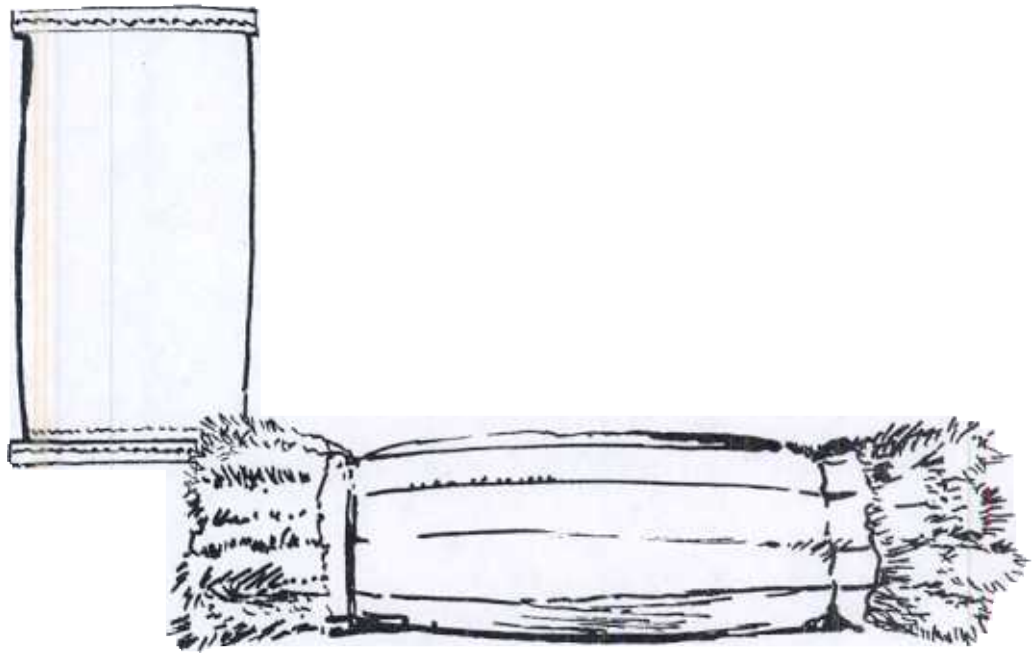




KRAFT BAGS Vs. CONVENTIONAL PACKAGING

EFFECTS ON SURVIVAL



SURVIVAL OF LOBLOLLY PINE SEEDLINGS PACKED IN KRAFT PAPER BAGS
COMPARED TO CONVENTIONAL PACKAGING

By: T. A. Dierauf and J. W. Garner

ABSTRACT

This is a report on two separate studies installed in the Spring of 1970. The purpose of these studies was to compare survival of loblolly pine seedlings packed in kraft paper bags ^{1/} with seedlings packed in conventional packages. ^{2/}

In one study, seedlings were stored four weeks in an unheated garage and then half of the seedlings were stored an additional two weeks in an open shed before planting. Seedlings were lifted on two different dates. Overall survival (averaging storage periods and lifting dates) of seedlings from conventional packages was 7 percentage points higher than seedlings from bags.

In the other study, unopened seedling packages and bags were exposed to the sun at the planting site for periods of 0, 2, 4 and 6 hours before planting. This was done on three different dates. Survival of seedlings from bags (averaging exposure periods) was 3 and 5 percentage points higher on two of the planting dates and three points lower on the third planting date.

SURVIVAL AFTER 4 and 6 WEEKS STORAGE

Description of Study

Seedlings were lifted and packed on two different dates to give 8 treatments:

<u>Lifted</u>	<u>Packaging</u>	<u>Garage Storage</u>	<u>Additional Shed Storage</u>	<u>Planted</u>
	Bag	4 weeks	0	3/1
	Bag	4 "	2 weeks	3/15
	Package	4 "	0	3/1
	Package	4 "	2 weeks	3/15
	Bag	4 weeks	0	4/1
	Bag	4 "	2 weeks	4/15
	Package	4 "	0	4/1
	Package	4 "	2 weeks	4/15

1/ Three ply, kraft paper seedling bags were used. Seedling roots were dipped in water before packing in bags, but no packing material was added.

2/ Roots dipped in kaolin clay slurry, wrapped in absorbent paper, wrapped in waterproof paper, reinforced with veneer slats, and finally, strapped.

