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PRELIMINARY EVALUATION OF PILOT-SCALE CONTAINER PLANTING IN THE FOOTHILLS OF ALBERTA. 1966 PLANTING.

by

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PRELIMINARY EVALUATION OF PILOT SCALE CONTAINER PLANTING IN THE FOOTHILLS OF ALBERTA -- 1966 PLANTING.

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H. J. Johnson[1] and G. Dixon[2]

INTRODUCTION

This report presents the first-year survival results of container stock planted on the lease area of North Western Pulp and Power Limited in 1966. This is the second year of container planting to be assessed in a three-year evaluation covering plantings in 1965, 1966 and 1967. For each year of planting, results are assessed after one and three years. The first-year survival results of the 1965 planting were reported in Regional Information Report A-X-11 (Johnson and Marsh 1967).

The objective of the trials is to evaluate container planting of white spruce (Picea glauca (Moench) Voss var. Albertiana (S. Brown) Sarg.) and lodgepole pine (Pinus contorta (Dougl.) var. latifolia Engelm.) on a variety of sites in the High Foothills Section (Rowe 1959) of the Boreal Forest Region. The results of this study will assist in defining problem

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conditions and in recognizing aspects of container planting requiring further research. A description of the container planting and culturing technique, as developed by North Western Pulp and Power Limited, is included in the earlier report. The same information, but in greater detail, is available in a paper by Carman (1967).

DESCRIPTION OF THE AREA

The planting is being done on the pulpwood lease of North Western Pulp and Power Limited near Hinton, Alberta in the High Foothills Section of the Boreal Forest Region (Rowe 1959) at elevations of from 4000 to 5000 feet. The surface soils are generally light textured loams of glacial colluvial or alluvial origin, those on a relatively small portion of the lease area are tills that are capped by aeolian silts and sands.

Competition from vegetation is not generally severe in this region, but after logging the well-drained sites develop a moderate grass-herb cover which seems to benefit seedling establishment on exposed slopes. Competition from heavy grass is generally significant only on cool, moist sites that have abundant surface moisture, and shrub competition is usually confined to the cool slope sites that have telluric moisture.

The climate of the lease area is continental, with summer highs and winter lows of precipitation, and summer precipitation is generally well distributed. Table 1 shows the temperatures and precipitation for May to August for 1958 to 1967.

TABLE 1: MEAN TEMPERATURE AND PRECIPITATION AT HINTON, ALBERTA.

Year	Mean Temp. F.				Precipitation - Inches				
	May	June	July	Aug.	May	June	July	Aug.	Total
1958	52	54	60	59	.52	4.09	2.24	1.73	8.58
1959	46	57	61	53	2.13	5.68	1.34	5.62	14.77
1960	44	52	63	56	4.54	6.95	1.13	4.85	17.47
1961	49	60	61	60	2.68	1.61	5.45	1.78	11.52
1962	45	54	57	56	2.22	2.62	3.48	1.83	10.15
1963	46	54	59	59	1.12	0.28	2.59	3.24	7.23
1964	46	55	58	54	2.18	2.91	2.16	2.87	10.12
1965	47	54	59	61	2.14	6.56	5.45	5.93	20.08
1966	48	51	57	55	4.00	1.51	4.26	6.82	16.59
1967	50	53	57	56	0.54	0.86	3.32	2.87	7.59
Mean (10 yrs.)	47	54	59	57	2.21	3.31	3.14	3.75	12.41

SAMPLING METHODS AND ANALYSES

Sixty-three plots were established, each of 100 seedlings usually in 10 rows of 10. A minimum of three plots were made for each of the major conditions planted. The site characteristics of individual plots were described as follows:

Soil fabric - on the basis of North Western Pulp & Power Ltd. landform classification.

Depth to mineral soil - according to 4 classes: 0 - 1", 1 - 3", 3 - 6", 6"+.

Local climate - based on a composite evaluation of slope, aspect and topographic position.

Surface textures (i.e., the top 6 inches of mineral soil) - sand, loamy sand, sandy-loam, silt, silt-loam, and clay.

Moisture regime - dry, normal, moist and wet (after Hills, 1952).

Competing vegetation - grass, herbs and shrubs in three density classes.

