EFFECT OF GRAFTED ROOTS OF STUMPS ON THE GROWTH OF A THINNED RED PINE PLANTATION

Pruning stump roots reduced the number of sound stumps with live roots and basal area increment of the remaining stand.

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Casual observations made several years after the thinning of red pine plantations disclosed that some stumps undergo decay and can be easily removed by hand, whereas other stumps remain perfectly sound. Subsequent examinations revealed that the roots of sound stumps are grafted to roots of residual trees while the stumps with ungrafted roots succumbed to fungi *(5)*.

The grafting of tree roots has received attention of several investigators *(1, 2, 3, 4)*, and redistribution of nutrients, as well as eradicants among trees with interlocked root systems, is well established. Our investigation was concerned with the effect of grafted roots of stumps on the growth of residual trees of a thinned red pine plantation. The study was conducted in the Nekoosa Papers, Inc. Industrial Forest, located in Adams County of central Wisconsin.

Materials and Methods

The object of this study, a red pine plantation, was established in the spring of 1949 using 2-2 transplants at 6-by 6-foot spacing. In the spring of 1972, the 27-yearold plantation exhibited a basal area of 135 square feet and an average height of 38 feet, corresponding to site index 60. At this time, two 1½-acre sample plots, surrounded by ½-chain buffer strips, were established. The stands on both plots were thinned by cutting every other row. The east plot served as a control; on the west plot the roots of the stumps were cut or severed with a 2½-foot-long, sharp blade along the cut rows (fig. 1).

Figure 1.—*A view of the thinned plot of 33-year-old red pine plantation with pruned stump roots. Paint marks indicate BH diameters (Nekoosa Industrial Forest, Wis.)*

One important requirement in all studies of the effects of silvicultural treatments is that the results are not influenced by the difference in the productive potentials of soils of the studied areas. In this connection, particular attention must be given to the textural composition of soils and their supply of organic matter, factors that influence interception and retention of water. To ascertain the similarity of soils of the two plots, a 5-foot deep trench was excavated in the center of each plot. These revealed uniform, mildly podzolized sand of glacial outwash. Eight composite soil samples, each of nine 6-inch cores, were collected at random from the entire area of each plot. The results of analyses, given in table 1, reveal a near identity of the two soils. The slightly higher supplies of available phosphorus and potassium in the soil supporting the stand with root-pruned stumps may have resulted from a reduced consumption of the nutrients due to elimination of some active roots, but the difference is of questionable practical significance.

A detailed inventory of both stands was taken following the thinning and again in the spring of 1978. The results are given in table 2. The negative effects of the stump root pruning, assembled in table 3, were calculated with consideration given to the original differences in heights and basal areas of the two stands.

Discussion

The results indicate that the pruning of stump roots had failed to influence the height growth of the stand or to increase significantly the percentage of deteriorated trees. The pruning along the cut rows greatly increased the number of dead, decayed stumps, but did not eliminate root grafting entirely as evidenced by the presence of about 25 percent of live stumps. In spite of this, the pruning decreased the increment of the basal area by about 17 square feet, or 21 percent. The reciprocal gain in the rate of diameter growth of the control stand signifies a pronounced beneficial effect of stumps with grafted roots. The latter may be of particular importance as transmitters of fertilizers applied broadcast to soils of thinned forest stands.

Table 1.—*Composition of soils supporting control stand of red pine and adjacent stand of red pine with pruned stump roots*

Soil Sample no.	Reaction pH	Silt plus clay	Organic matter	Exchange capacity ME/100 g.	Total N	Available P_2O_5	K_2O	Exchangeable Ca	Mg
		percent			*percent*	lbs/A		ME/100 g.	
1	4.7	10	1.60	3.7	.072	121	56	0.75	0.22
2	4.8	11	1.64	3.9	.074	116	56	0.75	0.22
3	5.1	9	1.64	3.5	.074	110	48	1.00	0.22
4	5.1	10	1.70	3.9	.079	116	60	1.00	0.20
5	4.6	9	1.84	3.8	.082	121	48	0.60	0.22
6	4.7	10	1.70	3.9	.079	128	58	0.60	0.19
7	4.3	8	1.70	3.4	.078	88	60	0.50	0.17
8	4.4	9	1.70	3.6	.079	83	70	0.50	0.18
Average	4.7[1]	9.5	1.69	3.7	.077	110.4	57.0	0.71	0.20
				Soils from Root Pruned Stands					
9	4.6	9	1.30	3.3	.064	127	58	0.80	0.22
10	4.7	10	1.20	3.4	.064	132	65	0.70	0.23
11	4.8	8	1.30	3.2	.068	127	58	0.95	0.25
12	4.8	9	1.34	3.4	.070	132	68	0.80	0.25
13	4.5	10	1.80	3.9	.082	121	72	0.70	0.22
14	4.5	9	1.84	3.7	.084	130	78	0.65	0.22
15	4.5	11	1.94	4.2	.089	110	78	0.70	0.23
16	4.5	9	1.84	3.7	.086	116	86	0.70	0.23
Average	4.6[1]	9.3	1.58	3.6	.076	124.4	70.4	0.75	0.23

[1]Medians.

Table 2.—*Effect of stump root pruning on the composition of thinned red pine plantation*

Stand features	Control stand	Stand with root pruned stumps
Composition of thinned stands in the spring of 1972		
Ave. height, ft.	39.7	38.5
Basal area, sq. ft.	66.5	68.9
Number of trees	686	707
Number of stumps	824	923
Composition of thinned stands in the spring of 1978		
Ave. height, ft.	45.0	43.0
Basal area, sq. ft.	147.4	132.9
Number of healthy trees	663	676
Number of deteriorated trees	17	36
Total number of stumps	830	918
Number of live stumps	686	69
Number of dead stumps	144	849

Table 3.—*Changes in the composition of thinned red pine plantation induced by pruning of stump roots*

Stand features	Effect of stump root pruning
Ave. height, ft.	- 0.8
Basal area per plot, sq. ft.	-16.9
Percentage of deteriorated trees	+ 2.7
Percentage of dead stumps	+75

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