The seedlings for the study were lifted from a uniform section of seedbed. On each lifting date, enough seedlings were lifted to pack 2 bags and 2 conventional packages for each storage period, a total of four bags and four packages on each lifting date. Each bag and package contained 1,000 seedlings.

Seedlings were planted on two tracts, one in the central Piedmont on the Buckingham State Forest and the other in the northern Coastal Plain in the Tappahannock District. The seedlings were stored in unheated garages for the first 30 days after lifting; the seedlings for the Coastal Plain planting were stored at the Tappahannock District office and the seedlings for the Piedmont planting at the Farmville District office. Minimum and maximum temperatures were recorded on weekdays during storage in the garages and later in the open sheds (see Table 1). In the open sheds, temperatures dropped below freezing on about half the days between March 1 and 15 and on about one-third of the days between April 1 and 15.

Table 1. Range in daily minimum and maximum temperatures in garages and open sheds (degrees Fahrenheit).

<u>Lifted</u>		<u>Range in Daily Temperatures</u>			
		<u>30 days in garage</u>		<u>15 days in open shed</u>	
		<u>Min.</u>	<u>Max.</u>	<u>Min.</u>	<u>Max.</u>
February 1	Piedmont	32-44	40-68	12-38	48-66
	Coastal Plain	30-47	44-62	14-41	49-77
March 1	Piedmont	35-49	42-58	24-52	50-82
	Coastal Plain	34-48	44-54	28-51	57-87

On each tract, the 8 treatments were replicated 4 times in randomized blocks. A block consisted of a 20 seedling row of each of the 8 treatments. The total number of seedlings planted was 1,280: 2 tracts x 8 treatments x 4 blocks/tract x 20 seedlings/treatment/block.

There were 80 seedlings planted from each bag and package, 4 rows of 20 seedlings each. Each bag and package contained 20 bundles of 50 seedlings. A single seedling was randomly taken from each of the 20 bundles to obtain the seedlings for a 20 seedling row.

Condition of Seedlings When Planted

When the bags were opened after a month of garage storage, water was standing in the bottom of each bag. Seedlings on the bottom were wet, while seedlings on top appeared to be dry. After two additional weeks of storage in the open shed, there was no water standing in the bags and the seedlings were very dry, some were brittle.

Seedlings in the conventional packages also appeared to be dry after a month of garage storage (it was difficult to compare them with the bag-stored seedlings because of the great variation in the bags from top to bottom). After another two weeks of storage in the open shed, the seedlings were very dry, but not brittle.

Results

Survival after two growing seasons is presented in Table 2.^{3/} Overall survival (averaging lifting dates and storage times) was 7 percentage points higher for seedlings packed in conventional packages, but the difference was not statistically significant. The additional two weeks of storage in an open shed reduced survival considerably, 34 percentage points for the February 1 lifting and 10 points for the March 1 lifting (averaging packaging methods).

Table 2. Average survival percent after 2 growing seasons, combining both tracts.

<u>Lifted</u>	<u>Storage</u>	<u>Packaging Method</u>		<u>Means</u>
		<u>Conventional</u>	<u>Bags</u>	
Feb. 1	4 weeks	90	68	79
	6 weeks	43	48	45
	<u>Means</u>	<u>67</u>	<u>58</u>	<u>62</u>
Mar. 1	4 weeks	72	71	72
	6 weeks	66	57	62
	<u>Means</u>	<u>69</u>	<u>64</u>	<u>67</u>
<u>Overall Means</u>		<u>68</u>	<u>61</u>	<u>64</u>

^{3/} Survival percents were transformed to arc sin and an analysis of variance was made. The difference between 4 and 6 weeks storage was significant at the .025 level. The difference between bags and conventional packages and the difference between February 1 and March 1 lifting were not significant. None of the interactions between treatments were significant; the lifting date x storage interaction was the largest, but it was not even significant at the .10 level. The study plan should have provided for more than 2 bags and packages (2 tracts) per treatment.