The logging history and kind of seed-bed treatment are included in each site description. The ratings of moisture regimes, local climate and vegetative competition were subjective and must be presumed to have significance only to the range of conditions characteristic of the lease area. The plots are examined for seedling mortality and survival one and three years after establishment, and obvious causes of mortality and injury are noted.

FIRST-YEAR RESULTS

Survival

While the first-year survival of 1966 plantings was lower than for 1965 plantings, the results must be considered encouraging in view of the exceptionally dry summer (Table 1). Average survival was 65 percent for spruce and 71 for pine. By comparison, the first-year survival for 1965 plantings was 81 percent for spruce and 80 for pine. The distribution of plots in the various percentage survival classes is shown in Table 2.

TABLE 2: PERCENTAGE DISTRIBUTION OF PLOTS IN VARIOUS PERCENTAGE SURVIVAL CLASSES - 1966 PLANTINGS.

Species	Percentage Survival Class				
	0 - 20	21 - 40	41 - 60	61 - 80	81 - 100
White Spruce	0	7.7	25.6	46.2	20.5
Lodgepole Pine	0	0	29.2	50.0	20.8

The first analysis of 1965 planting data showed no well-defined trends that could be associated with site at the end of one year. However, analyses of 1966 planting data indicate some correlation between the various site factors and first-year survival. This could be a reflection of the 1967 drought which undoubtedly allowed a greater expression of site factors than would normally be expected after one year. Seedling survival in relation to site factors are discussed below.

1. Aspect

While limited data precludes an analysis on the basis of the four cardinal directions, there appears to be a relationship between aspect and first-year survival Fig. 1. Groupings of northerly and southerly aspects for the spruce plantings provide averages which are significantly different at the 10 percent level. A similar grouping of pine plantings shows significant differences at the five percent level.

2. Moisture regime

Figure 2 presents the average percent survival by moisture regime classes for spruce and pine. A statistical analysis of these data for spruce indicates significant differences at the 5 and 1 percent levels, respectively, for 0 - 1 and 4+ classes compared to the 2 - 3 class. An analysis was not possible for pine as all plots are within one moisture regime class. There was no significant difference between average survival of the 0 - 1 and 4+ class for spruce. Survival for these classes averaged approximately 15 percent lower than the 2 - 3 class.

