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Reforestation on the Minnesota National Forest

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The Minnesota National Forest was created by an Act of Congress in 1902. It comprises a net area of 197,000 acres. The tract is located at the headwaters of the Mississippi River and aside from an economic standpoint, is valuable as a protection forest and also as a public recreation ground. It is known throughout the middle west and even on the Atlantic Coast as the playground of Minnesota. Its many lakes, its excellent beaches and bathing facilities, combined with a stand of virgin white and norway pine, such as can be found nowhere else in the United States, attract many tourists. As a result, during the past four years, two summer hotels have been constructed. In addition, thirty-five summer homes have been built along the lake shores by people from Minnesota, Iowa, North and South Dakota, Nebraska, Missouri, Illinois and even New York.

From an economic standpoint, the Forest is entirely accessible either by water or railroad. The Mississippi River flows through the center, while two railroads cross the Forest from East to West. It is bounded both North and South by waterways. The market for timber is unlimited and the quality of the stumpage is unsurpassed. No substitute can be found for white pine and as for norway, it is second only to the first named species.

The silvicultural system in vogue on the Forest consists of clear cutting with scattered seed trees. Until 1908, 5% of the entire stand was left as scattered seed trees, but after careful observations it was found that 5% was insufficient to restock the area. As a result a bill was passed which required 10% of the stand to be left instead of 5% as formerly. The scattered seed tree system has not proven an entire success on the Minnesota National Forest. It has had many oppon-

ents among the lumberman who could not understand such a system of management. It was necessary in marking the seed trees to leave many that were mature and over mature and of little value as seed producers. Many of the seed trees have blown down. After ten years of close observation, it has been found that the seed trees have been practically valueless. On the other hand, the policy should not be condemned because it has been one step—a great stride—toward the advancement of Forest management. It is needless to quote statistics or dwell upon the causes and results of the failure.

In July, 1915, the writer spent several days with Mr. Raphael Zon in examining cutover 5% and 10% areas. Not a single instance could be found where reproduction could be attributed to the seed trees. A good seed year occurred in 1910 and accordingly, examinations were made upon areas that were logged in 1909, 1910 and 1911. On one particular area where the logging had been done in the winter of 1910 and 1911, a fine stand of reproduction covers the ground. The entire stand produced the seed and it cannot be attributed to the 10% left as seed trees. The seed was on the ground at the time of logging and the same results would have been accomplished had the area been clear cut. Examinations of all other areas proved the seed trees valueless. Under present conditions, there is little or no chance for the seed trees to restock the area. The ground cover has grown up very dense and in addition there is a tremendous amount of litter that effectively keeps the seed from reaching the mineral soil and precludes all chance of reproduction. Cultivating the soil with the advent of a logging operation seems to be the only method by which natural reproduction has been obtained. In that case, the 10% left has had no more influence in the reproduction than the 90% that was logged. The seed was produced by the entire stand and was on the ground at the time of the lumbering.

Ten sections of the Minnesota National Forest were not included in the timber sale and have been set aside to be maintained on a sustained annual or periodical yield basis. The cutover area produced 500 million B. F. which have been removed in the past 13 years. Had this area been handled on a

sustained annual or periodic yield basis the Forest would have been perpetuated and today we would not be worrying about the reforestation of 85,000 acres of land. In addition, there would have been a permanent industry in our midst drawn directly from the economic resources of the Forest. As it is, the business has moved to new fields.

Natural regeneration has proven unsuccessful, and it will be necessary to restock the area artificially. Planting is far more economical than the scattered seed trees, even if they had been a success in starting a new stand. Reforestation by planting falls under two lines of work, namely nursery operations and field planting.

NURSERY OPERATIONS

The Forest Service recognizes the value of reforestation work. White pine and norway pine, the two most important economic species, are represented in the nursery, because they have the highest market value. They are fairly rapid growing trees and combined with favorable soil, site and moisture conditions such as are found in Northern Minnesota make field planting a proposition that will bring a fair rate of interest on a long time investment. In 1913, a small ranger nursery existed at Cass Lake. At that time it was authorized at 200,000 capacity. In the same year it was enlarged and authorized at 500,000 capacity, with 300,000 white pines and 200,000 norway pines. Fifty per cent of the output is 2-1 stock, 20% 3-0 stock and 15% 1-1 and 2-0 respectively.

The nursery is located on National Forest land bordering the townsite of Cass Lake. The location is a particularly favorable one. In locating a nursery, the following factors are taken into consideration.

1. It should be located favorably in regard to the distribution of its products.
2. A well drained sandy loam soil is preferable.
3. It should be situated so as to escape frost and other injuries and should never be located in low, damp surroundings where it is highly susceptible to damping off.
4. An adequate water supply should be at hand.
5. Labor should be available at all times.

