

RESEARCH NOTES



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BORROW PIT REFORESTATION

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Introduction

Along the highways of the Upper Peninsula, numerous acres have been stripped for fill, gravel, or crusher rock. Although most pits are of limited size (less than 40 acres), the sum total of the area concerned amounts to thousands of acres. Pits immediately adjacent to a highway usually are graded, or otherwise dressed, but pits more or less hidden from view ordinarily remain ugly scars. Usually they are of little further value to the owner. Graded or not, pits often do not become restocked by the forest tree species adjacent to them and may remain bare of any forest trees for a very long time. Some pits have not become reforested after more than 50 years.

It is recognized that a gravel mineral deposit on an acre of land is an essential commodity more valuable than the timber the same acre could produce in many years. Nevertheless, it is also true that the acre must remain in someone's ownership, whether public or private, after the mineral deposit is exhausted, and in case of private lands, taxes will be assessed against it. The question, therefore, concerns how best to make the land productive again. To test the feasibility of reforesting such an area, a Ford Forestry Center "borrow pit" was planted with a variety of tree species, native and introduced, to determine which were best adapted for growth on coarse gravelly materials from which topsoil had been stripped.

Study Area

The "borrow pit" is located in the northeastern corner of the NW 1/4 of the NE 1/4, Section 18, T49N, R33W, on Ford Forestry Center property. It lies immediately adjacent to old U.S. 41. Originally it comprised about a half acre and provided fill for the construction of highway U.S. 41 in the 1920's.

In 1957 about 4000 cubic yards of crushed rock was produced by the Caspian Construction Company, of Caspian, Michigan, to blacktop the streets of L'Anse. In 1958 the Caspian Construction Company, produced approximately 15,000 tons of material for road shoulders. In 1959, the Baraga County Road Commission removed approximately 5,000 cubic yards of crushed rock. This activity enlarged the pit to about 3 acres.

The grade of the materials in the pit is coarse, composed of some boulders up to 5 feet in diameter. The crushed aggregate tested about 7% fines and about 20% sand. Constitution of the rock is extremely varied, almost all the igneous, metamorphic, and sedimentary rocks of the county being represented.

The origin of the crushable "borrow" appears to be glacial outwash. Stratification of the material is not strong, but is unmistakable on a weathered face. About

10 to 14 feet of outwash overlies a stiff, red clay, some of which appears to be of lacustrine origin and some of thrust origin. Drainage channels within the outwash become springs when a face is made; and after heavy rains, flow fast enough to fill the deeper portions of the pit with water to depths of one to three feet. Subsequent dressing of the pit raised the bottom above this temporary water table.

Procedure

On May 14, 1958, a small mixed plantation was made on a west-facing slope of the pit. The plantation is somewhat triangular in outline, its greatest length being about 120 feet and its greatest width 100 feet. Some good soil occurred at the easternmost (highest) portion of the plantation, because top soil had been bulldozed there to expose the subsurface "borrow." Most of the pit contained only a residue of coarse cobble mixed with even larger rocks.

For planting the site a total of 230 seedlings of 5 species were used. There were: red pine (*Pinus resinosa* Ait. - Ohio seed source), red pine (Michigan seed source), jack pine (*Pinus banksiana* Lamb. - Michigan seed source), pitch pine (*Pinus rigida* Mill - Ohio seed source), white spruce (*Picea glauca* (Moench) Voss - Michigan seed source) and black locust (*Robinia pseudoacacia* L - Ohio seed source). A few sycamore (*Platanus occidentalis* L.) and tulip poplar (*Liriodendron tulipifera* L.) were also planted at the woods periphery and elsewhere. All Ohio seed source seedlings were produced by the Ohio State nursery at Zanesville. All Michigan seed source seedlings were produced by the Wyman Nursery at Manistique, Michigan.

All seedlings were set approximately 6 feet apart in rows spaced the same distance from each other. Only one species was planted per row. All seedlings were planted in small pits grubbed with pick and grub-hoe. Usually materials fine enough to fill the hole had to be scraped from the immediate vicinity, since less than half of the material grubbed from holes was suitable for refilling them.

A second plantation was established in May, 1960, immediately north of plantation 1. Site characteristics on this plantation were similar to the first. Black walnut (*Juglans nigra* L.) and white ash (*Fraxinus americana* L.) were additional species included in this plantation, but they died within the first five years after planting. The rationale for including them was related to their use in strip mined areas. In all, 679 seedlings were planted, as outlined on page 3, 227 in plantation 1 and 352 in plantation 2. An initial survival of 91% among the 227 trees planted in plantation 1 is remarkable, considering the adverse site.