While lower average survival might be anticipated on the driest site

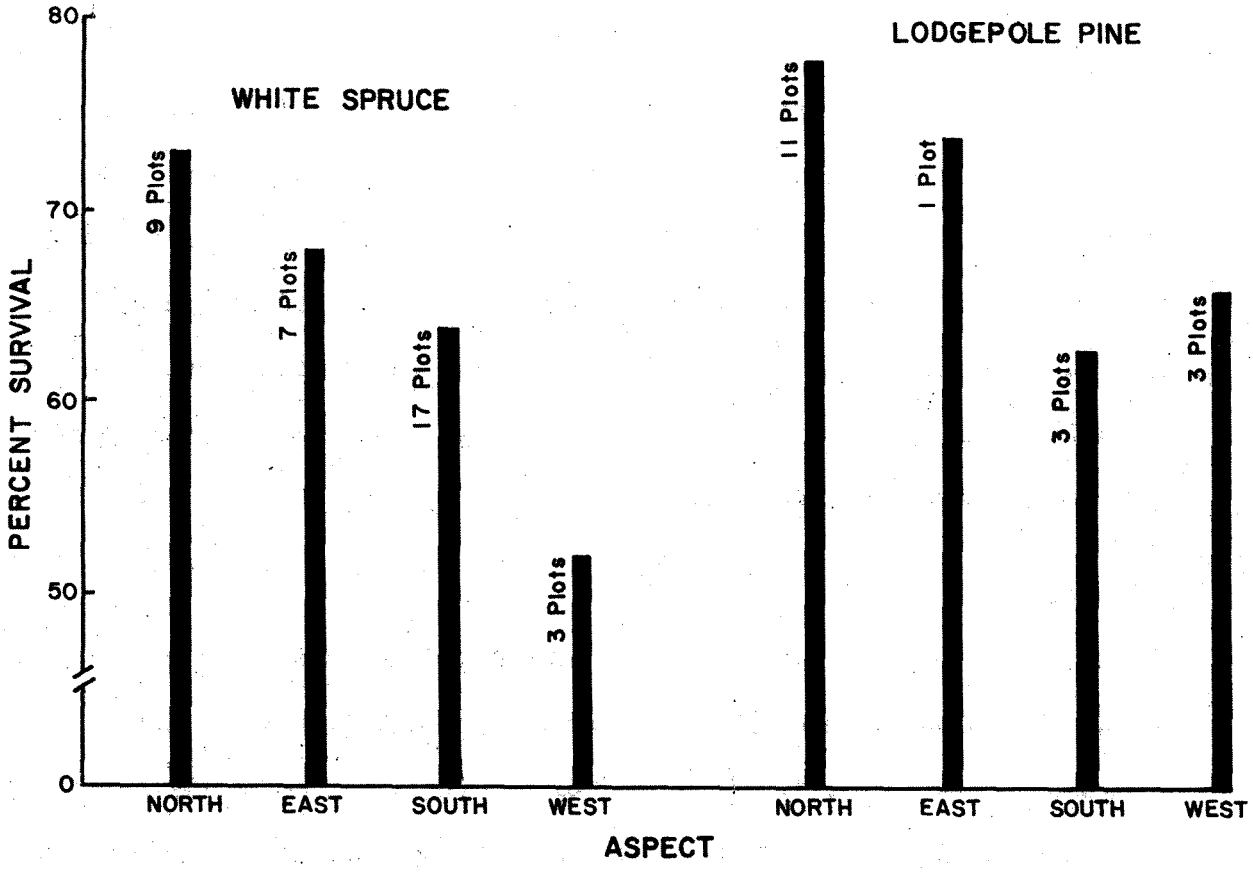

Figure 1. SURVIVAL PERCENT RELATED TO ASPECT

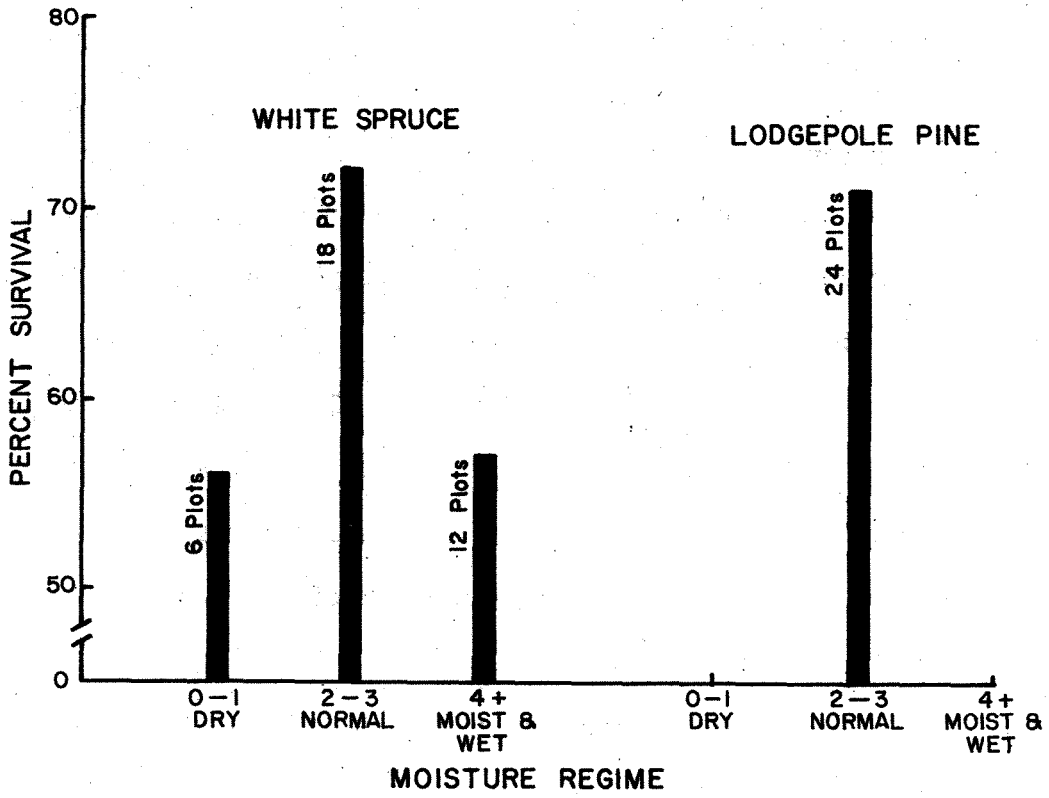

Figure 2. SURVIVAL PERCENT RELATED TO MOISTURE REGIME

(0 - 1), the equally low average survival on moist and wet sites (4+) was unexpected. By way of partial explanation, moist and wet sites have a relatively deep duff layer which in 1967 became exceedingly dry to well below the bottoms of containers. This could have accounted for the relatively low first-year survival of spruce on moist and wet sites. Assuming that 60 percent survival after one year is the lowest desirable stocking, the results shown in Table 3 are of interest.

TABLE 3: PERCENTAGE OF PLOTS LESS THAN 60 PERCENT STOCKED.

Moisture Regime Class	Percentage of Plots Less Than 60 Percent Stocked
0 - 1	33
2 - 3	16
4+	50

3. Logging date

The date of logging and scarification had little effect on initial survival. Where scarification had been conducted this treatment had occurred from one to three years after logging.