The Cass Lake Nursery has all of these peculiarly de-

sirable points except soil, which is for the most part sand and must be subjected to a building up process. It represents the one big factor with which the nurseryman has to contend. It is being overcome by the application of large quantities of well rotted manure that is stratified in manure receptacles. In addition, every square foot of available surface is sown to a cover crop, such as cow peas and rye. Commercial fertilizer applied directly to the beds during the growing season proved to be of great value in 1914. Because of the absence of a subsoil or even substrata, the plant food leaches away very quickly, but there can be no doubt that commercial fertilizer or immediately available plant food applied at the proper time and in the proper manner will stimulate plant growth.

The nursery is situated between two rather large bodies of water which, during times of low temperatures, prevent injuries from frost. Its close proximity to the town of Cass Lake eliminates the labor question and no mess or bunk house is required. The stock may be distributed either by rail or water. The freight or express depot is only one-half mile from the nursery, while a three-quarter mile haul will place the young trees at the dock. The latter combined with a government owned motor boat and barge affords a low distribution cost.

A pressure system supplies the water which is pumped into a tank installed on the top of a tower 30 feet high. The nursery proper, upon the installation of the water system, was divided into 100 foot squares and at the center of each a hydrant was erected.

Few nurseries have advantages such as this one. In fact, the writer does not believe there is another nursery in the United States where the supply and demand is entirely taken care of by the local forest. The seed is obtained from the Minnesota National Forest area. Everything necessary in nursery operations is obtained from the Forest and all of the stock raised is planted back on it, so it may be truthfully said that the Cass Lake Nursery exists through and for the Minnesota National Forest. Even the moss—such an essential factor

which is hard to procure for some of our nurseries—is found in great abundance not forty rods from the nursery site.

SEEDLINGS

Nursery work does not differ materially from many other agricultural pursuits. It is only a few steps in advance toward what we might call intensive farming. With that idea in mind, the ground is worked both fall and spring and placed in a mellow, friable condition. The beds are laid off 4' x 12' over which a seed bed cage is placed. Two foot paths are left between the beds while at regular intervals 4' paths are left. This is done to facilitate the work of watering and cleaning up.

Equal amounts of seed are sown both fall and spring. One half of the beds are sown broadcast and the other half drilled. In drilling, the beds are prepared the same as for broadcasting. They are then marked off into drills 4" apart. A board 4' long and 2' wide, with six V shaped markers is used in making the drill. By exerting pressure on it, the drills are made $\frac{1}{4}$ " deep. The quickest and most economical method of drilling seed is to take an empty shot gun shell and cut it off until it holds the amount required for sowing one half row. It is easier to work around the bed and sow one half row at a time. The cost of drilling exceeds that of broadcasting but it is not excessive. The beds are sown with the idea of growing 100 seedlings per square foot. It has been demonstrated conclusively that the beds have been overcrowded with the result that the seedling stock, whether used for transplanting or field planting was small, spindling and lacking in general appearance and suffered enormous losses. One hundred seedlings per square foot allows sufficient root and growing space and produces, stocky, sturdy plants that are able to withstand the shock of transplanting or field planting.

The one great danger, especially with norway pine, is the damping-off fungus. Each year we have suffered great losses. No practice, such as the manipulation of shade frames or the application of sand, seems to check it. The Bureau of Plant Industry is now working on prophylactic measures to control the disease.

A comparison of spring and fall sown seed brings out the

fact that the seedlings in the norway pine fall-sown beds are a little larger but there is not such an appreciable difference as is seen in the white pine. The white pine seedlings are one-fourth larger in the fall sown beds and while the same amount of seed is sown per square foot there are many more seedlings probably 25% more than from spring sowing.

During the early part of the season, while the seed is still germinating the beds are watered daily. It is thought that frequent light waterings are more beneficial than flooding of the beds. At the end of the germination period the water is gradually reduced until at the end of the growing season, the beds are watered but once a week. The older class of seedling stock receives water but twice a week during the early part of the growing season and but once every ten days toward the end. More water is applied to this class of seedling stock but at no time are the beds in a flooded condition.

TRANSPLANTS

Transplanting requires very close supervision. Under poor management, the transplanting is done at a very high cost and in the majority of cases results in large losses of stock. These losses may be due either to subjecting the plants to the sun and wind or it may be due to improper methods of placing the plants in the transplant bed, or a combination of the two. The personnel of the transplant crew may vary according to conditions and methods, but on the whole it has been found that the trencher method is the most satisfactory and has produced the best results at lowest expense and with less loss of stock. The transplanting crew as used here consists of seven men, namely: one trencher, two tampers and four threaders. Two crews are worked under the supervision of one man.