SURVIVAL AFTER EXPOSURE TO THE SUN

Description of Study

Unopened seedling bags and packages were exposed to the sun at the planting site for 0, 2, 4 and 6 hours, giving 8 treatments;

Bags	0 hours exposure
	2 " "
	4 " "
	6 " "
Packages	0 hours exposure
	2 " "
	4 " "
	6 " "

This study was installed 3 times: on March 17, April 3 and April 29. Seedlings for all 3 dates were lifted from a uniform section of a seedbed on March 13 and packed the same day. A total of 12 bags and 12 packages were packed, 1 bag and 1 package for each exposure period on each date. Each bag and package contained 1,000 seedlings. The bags and packages were kept in cold storage ^{4/} until they were planted.

On each date, the 8 treatments were replicated 4 times in randomized blocks. A block consisted of a 20 seedling row of each of the 8 treatments. The total number of seedlings planted on each date was 640; 8 treatments x 4 blocks x 20 seedlings/treatment/block. The 3 different plantings (planting dates) were installed adjacent to each other on the same tract.

The planting site was a well drained soil on the Buckingham State Forest in the central Piedmont of Virginia. The site was prepared by drum-chopping followed by prescribed burning.

4/ *Temperatures in the cold storage unit averaged around 38 degrees Fahrenheit and ranged from about 34 degrees at night to perhaps 45 degrees at times during the day when seedlings were being put in and taken out.*

Sunny, seasonably-warm days were selected for planting. Planting, and exposure, started at 9:30 A.M. on each planting date. Temperatures adjacent to the exposed bags and packages were recorded. A small hole was made in each of the bags to be exposed, a thermometer was laid on top of the seedlings inside the bag, and the hole was then taped shut. The bags were set upright. When the bags were opened after the proper exposure period, the temperature inside the bag was recorded. Temperatures are given in Table 3.

Table 3. Temperature (degrees Fahrenheit) at the planting site.

<i>Planting Date</i>	<i>Time</i>	<i>Hours Exposure</i>	<i>Air Temperature</i>	<i>Temperature In Bag</i>
17	9:30	0	38	
	11:30	2	43	70
	1:30	4	48	72
	3:30	6	48	61
	9:30	0	53	
	11:30	2	59	77
	1:30	4	64	79
	3:30	6	65	69
29	9:30	0	71	
	11:30	2	79	87
	1:30	4	84	105
	3:30	6	82	97

Condition of Seedlings after Exposure

Air temperatures inside the exposed bags never reached lethal levels, but the seedlings near the top and on the side toward the sun felt warm to the touch when the bags were opened at 1:30 and 3:30 on April 3 and 29. The seedlings also dried out around the outside, staying moist in the interior.

In the conventional packages, the seedlings also got warm to the touch around the top and side facing the sun. On April 29 the needles had started to turn yellow-green by 1:30 and were quite yellow-green by 3:30.

Results

Survival after two growing seasons is presented in Table 4. ^{5/} Overall differences between bags and conventional packages (averaging exposure periods) were not statistically significant for any of the three planting dates. Survival decreased with increasing exposure for all three planting dates, with two notable exceptions that cannot be explained:

1. Unexpectedly high survival of seedlings from the bag after four hours exposure on April 3.
2. Unexpectedly high survival of seedlings from the conventional package after four hours exposure on April 29.

The average reduction in survival (averaging packaging methods) after six hours exposure was 11, 22 and 28 percentage points for March 17, April 3 and April 29, respectively.

Table 4. Survival percent after two growing seasons

Planting Date	Packaging	Hours Exposure				Means
		0	2	4	6	
March 17	Bags	98	95	82	89	91
	Packages	96	88	84	84	88
	Means	97	91	83	86	89
April 3	Bags	64	68	(85)	50	67
	Packages	79	69	51	48	62
	Means	71	68	68	49	64
April 29	Bags	60	41	40	36	44
	Packages	60	38	(64)	28	47
	Means	60	39	52	32	46

() Unexpectedly high survival

^{5/} Survival percents were transformed to arc sin and an analysis of variance was made for each planting. The difference between bags and conventional packages was not significant for any of the three plantings. The effect of exposure was significant for all three dates, at the .05 level for the April 3 planting and the .005 level for the March 17 and April 29 plantings. The interaction between packaging method and exposure was significant at the .05 level for the April 3 planting. (This significant interaction was due to the unexplainable, very high survival of the seedlings from the bag after four hours exposure). The study plan should have provided for more than one bag and package per exposure period for each planting date.