were planted.

The Australian toon seedlings were examined at the time of planting and again after 1 and 2 months at the nursery site and after 1, 2, 6, and 12 months at the field site. Slash pine seedlings were examined according to the same schedule, except they were also checked after 4 months at the field site. Seedling height, vigor, and dieback were recorded.

Results and Discussion

Australian Toon

Nursery site.-Seedlings were planted 1 day after being packed. The weather was hot and sunny. The soil was moist. When planted, the seedlings packed in K-P bags looked much fresher than those packed in moss and plastic. However, about half an hour after planting, all seedlings had begun to wilt.

Two months after planting, seedling survival exceeded 90 percent for each packing method (table 1). The slight differences were not statistically significant. Almost all live seedlings were growing, but they averaged 2 to 4 inches less in height than when they were planted. I attribute this height difference to stem dieback.

Field site.-Seedlings were planted 3 days after being packed. The weather was hot and sunny, and the soil was dry. Seedlings packed in the K-P bags were fresher than those packed in moss and plastic. Again, there was no distinction after planting between seedling condition and packing method-all were severely wilted. Sufficient rain fell after planting so that after 2 months, results were similar to those at the nursery site. The generally harsher conditions on the field site eventually caused survival and vigor to be lower, and dieback and height differences to be greater (table 1).

One year later, the seedlings packed in moss and plastic had a better survival rate, were taller, and had a higher percentage growing than did seedlings packed in the K-P bags. Large between-block variations masked statistical significance of any differences. Variation in survival between blocks was much less for seedlings packed in moss and plastic than for those packed in K-P bags.

	Percent Survived	
	High	*Low*
Moss and plastic	93	73
K-P bag without moss	87	47
K-P bag with moss	93	40

Dieback that occurred on all seedlings was still evident on most stems after 1 year. All seedlings averaged about half their original height (table 1).

Under field conditions, seedlings packed in moss and plastic had better survival rates and were generally more vigorous than those packed in the K-P bags, with or without moss.

TABLE 1.—*Survival, height, and vigor of Australian toon seedlings packed by three methods and planted on nursery and field sites*

Packing methods	NURSERY SITE									
	Survival		Height						Vigor	
			0 month		2 months		12 months			
	2 mo.	12 mo.	Av.	Range	Av.	Range	Av.	Range	2 mo.	12 mo.
	Percent	*Percent*	*Ins.*	*Ins.*	*Ins.*	*Ins.*	*Ins.*	*Ins.*	*Percent Growing*	*Percent Growing*
Moss and plastic	98	—	19	11-26	17	5-29	–	—	100	—
Kraft-polyethylene bags without moss	91	—	17	11-21	13	4-19	–	—	98	—
Kraft-polyethylene bags with moss	93	—	16	10-24	13	3-21	–	—	100	—
	FIELD SITE									
Moss and plastic	95	81	16	11-25	9	2-20	8	2-18	81	88
Kraft-polyethylene bags without moss	83	61	17	10-25	8	2-15	6	2-19	64	79
Kraft-polyethylene bags with moss	88	60	15	10-23	8	1-21	7	2-16	57	75

Slash Pine

Nursery site. - Seedlings were planted 1 day after being packed and watered immediately. The weather was warm and partly cloudy and the soil moist. Any differences in condition before or after planting between seedlings packed in moss and plastic and those packed in K-P bags were not visible. Seedlings were cool and moist when taken from the K-P bags for planting, but only the roots of the regularly packed seedlings were cool and moist.

Four months after planting there were still no differences in survival, height, or vigor among seedlings packed by the different methods (table 2).

Field site.-Seedlings were planted 2 days after being packed. The weather was warm and sunny, and the soil moist. Seedlings packed by the different methods were similar in condition before and after planting.

After 4 months, seedlings packed in moss and plastic showed little effect of the, dry weather that followed planting. Ninety percent of them had survived (table 2), but only 40 percent of those packed in K-P bags were alive. Wet moss in K-P bags failed to improve survival. Of the seedlings surviving, about 85 percent of those packed in moss and plastic and those packed in K-P bags without moss were growing (table 2). Seedlings packed in K-P bags with moss, for some unknown reason, had only 42 percent growing.

A year after planting, seedling survival and vigor for the different packing methods was about the same as after 4 months, except that vigor of seedlings packed in K-P bags with moss improved (table 2).

The survival of slash pine seedlings packed in K-P bags and planted on a nursery site was similar to that reported for field plantings of seedlings packed in K-P bags on the mainland (2). Field plantings of slash pine seedlings packed in K-P bags resulted in 50 percent lower survival rate than for those packed in moss and plastic. The nursery site plantings had ample moisture; the field site plantings were subjected to an extended dry spell. Apparently, the seedlings packed in moss and plastic were better able to withstand this dry period.

Conclusions

Packing Australian toon and slash pine seedlings in K-P bags, with or without moss, does not appear to be a practical alternative to packing seedlings in moss and plastic. More research is needed to develop a packing method that will reduce or eliminate the amount of sphagnum moss now used at the Hawaii Division of Forestry Nursery.

Literature Cited

1. Duflield, John W., and Rex P. Eide
   1959. Polyethylene bag packaging of conifer planting stock in the Pacific Northwest. J. Forestry 57: 518-519.
2. Hammer, J. G., and F. S. Broerman
   1967. A comparison of three packaging methods, for slash pine seedlings. Tree Planters' Notes 18(4): 3-4.
3. Lanquist, K. B., and J. H. Doll
   1960. Effect of polyethylene and regular packing methods on ponderosa pine and Douglas-fir seedlings stored over winter. Tree Planters' Notes 42:29-30.
4. Ursic, S. J.
   1963. Kraft-polyethylene bags recommended for packaging and storing loblolly seedlings. Tree Planters' Notes 57: 23-28.
5. Williston, Hamlin L.
   1965. Moss not needed in Kraft-polyethylene bags during loblolly pine seedling transport and cold storage. Tree Planters' Notes 72:10-11.

TABLE 2.—*Survival, height and vigor of slash pine seedlings packed by three methods and planted on nursery and field sites*

Packing methods	NURSERY SITE									
	Survival		Height						Vigor	
			0 month		4 months		12 months			
	4 mo.	12 mo.	Av.	Range	Av.	Range	Av.	Range	4 mo.	12 mo.
	Percent	*Percent*	*Ins.*	*Ins.*	*Ins.*	*Ins.*	*Ins.*	*Ins.*	*Percent Growing*	*Percent Growing*
Moss and plastic	88	—	13	9-17	16	8-21	—	—	94	—
Kraft-Polyethylene bags without moss	90	—	12	7-16	14	9-22	—	—	91	—
Kraft-polyethylene bags with moss	95	—	13	8-20	16	9-26	—	—	91	—
	FIELD SITE									
Moss and plastic	90	90	12	8-17[1]	16	9-22	20	12-28	87	98
Kraft-polyethylene bags without moss	40	40	13	8-17[1]	15	8-21	18	12-25	83	96
Kraft-polyethylene bags with moss	43	37	13	8-19[1]	13	8-20	18	6-27	42	100

[1]Cattle clipped off most of the terminals.