4. Depth to mineral soil

The depth to mineral soil was not strongly correlated with first-year survival, but there was some evidence to suggest that deep-duff sites may be critical in drought years when undecomposed organic materials become exceedingly dry.

5. Vegetative competition

Limited data were available to analyze survival on the basis of the nine possible classes of vegetative competition. The majority of the 1966 plots were established in the grass vegetative type. There is some evidence that heavy grass enhances first-year survival of spruce (Fig. 3).

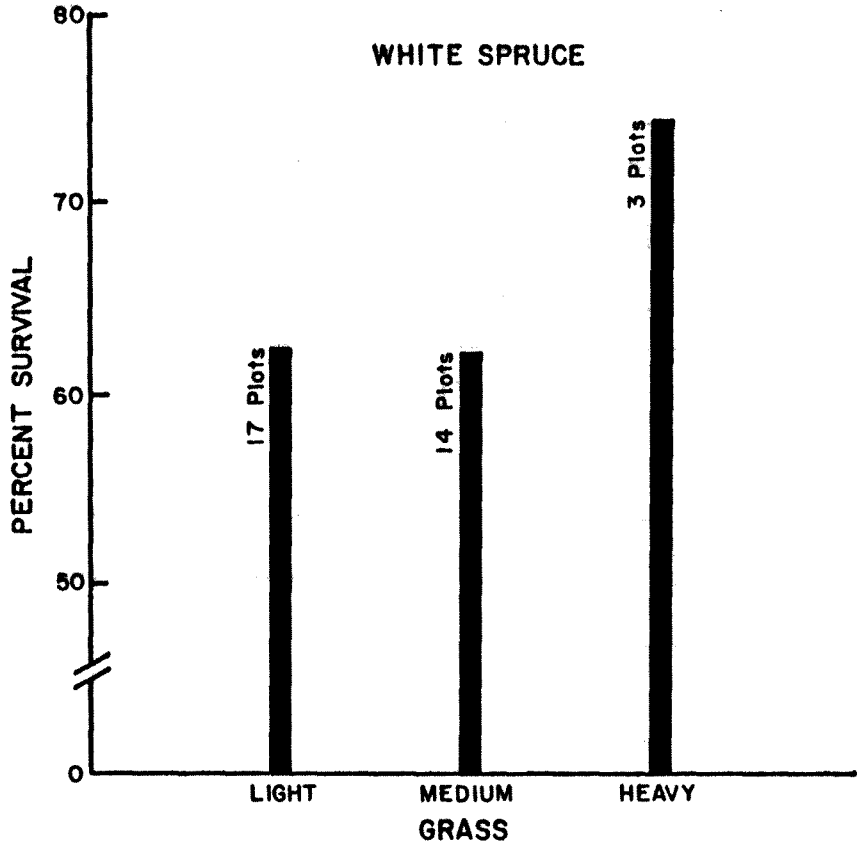

Figure 3. PERCENT SURVIVAL IN SRUCE RELATED TO GRASS VEGETATIVE TYPE

6. Confounding factors

Large-scale trials usually preclude uniformity of stock and planting quality, and this can obscure relationships between survival and site. With this in mind, individual case histories were discussed with the forestry staff of North Western Pulp and Power Limited in an attempt to rationalize planting successes and failures.