Survival counts of trees in plantation 1 were made in 1959, 1965, and 1975. Individual tree height and conditions were noted and recorded. Only one such count was made of plantation 2, that being in 1975. Observations on plantation 2 qualitatively support quantitative data on plantation 1. Unfortunately, sufficient measurements were not made subsequently to justify equally intensive quantitative analysis of plantation 2 data.

Discussion

Results of periodic height measurement and survival counts are illustrated in Figures 1, 2, and 3. Note the typical sigmoid curves for growth in plantation 1 (Fig. 1). Undoubtedly similar curves could have been constructed for species in plantation 2, except that only one measurement was available.

At present, the overall survival rate, including hardwoods and conifers in both plantations, is 48%. However, the survival rate for conifers in both plantations is 69% (75% survival in 1 and 66% survival in 2). The survival with respect to individual species is given in Figure 2. No hardwoods of the original plantings remain, although the black locust is sprouting prolifically after repeatedly being killed back by early or late frosts. Therefore, it appears to be serving its intended purpose of providing nitrogen to the impoverished soil. Elsewhere at the Center (and within 1/2 mile of these plantations) black locust has survived to become a 30 foot tree on better soils. On the eastern edge of the plantation, in heavier soil, a number of seedlings were obviously choked out by the "rank growth" of grasses and forbs.

In plantation 1, jack pine made the fastest initial height growth, followed by pitch pine, red pine and white spruce in that order (Fig. 3). Both jack and pitch pine, although low in tolerance to competition and shade, are adapted to poor sites (both species in their natural habitat are frequently found on sites too poor to support other tree species). Red pine of both native and Ohio seed sources made similar growth (Figs. 1, 3). The occurrence of chlorosis and slow growth among many of the spruce, developed soon after planting, indicating their inferior ability to respond where drought and adverse exposure entail. However, a survival rate of 87%, the highest of all species, attests the ability of the spruce to endure and to survive in the long run (Fig. 3). At present, the spruce has good color, form, and crown density and is achieving a significant yearly increment (Figs. 1, 3).

The period from 1965 to 1975 reveals that jack pine has maintained a good rate of growth. However, Michigan stock red pine has now surpassed it in yearly increment (Fig. 3). Ohio stock red pine and Michigan white spruce, although developing less growth per year than jack or Michigan red pine, have maintained their codominant position in the plantation. Pitch pine, with a survival rate of only 43%, has fallen behind all other conifers in both height and vigor. Many of the remaining pitch pine have been damaged by woodpeckers (especially sapsuckers, Sphyrapicus varius) and snow. Evidently this species, although capable of rapid initial growth and establishment on poor sites, is not tolerant of the severe winters and woodpecker attacks. It is remarkable, however, that the species has survived and produced cones so far north of its natural range.

There is no evidence of the originally planted hardwoods, except the numerous stump and root sprouts of black locust. The black walnut, tulip poplar, sycamore, and white ash did not survive, although trees of the same seed source, except for tulip poplar, have survived and are now 10 to 20 feet tall where planted within the town of Alberta. Initially the black locust grew rapidly, attaining a height of eight feet within several years after planting. Repeated killing by frost induced stump and

root sprouting. Undoubtedly, heavy winter snowfall protects the lower stem and roots of locust, enabling it to develop sprouts, some of which have attained heights of up to 15 feet. Some stems even bear seed pods. Where light and competition from the conifers is not limiting, the locust sprouts form a dense, thorny thicket. Where conifer competition is greatest and especially where the ground is continuously shaded, locust is almost entirely absent, apparently having been "shaded out."

Since establishment of the plantations, the site is subsequently supporting, at minimal levels, naturally occurring aspen (Populus tremuloides Michx.), balsam poplar (Populus balsamifera L.), elm (Ulmus americana L.), and sugar maple (Acer saccharum Marsh.). It is likely that site modification, created by the planted trees, has enabled these native species to become reestablished.

Summary and Conclusions

Numerous acres in the Upper Peninsula have been stripped for fill, gravel, or crusher rock. Although most pits are of limited size (less than 40 acres), the sum total of the area concerned amounts to thousands of acres. To determine the feasibility of reforesting such areas, two plantations were established in a large borrow pit located on Ford Forestry Center property. The first plantation, consisting of red pine, pitch pine and black locust obtained from an Ohio nursery, and red pine, jack pine and white spruce, obtained from an Upper Peninsula nursery, were planted in 1958. The second plantation had a similar species composition except that white ash and black walnut seedlings from Ohio were included. It was planted in 1960.

