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Introduction

Jack pine (*Pinus banksiana* Lamb.) reproduces itself and spreads mainly through the occurrence of forest fires, and hence its regeneration is seldom adequate after logging. This is primarily due to the rather peculiar reproductive requirements of the species.

Jack pine cones open only under the stimulus of high temperature, because of a gummy resin that seals the scales (1). Cones may be opened either by a forest fire if they are still on the trees, or by the heat from the sun when logging and subsequent slash disposal bring these cones close to the ground. Temperatures of 130 deg. to 150 deg. F. have been recorded in the summer on bare forest floor, and such temperatures are sufficient to open the cones (4).

Under normal moisture conditions in the field, jack pine regeneration varies with the character of soil surface. On exposed mineral soil, or where the soil is covered only by ash mixed with traces of humus, good regeneration will usually occur providing the seed supply is adequate. Undisturbed duff, on the other hand, will always produce insufficient regeneration, regardless of the intensity of seeding (2). In other words, mineral soil is a good seedbed, burned humus is often suitable, but undisturbed humus is poor (4). Thus the success of jack pine regeneration depends mainly on an adequate release of seed from cones over a seedbed favourable for germination and survival of seedlings.

In recent years, the KVP Company Limited, in co-operation with the Federal Forestry Branch, carried out a series of experiments dealing directly with the problem of restocking cut-over areas to jack pine. Experiments included: logging by various methods, and subsequent treatments such as burning slash, ground scarification with Athens plow, broadcast seeding, and scattering lopped slash (5); spot seeding on manually scarified scalps (3); burning slash followed by broadcast seeding (2); and burning slash in the presence of seed trees (2). So far, scattering lopped slash on exposed mineral soil has produced the best regeneration. Similar findings were also reported from the Longlac Pulp and Paper Company Limits (now the Kimberly-Clark Pulp and Paper Company Limited), where several areas have been successfully regenerated to jack pine by the slash scattering method (6). This method was tried again in 1956 by the KVP Company on a 26-acre clear-cut area to secure a further proof of its effectiveness. The results of the latter operation are presented in this report.

Description of Area

The treated area is located on the KVP Company limits, north of Espanola, Ontario. The site is a sandy lower terrace with a shallow cap of sandy loam which forms the B horizons. Its soil moisture ranges from somewhat dry to fresh, and its ecoclimate is warm and dry. The ground vegetation consists mainly of velvet-leaf-blueberry, (*Vaccinium myrtilloides* Michx.), sweet fern (*Comptonia peregrina* (L.) Coutl.), large-leaved aster (*Aster macrophyllus* L.), and moss (*Calliergon* sp.). Before cutting, the area supported an 80-year-old stand of jack pine with a small admixture of black spruce (*Picea mariana* (Mill.) BSP., balsam fir (*Abies balsamea* (L.) Mill.), and trembling aspen (*Populus tremuloides* Michx.). This stand yielded approximately 35 cords per acre.

Methods

In the summer of 1955, the area was clear cut by a bundle yarding method. Timber was cut in one-chain-wide strips at right angles to haul roads, and 8-foot logs were piled along the centre lines of the strips. A yarder was usually set up on the road between strips, and two strips were yarded from each setting. It was estimated that about 10 to 15 per cent of the total area was scarified by this operation, with scarification becoming progressively better toward the yarder. Slash piled in windrows on the edges of the cutting strips ranged in height up to 4 feet.

On June 1, 1956, a six-man crew lopped and scattered cone-bearing jack pine branches on scarified portions of cutting strips, on secondary haul roads, and wherever the mineral soil was exposed. Suitable branches were selected from the nearest slash windrows, cut by axe to the lengths of 2 to 3 feet, and scattered at about 4-foot spacings. Since slash in this

area was one-year-old, there was some difficulty in selecting branches with unopened cones. Sometimes they had to be carried for a distance of more than one chain before scattering. Regardless of this difficulty, the whole area of 26 acres was treated in 6 hours and 30 minutes, or at the rate of 1.5 man-hours per acre.

In the autumn of 1957, a portion of this area was sampled for regeneration by means of strips of milacre quadrats. Two sets of strips were established on the same sample area: strips in the first set were located between slash windrows where mineral soil was exposed, and strips in the second set were located 33 feet apart across slash windrows traversing both scarified and unscarified portions of the sample area. Seedlings were tallied on a total of 160 milacre quadrats in each of the two sets. The survey was carried out on two sides of a secondary haul road where scarification due to yarding was most intense. The purpose of making this survey by means of two separate sets of strips was first, to determine the effectiveness of the treatment when mineral soil is exposed, and second, to demonstrate that, unless an area is thoroughly scarified, the treatment will not sufficiently improve the overall stocking.

Results and Conclusions

From Table I it is evident that scattering cone-bearing branches on exposed mineral soil was successful. Although the overall stocking of all species was only moderate (40 per cent), half of it may be attributed to jack pine regeneration that directly resulted from the treatment. In fact, jack pine stocking on exposed mineral soil was excellent (90 per cent), and many patches supported even more seedlings than are normally required to produce a well stocked stand. Almost all seedlings were found directly under the branches and near the cones that had opened and released seed following the lopping and scattering operation. Practically all seedlings had good form, and their total height ranged up to 6 inches.

TABLE I

PER CENT OF MILACRE QUADRATS STOCKED WITH ONE OR MORE SEEDLINGS

	J. Pine	B. Spruce	B. Fir	T. Aspen	All Species
Stocking on Exposed Mineral Soil ..... (between slash windrows)	90	no other species recorded			
Average Stocking on Sample Areas .... (across slash windrows)	20	11	4	9	40

Successful regeneration of jack pine by scattering lopped slash on exposed mineral soil depends to a great degree upon the quality of selected branches. This was clearly demonstrated by the experiment. Although the one-year-old slash had many opened cones, steps were taken to select and scatter only branches with unopened cones. By so doing, adequate seeding was assured and, as far as exposed mineral soil is concerned, the resulting regeneration was satisfactory. The only disadvantage of using this or older slash is that the selection of suitable branches takes more time and increases the operational costs. It is believed that the application of this treatment would be much more efficient immediately after logging, when fresh slash is present.

An equally important factor affecting the results of a lopping and scattering operation is the actual spacing between patches with exposed mineral soil. Unless an area is thoroughly scarified, these patches must be uniformly distributed and not too widely spaced. This also was demonstrated by the experiment. Since relatively small portions of the cutting strips were scarified by yarding, subsequent scattering of slash on those scarified portions, though successful as a treatment, did not sufficiently improve the overall stocking. Unless other species fill the gaps, the future stand will be very irregular and patchy. From a standpoint of acceptable stocking, it is far more important to have scarified patches at say, 4-foot spacing, even if they are relatively small, rather than few larger patches at a much wide spacing. Although bundle yarding provides better scarification than other methods of logging used for the extraction of 8-foot pulpwood, the actual amount of exposed mineral soil is usually insufficient. This situation may be considerably improved by the use of some means of mechanical scarification supplementing the normal logging operations.

The significant point brought out by this and previous experiments is that scattering cone-bearing branches on exposed mineral soil can be regarded as a dependable means of regenerating jack pine after cutting.

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