Low survival could often be attributed directly to either poor planting or low quality of container stock. This was particularly evident in cases where three replicate plots were chosen for discussion, and where for no apparent reason the first-year survival on one plot was significantly different from that on the others.

Appendix I is a list of plots established in 1966, by logging camp location, showing first-year survival results. Replicates are grouped and pertinent remarks are made on the basis of discussions with North Western Pulp and Power Limited personnel who directed and supervised the planting operations.

Mortality and injury

An assessment of mortality and injury, by species and logging camp location, is provided in Table 4 which shows that undetermined factors were responsible for about one-half of the total mortality of both spruce and pine.

Smothering, trampling and frost appeared to have been the most important individual causes of mortality in spruce, frost and smothering were most important in pine. In many cases smothering of both species had re-

TABLE 4: PERCENTAGE MORTALITY AND INJURY IN 1967 TO WHITE SPRUCE AND LODGEPOLE PINE SEEDLINGS PLANTED IN 1966.

CAMP	WHITE SPRUCE																																			
	AGENT OF MORTALITY OR INJURY																																			
	Trampling			Smothering			Frost Heaving			Poor Planting			Frost Damage			Container Empty			Container Missing			Unknown			All		
	D[1]	I[2]	D+I	D	I	D+I	D	I	D+I	D	I	D+I	D	I	D+I	D	I	D+I	D	I	D+I	D	I	D+I	D	I	
1	2	-	2	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	5	-	5	15	-	15	24	-	
6	3	-	3	3	-	3	-	-	-	1	-	1	3	-	3	7	-	7	6	-	6	22	-	22	45	-	
7	-	-	-	3	-	3	-	-	-	1	-	1	2	-	2	-	-	-	-	-	-	13	-	13	19	-	
13	11	-	11	7	-	7	1	-	1	-	-	-	4	-	4	-	-	-	5	-	5	14	-	14	42	-	
29	5	-	5	8	-	8	3	-	3	2	-	2	6	-	6	1	-	1	4	-	4	15	-	15	44	-	
33	5	-	5	10	-	10	-	-	-	1	-	1	8	-	8	-	-	-	2	-	2	20	-	20	46	-	
MEAN	4	-	4	5	-	5	1	-	1	1	-	1	4	-	4	1	-	1	3	-	3	16	-	16	35	-	
	LODGEPOLE PINE																																			
7	-	-	-	3	-	3	-	-	-	-	-	-	2	-	2	-	-	-	-	-	-	10	-	10	15	-	
20	1	-	1	3	-	3	-	-	-	-	-	-	6	-	6	-	-	-	2	-	2	10	-	10	22	-	
23	1	-	1	5	-	5	-	-	-	2	-	2	2	-	2	-	-	-	1	-	1	20	-	20	31	-	
33	4	-	4	6	-	6	-	-	-	2	-	2	6	-	6	-	-	-	-	-	-	20	-	20	38	-	
7+29	1	-	1	5	-	5	2	-	2	-	-	-	10	-	10	2	-	2	2	-	2	17	-	17	39	-	
MEAN	1	-	1	4	-	4	-	-	-	1	-	1	5	-	5	-	-	-	1	-	1	16	-	16	29	-	

1 - DEAD

2 - INJURED

sulted from deep planting. Trampling of the 1966 planting by horses and game was significantly lower than in 1965 plantings. It is possible that many of the containers which were thought to have been damaged by trampling had actually been shattered as the result of solar radiation. Shattering of containers due to the hot, dry summer of 1967 was quite common (see photographs, Appendix II), but this rarely resulted in seedling mortality or damage.

Poor planting was a relatively minor factor in mortality as the result of intensified supervision in 1966.

Effect of more than one seedling per container

The number of seedlings per container in 1966 varied from 1 to 4, mostly 1 to 2. Figure 4 shows the relationship between seedling survival and the number of seedlings per container. There were insufficient samples of containers with more than 2 seedlings to analyze statistically but the difference between one and two seedlings per container was highly significant for both spruce and pine at the .001 level. The advantage of more than one germinate per container is clear, particularly when drought occurs in the year following planting, but the optimum number of seedlings per container is unknown. The over-riding effects of the number of seedlings per container, over factors of the environment, are evident in Table 5. Almost without exception when the percentage of multiple seedlings per container is highest seedling survival is also highest.