Sixty-nine percent of the conifers have survived to present, white spruce having the highest survival rate and pitch pine the lowest. None of the original hardwoods remain, except for the black locust which in certain areas has sprouted profusely. Jack pine made the fastest initial growth, growing 9.7 feet in the first 8 years. It was followed by pitch pine, Michigan source red pine, Ohio source red pine, and white spruce, in that order. All species at present display good vigor, color and crown density with the exception of pitch pine, whose survival seems jeopardized by the severe winters and woodpecker attacks. Jack pine still maintains the greatest total height, though Michigan red pine has now surpassed it in yearly increment, and white spruce is fast catching up.

From these results it is evident that all the coniferous species tested, except pitch pine, are capable of surviving and maintaining a good yearly increment on borrow pit sites, such as that found on Ford Forestry Center property. Successful establishment, however, is dependent upon the proper dressing of the mined area and careful planting techniques.

It appears that both public and private owners of land from which heavy "borrow" has been removed for whatever reason, should be encouraged to reforest this land with native conifers rather than the hardwood species which formerly grew on them. White spruce, red pine, and jack pine, in that order of preference, should be planted. It should be kept in mind that jack pine, which shows the best initial

growth on these demanding sites, probably acts as a "nurse" to modify the harsh environment and to encourage better survival and growth of the red pine and white spruce. Such reclamation would not only make the land productive once more but would also serve in the interest of highway beautification.

Figure 1. Tree Height by Species (1958-1974)

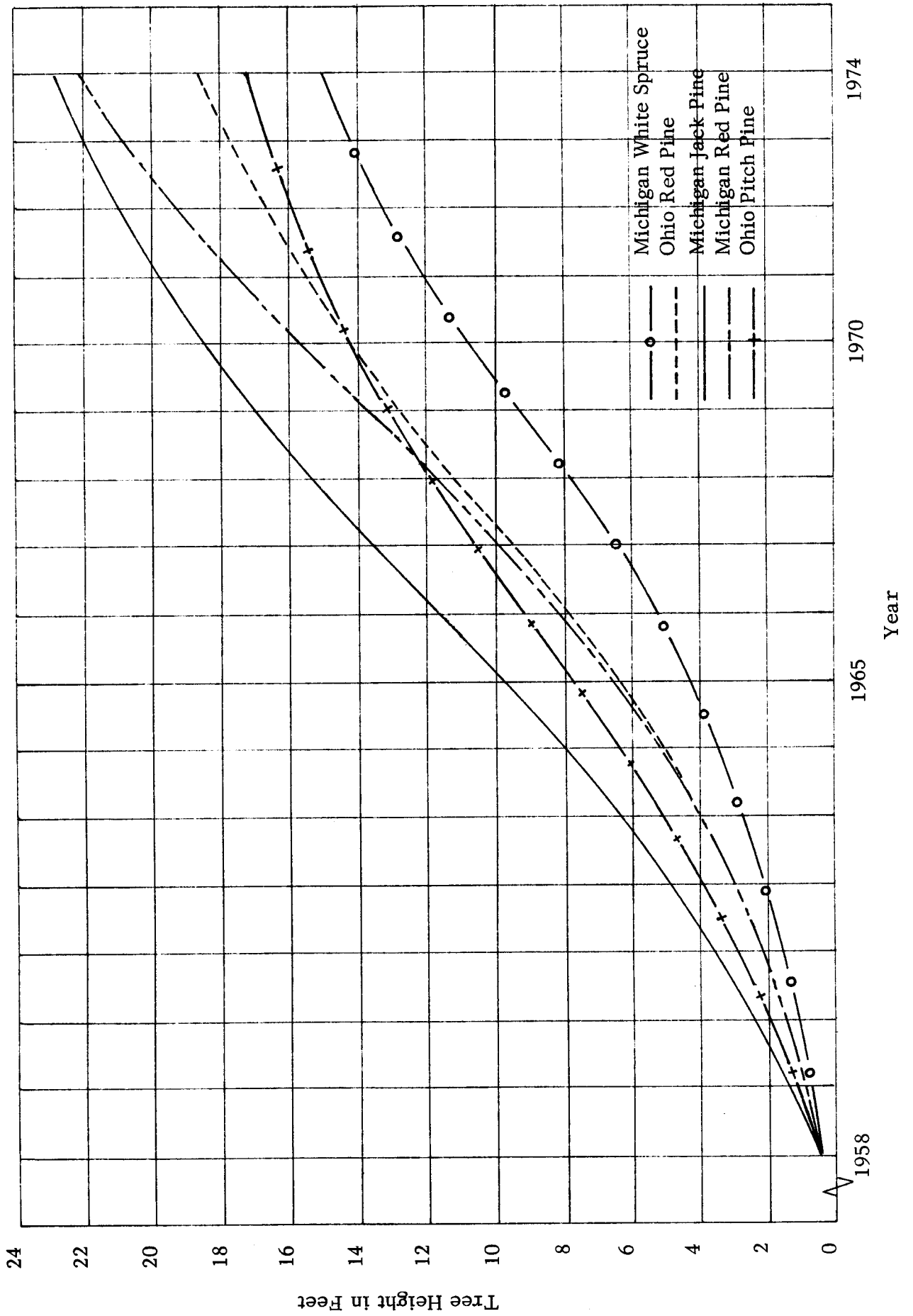


Figure 2. Percent survival by species (1958-1974)

