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SITE IDENTIFICATION FOR BIGTOOTH ASPEN SUCKER STANDS[1]

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Bigtooth aspen *(Populus grandidentata)* is an upland species that reaches its best development on relatively moist, loamy and sandy soils. Following logging of this tree, reproduction is almost invariably by root suckers which, in clear-cuttings, appear in profusion. Because these suckers are supported by the fully developed root systems of the parent trees, they grow at an almost unbelievably rapid rate on both good and poor sites. As a result it is impossible to recognize site quality from their growth rate alone. For this reason other indicators of site are needed in order to judge the potentialities of sucker stands.

The rapid initial growth of the suckers is usually interrupted either by unfavorable weather, the attainment of a combined transpiring leaf-surface approaching the moisture limitation for the site, or by a combination of these conditions. Often it is impossible to distinguish between reduced growth due to weather from that caused by site limitations. In either case the slacking in growth rate is temporary, because the unfavorable conditions are promptly followed by the death of some of the trees and release of the others. The mortality referred to is usually the immediate result of combined insect and fungus attack. In this way the stand passes through a stage of natural thinning followed by a second spurt of rapid growth. During the life of an aspen stand the trees may pass through several such periods; the number of trees being reduced from the original six thousand to forty thousand suckers per acre to the final mature stand numbering, on medium to good sites, between 4 and 6 hundred trees. On very poor sites the stands usually go to pieces before reaching merchantable size, but until that time it is difficult to distinguish the poorer but potentially merchantable stands from those that will never attain merchantability.

Therefore, if the potentialities of developing aspen stands are to be correctly evaluated it is necessary to recognize site quality without depending upon evidence provided by the trees themselves. In the course of the University of Michigan aspen study[2] an attempt was made to discover such indicators of site quality. The results showed clearly that the best indicators were soil texture, depth to moist soil in midsummer, and position in reference to topography. In the accompanying tabulation the influence of these factors upon growth of the trees is summarized.

Although more than 300 areas were examined in detail, the data were conclusive only in the case of frequently encountered conditions. Under other conditions less frequently encountered conclusions had to be based upon fewer observations than might have been desired. Nevertheless, the trends seem clear and even in situations represented by a limited number of examples, the observations all seemed to fit together. Since some possible combinations of conditions were not actually observed, it was necessary to fill the gaps by interpolation. No extrapolation was done, however.

In order to understand the tabulation it will be necessary to discuss its basis. Site quality is the expression of a complex of variable conditions. Therefore, it is to be expected that during a certain life stage of a tree one set of factors will be dominant, whereas at another stage a different set may be operating. With most tree species, the relative influence of the various factors is related chiefly to root and crown development, and to the increasing size of the individual trees. With aspen, however, because the root systems of a sucker stand are already fully developed when the suckers become established, the variations

[1] PAPER NO. 4, UNIVERSITY OF MICHIGAN PHEONIX PROJECT NO. 29
[2] PHEONIX PROJECT NO. 29 - FINAL REPORT IN PREPARATION

Cutbank on the Big Manistee River showing a clay stratum overlaid by eight feet of coarse sand the day after a rain. The dark areas on this clay surface are caused by water seeping from the porous sand above. Note differences in tree heights ranging from less than thirty feet on top of the bank to sixty feet or more at the foot of the slope.