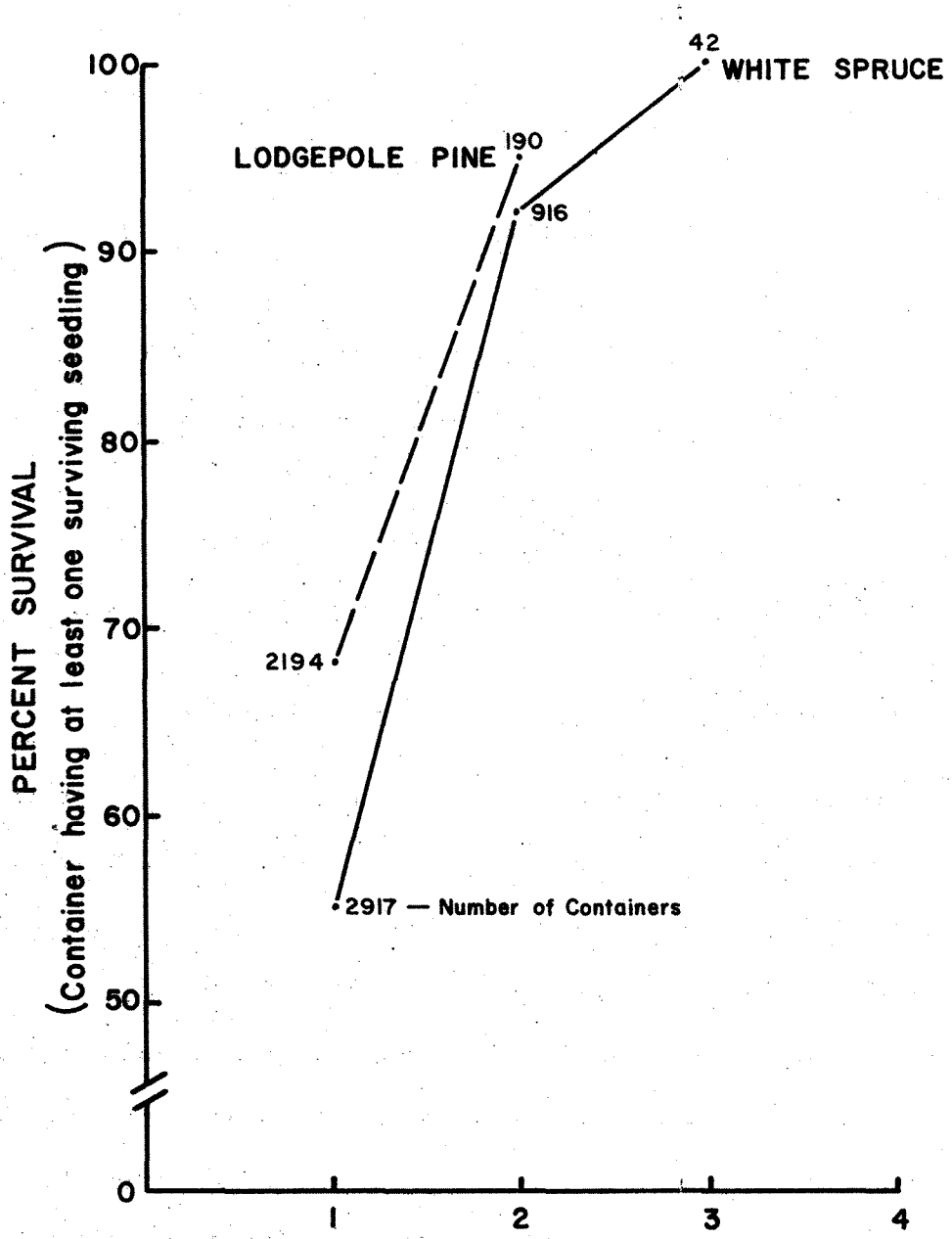

Figure 4. RELATIONSHIP OF INITIAL NUMBER OF SEEDLINGS PER CONTAINER TO SURVIVAL AFTER ONE YEAR

TABLE 5: PERCENTAGE SURVIVAL RELATED TO PERCENTAGE OF CONTAINERS WITH MORE THAN ONE SEEDLING BY CAMP AND SPECIES.