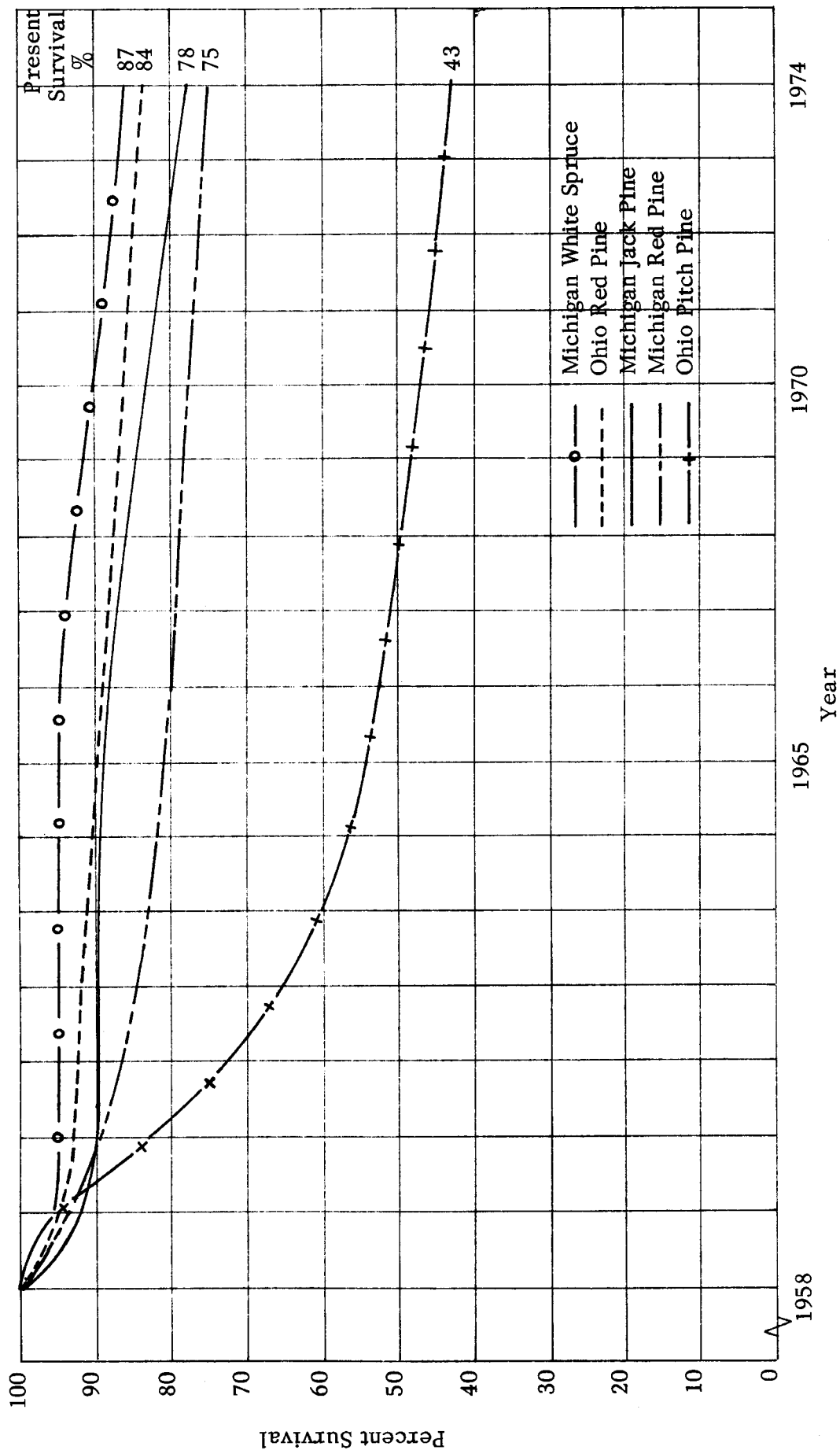


Figure 3. Height growth per year by species (1958-1974)