Five or six beds are laid out and worked as a unit, carrying forward a continuous front. Each threading table is provided with at least three planting boards. The boards are constructed so that the plants are spaced $1\frac{1}{2}$ " apart and in rows six inches apart. The threading table is covered with canvas, only one side remaining open allowing men freedom for work. It was found in using 2-0' stock that two men at

a threading table are more than enough to form a well balanced crew. There is always a little time intervening between boards so that in using 2-0 stock of good quality, three men at two tables, the odd man alternating between tables, will be the most economical crew. The small 1-0 stock requires two men at each threading table to keep the tampers busy. The soil on the newly made beds is raked down at the close of each day and flooded to firm it about the roots and thus eliminate air pockets and the consequent drying of the roots and loss of plants. Previous to transplanting the soil should be wetted down so that the trencher leaves the trench in good condition for the plants. Trench slits must be left perpendicular since small "cave-ins" of dry soil will keep plants from being properly transplanted.

Transplants as a rule, depending upon the nature and the texture of the soil, require an application of water at least every ten days during the early part of the growing season. Light sprinklings while beneficial do not fill the needs, a thorough soaking and even at times a flooded condition seems to bring the best results. Cultivating aside from hand weeding should be avoided as much as possible. Mechanical cultivation, unless accomplished in a very conservative and careful manner results in great destruction of young trees. Transplants must be spaced as closely as is compatible with growing conditions. Mechanical cultivation is very apt to sever lateral roots which results in dead, weak or spindling plants that have to be culled before being planted in the field. Transplants, while not so exacting as seedlings in regard to soil and moisture conditions must have for the very best results a soil that is rich and well drained. Every effort should be put forth to bring the soil up to the condition necessary for seedlings.

FIELD PLANTING

The stock is dug with a spade and placed in the packing box with the roots to the center. A small amount of soil is left on the roots which are securely packed in sphagnum moss. When the packing boxes are filled, they are placed in a cool, damp situation to await their immediate distribution to the field. The cost of digging and packing transplants and

seedlings amounts to \$.39 and \$.13 per M respectively. This cost could be materially lessened by the use of some mechanical device such the the Smith tree digger now in use at the Halsey Nursery.

The planting area on the Minnesota National Forest represents two types of soil—clayey loam and sand. These respectively represent white pine and norway pine situations. These sites are again divided into three different planting areas representing burned and cutover land. Some of the area is very open with very little ground cover. This condition signifies a hard burn. Other portions of the area are similar but in many places a dense growth of grass and low bushes has sprung up, while other parts of the area are entirely brush land.

These situations represent individual problems which must be solved by constant attention and a diversity of planting stock. It would seem that the open, barren soil, where there is no competition with grass or other undergrowth would afford an ideal planting site. Certain classes of stock, the older and hardier, do survive on such sites, but the smaller classes cannot live unless they are planted during a year when the precipitation is above normal and comes at the proper time. The roots of the smaller classes, such as the 1-1 are very short, compact and well developed but they do not penetrate the ground to a sufficient depth to survive a drought. This same stock with the same seasonal conditions planted in the brushy type or on the shady side of a log or stump does very well. Observations have proven that the smaller stock during the fore part of the growing season will appear healthy and produce strong growing shoots but upon the advent of a drought during midsummer, the survival percentage will materially decrease. The matted sod and low bush type is the most difficult with which we have to contend. None of the stock seems to be able to cope successfully with it. It is necessary, in extreme cases, to remove a certain portion of the sod in the immediate vicinity of the plant. This is done with a spade, but in cases where the country is open and there are few stumps, or old windfalls, logs or other debris that may be left on the ground at the

completion of a logging operation, it is advisable to plow a furrow and plant in it.

The slit method is used in planting which requires a crew of two spaders and one planter. The spader opens the slit, the planter puts in the tree and the spader completes the operation by inserting the spade and forcing the soil against the tree. The soil is then firmly pressed around the tree by tamping with the foot. Five of these crews work together and form a solid front under the supervision of one man or crew foreman who constantly walks back and forth behind the line to see that plants are set properly. The stock is wrapped in moss and burlap and carried under the arm. A thousand trees per man per day is an average day's work.

Some apprehension was felt as to whether the slit method would prove practical in the clay loam soil. It was found that by planting before the frost was out of the ground the work progresses even faster than in the sand.

The work of reforestation on the Minnesota National Forest has been firmly established. There is no doubt about the practicability of it, nor the success of the plantations already made, and it is only a question of time before the entire area will be covered with a tree growth that will be perpetuated.

If the twenty-five million posts required each year for Iowa fence-posts were set in one line and spaced a rod apart, they would build a fence three times around the earth at the equator. Their cost is nearly four million dollars.

A clearing house for fence-posts has been established by the Forestry Department at Iowa State College for the benefit of the farmers. "Many farmers in Iowa want to buy native grown fence-posts, but do not know where to buy them", says Prof. G. B. MacDonald. "Other farmers have fence-posts to sell, but do not know where to sell them". Several carloads of Osage Orange posts have been listed.