Species	Camp	Percentage of Containers With More Than One Seedling	Percentage Survival
White Spruce	7	38	81
	1	31	76
	13	26	58
	29	14	56
	6	22	55
	33	4	54
Lodgepole Pine	7	17	85
	7-29	13	61
	20	9	78
	23	7	69
	33	2	62

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APPENDIX I

Camp	Plot	Species	No. of Plants	Aspect	% Survival	Remarks
1	1	Sw	98	East	81	
	2	Sw	100	N15E	89	
	3	Sw	99	North	74	
	4	Sw	99	S10W	64	
	5	Sw	98	S55W	69	
	6	Sw	100	N25W	80	
6	1	Sw	100	S18E	60	
	2	Sw	97	S32E	62	Poor planting
	3	Sw	97	S80E	63	
	4	Sw	98	S12W	70	Good moisture
	5	Sw	99	S11W	42	Very poor planting
	6	Sw	100	S15W	32	penalties to cutters
7	1	Sw	100	N14W	86	
	2	Sw	100	N17W	80	
	3	Sw	100	N 6W	86	
	4	Lp	100	Pattern	89	
	5	Lp	100	Pattern	79	
	6	Lp	100	Pattern	86	
	7	Sw	101	S 8E	76	
	8	Sw	100	S10E	89	
	9	Sw	100	S13E	85	
	10	Sw	100	S21E	79	
	11	Sw	100	South	82	
	12	Sw	100	S30E	67	

APPENDIX I - CONT'D

Camp	Plot	Species	No. of Plants	Aspect	% Survival	Remarks
7&29	13	Sw	99	Pattern	79	Good supervision
	14	Sw	99	Pattern	46	Poor supervision
	15	Sw	98	S50W	60	Poor supervision
13	1	Sw	100	N35E	67	
	2	Sw	100	N40E	58	
	3	Sw	100	S E	68	
	4	Sw	100	N44E	55	
	5	Sw	101	N53E	61	
	6	Sw	98	N10E	40	Some poor stock, sun bleached.
20	1	Lp	99	S58W	65	
	2	Lp	97	S65E	74	
	3	Lp	100	S55W	74	
	4	Lp	99	N23E	84	
	5	Lp	99	N30E	85	
	6	Lp	100	N25E	84	
23	1	Lp	97	S20W	58	Extended drought
	2	Lp	100	S19W	77	
	3	Lp	100	S13W	55	
	4	Lp	100	N25E	78	
	5	Lp	100	N30E	74	
	6	Lp	100	N 4E	72	

APPENDIX I - CONT'D

Camp	Plot	Species	No. of Plants	Aspect	% Survival	Remarks
29	1	Sw	100	S30E	57	
	2	Sw	100	S41E	62	
	3	Sw	100	S67E	58	
	4	Sw	100	S63E	68	
	5	Sw	100	S72E	63	Good supervision,
	6	Sw	100	S68E	81	scarified year before.
	7	Sw	101	S 8E	32	Very poor supervision
	8	Sw	98	S45W	42	
	9	Sw	100	S45W	44	
33	1	Lp	100	N.W.	60	
	2	Lp	100	N.W.	69	
	3	Lp	101	N.W.	58	
	4	Lp	100	N.W.	78	
	5	Lp	100	N.W.	48	Poor planting
	6	Lp	100	N.W.	61	
	7	Sw	100	Flat	47	Poor planting
	8	Sw	98	Flat	53	
	9	Sw	98	Flat	61	