SITE QUALITY INDEX FOR BIGTOOTH ASPEN ON WELL DRAINED SANDY SOILS

EXPRESSED AS HEIGHT AT 30 YEARS

TOPOGRAPHY	COARSE SANDS						FINE SANDS						LOAMY SANDS					
	PERMEABLE SUB-SOIL, DRY TO 5' IN SUMMER	IMPERMEABLE STRATUM AT 12" OR LESS	IMPERMEABLE STRATUM AT 13" TO 18"	IMPERMEABLE STRATUM 18" TO 5'	SUB-SOIL MOTTLED	WATER TABLE WITHIN 5'	PERMEABLE SUB-SOIL, DRY TO 5' IN SUMMER	IMPERMEABLE SUBSTRATUM AT 12" OR LESS	IMPERMEABLE SUBSTRATUM 13" TO 18"	IMPERMEABLE SUBSTRATUM 19" TO 5'	SUB-SOIL MOTTLED	WATER TABLE WITHIN 5'	PERMEABLE SUB-SOIL, DRY TO 5' IN SUMMER	IMPERMEABLE STRATUM AT 12" OR LESS	IMPERMEABLE STRATUM 13" TO 18"	IMPERMEABLE STRATUM 19" TO 5'	SUB-SOIL MOTTLED	[illegible]
FLAT UPLANDS	UN-MCH.	UN-MCH.	30-40	40-50	50-60	60-75	UN-MCH.	UN-MCH.	30-45	45-60	45-60	60-65	UN-MCH.	UN-MCH.	40-50	50-60	50-60	60
BROW OF SLOPE	UN-MCH.	UN-MCH.	UN-MCH.	30-40	40-45	—	30-40	UN-MCH.	UN-MCH.	30-40	40-50	—	30-40 MCH.	—	40-45	45-50	50-60	—
UPPER SLOPE STEEP	UN-MCH.	—	UN-MCH.	30-40	40-45	—	UN-MCH.	—	30-40	40-50	50-55	—	UN-MCH.	—	30-40	40-50	50-55	—
MODERATE	"	—	"	"	"	—	30-40	—	35-45	45-50	50-60	60-70	30-40	—	30-40	40-50	50-60	6[illegible]
GENTLE	"	—	"	"	"	—	"	—	35-45	45-55	55-65	65-75	30-40	—	35-45	45-55	55-65	6[illegible]
LOWER SLOPE	"	—	—	50-60	60-70	70-80	30-45	—	40-50	50-60	60-70	70-80	30-45	—	45-50	50-60	60-70	7[illegible]
BASE OF SLOPE	—	30-40	40-50	50-60	60-75	75-90	—	30-40	40-50	50-60	60-75	75-90	—	30-45	45-60	60-65	65-75	7[illegible]
FLOOD PLAIN	—	—	—	—	65-70	70-80	—	—	—	—	65-75	75-80	—	—	—	—	65-75	7[illegible]

due to root development are for the most part eliminated. The trees are, therefore, able to utilize the site to the maximum degree from the start.

Evidence collected in our study of aspen leads to the conclusion that water conditions in the upper 5 feet of soil are far more important in determining site quality than is soil texture. These water conditions are of course determined in part by the soil structure. In sandy soils, however, they are influenced far more by the character of layers beneath the topsoil and by slope. Generally speaking, if oxygenated water is available within five feet of the soil surface throughout the normal summer season, bigtooth aspen will attain merchantable size regardless of the surface soil texture. If, however, the water falling on the surface rapidly seeps to depths below 5 feet the site will invariably be unfavorable.

If water percolating from the surface encounters an impermeable layer it will of necessity move sidewise following the layer of clay or hardpan through which it cannot pass. In this way it will remain within reach of the tree roots.

Information concerning the presence or absence of free water in a sandy soil may usually be obtained by taking a soil boring to a depth of 5 feet. If no impermeable, dark colored, or mottled layer, indicating a permanently high water table, is encountered before that depth is reached we may logically conclude that the soil will become excessively dry by mid-summer. No reliable way of recognizing soil water conditions by examining the surface has been found, although the use of plant indicators is a promising possibility to be discussed in a later paper.

Although the presence of impermeable layers beneath the surface, encouraging lateral movement of water in sandy soil, is usually favorable, sometimes such a layer may be too close to the surface to permit normal root development. Generally if this undesirable condition occurs the impermeable layer will be within 12 inches of the surface. Then either a perched and sometimes stagnant water table will inhibit root development during a part of each season, and in midsummer, when the surface layers usually become dry, there will be no possibility for water to be replaced from below by capillarity. With increasing depth of the impermeable layer down to four or five feet, the site for bigtooth aspen tends to improve; the best sites being locations where a supply of fresh water is continuously available between the three and five foot level.

With this explanation, the following site tabulation should be easily interpreted. The use of the tabulation should be restricted to the sandy soils. However, it is on such soils that the greater proportion of bigtooth aspen stands grow. The soils, as shown in the table, are first divided according to three texture classes. These are further divided according to the depth to an impermeable layer or to the normal midsummer water table. These conditions are then compared with the position in reference to slope in order to find the site index for any location.

Dashes in a space indicate that such combinations are unlikely to occur, although there may be some exceptions. The observer can arrive at an approximation under such unusual conditions by interpolation or extrapolation.

Some conditions not included in the table may also affect site quality and should be taken into consideration. For example, other things being equal, the presence of gravel-size particles mixed in the upper soils layers will tend to raise site quality above the values shown. This statement of course does not refer to water washed gravelly layers. Also, converging slopes or draws will tend to raise site quality about one site class above the values indicated.

Site quality in this paper is expressed in terms of total height in 30 years. The difference between the height of trees growing under the poorest and best condition is tremendous, ranging from less than 30 to over 90 feet tall in thirty years. Obviously, in the appraisal of young sucker stands such differences should be recognized, and it is hoped that this basis for evaluation of the factors influencing site quality for bigtooth aspen will aid in making more accurate appraisal of sucker stands than otherwise would be possible.