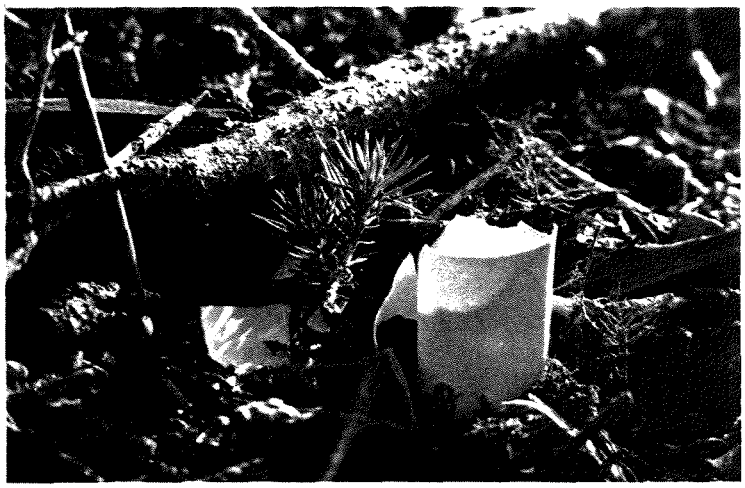
APPENDIX II

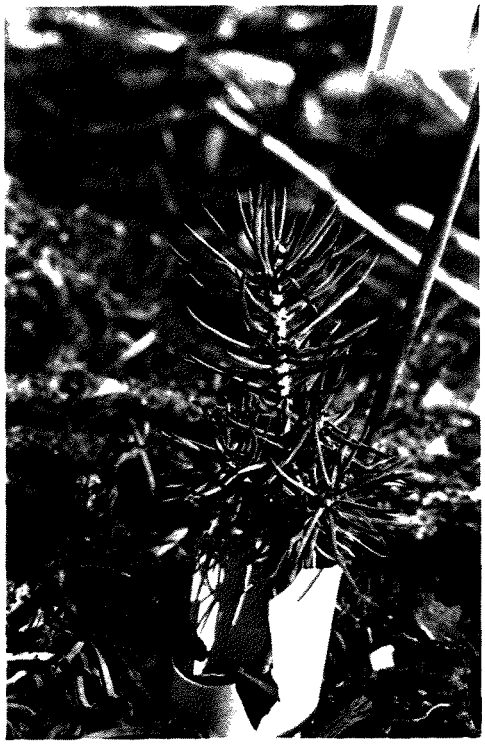
Good growth

Spruce

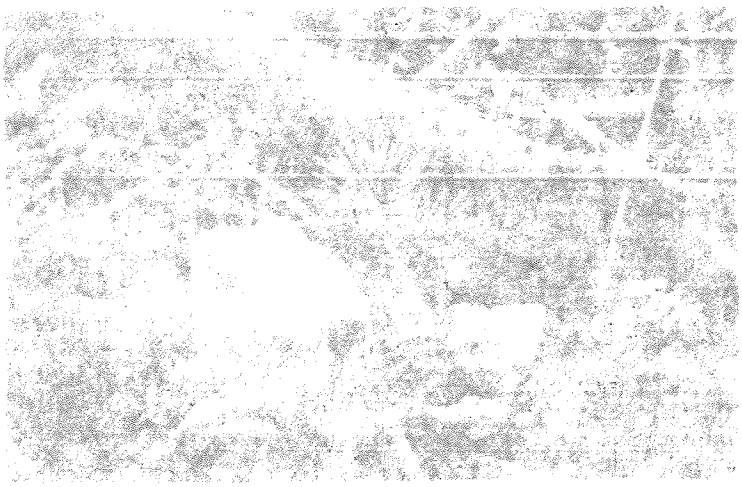
Pine

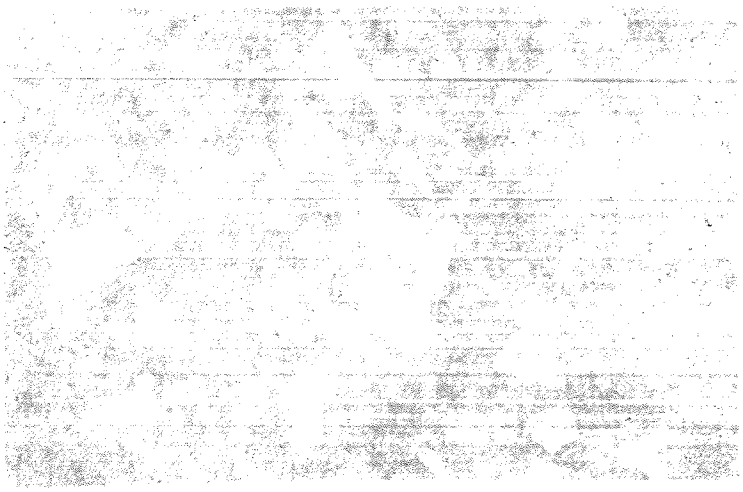
Poor growth spruce





Fragmentation
resulting
from heat





APPENDIX II CONT'D

Frost-heaved containers