Management and Use of Aspen Poplar in North America

by

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Abstract

Aspen poplar, although widely distributed over the northern half of North America, is greatly underutilized. However, because of its ease of reestablishment through vegetative reproduction, its short rotation management on appropriate sites and new technological development favouring such uses as chemimechanical pulp and waferboard, the forest industry will probably pay more attention to it in the future. Regional differences throughout its range are discussed for Ontario, the Prairie Provinces and the U.S. Lake States.

Résumé

Le peuplier, bien qu'ayant une très grande distribution dans la partie nordique de l'Amérique du Nord, est plutôt sous-utilisé. Toutefois, par sa facilité de régénération par reproduction végétative, ses courtes rotations lorsqu'aménagé sur des sites adéquats, et par suite d'un nouveau développement technologique favorisant ses utilisations comme pâte chimio-mécanique et comme panneaux gauffrés, l'industrie forestière y portera probablement plus d'attention que par le passé. Les différences régionales retrouvées à travers sa distribution sont illustrées pour l'Ontario, les provinces des Prairies et les états américains des Grands Lacs.

The aspen poplars, trembling aspen (*Populus tremuloides*) and largetooth aspen (*P. grandidentata*) are extremely widely distributed in North America. Trembling aspen occurs from the Atlantic coast and Hudson's Bay south into New England and the Lake States across the continent to the mouth of the Mackenzie River and Alaska and south to the mountain states of the western United States. Largetooth has a more southern distribution, generally being confined to an area south of the height of land dividing the basins of the Great Lakes and Hudson's Bay.

The aspens are intolerant pioneer species that will readily invade an area that has suffered a major disturbance such as logging or fire. They are relatively short-lived, grow rapidly and are easily regenerated if some basic forest management principles are applied. They are more susceptible to the effect of climatic factors, insect attack and disease than many other species, being especially prone to cankers and stem decay. But this disadvantage can be offset to some degree by good management and some changes in technological processes and products that have been developed over the past two decades. When softwood resources are being stretched, and in some areas overcut, the aspens appear to represent a renewable resource, still largely untapped.

Indeed the aspen resource in Canada is huge and underutilized. Although it comprises about 10% or 2¼ billion m³ of the country's forest inventory, less than one tenth of the

annual allowable cut is being utilized. In the Lake States (Wisconsin, Minnesota and Michigan), aspen constitutes about 51% of the total wood harvested; yet even this, an average cut of 2.4 million cords in the period 1964-83, is much below the allowable annual cut of 3.5 million cords for these species.

The management and use of this "hidden" resource was the theme of the seventh annual meeting of the Poplar Council of Canada, held at Timmins, Ontario, last October. The Council is an unusual body, being an incorporated, non-profit association, comprising private individuals and industry and government representatives. Its objectives include the exchange of information through meetings and information bulletins concerning the management and use of poplars.

The Timmins meeting included presentations on aspen management and use in Ontario and the Lake States, also field visits to an aspen management area in the Kirkland Lake district of the Ministry of Natural Resources and to waferboard plants in Timmins and Englehart. Out of the meeting, came the suggestion for this overview of aspen management and use in North America. In it, reference has been made not only to material presented at the meeting but also to studies made on aspen management and use in the Prairie Provinces.

Aspen Management

All investigators agree that the secret of aspen management is to have a market for the low quality trees in the

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stand. There has always been a market for the high grade large trees for products such as veneer and sawlogs. But the highgrading of stands for these products is not only an extremely wasteful practice, but it plays havoc with the residual stand due to logging damage and the leaving of cull trees. With the advent of the waferboard industry, however, the whole picture has changed for aspen management.

Where aspen occurs in mixedwood stands as is usual in the boreal forest, there is another problem. Forest managers for years have either tried to ignore it by cutting out the conifers or to eliminate it by the use of herbicides. Neither method has been too successful. Clearcutting of a stand, unless followed by very heavy scarification, favours aspen which regenerates readily by vegetative reproduction through the root suckers. Present aspen management capitalizes on this situation and endeavours to work with nature rather than against it.

Heeney *et al* (1975) and Hambly (1985) have reviewed the silviculture, management, and use of aspen. Although these reviews refer primarily to Ontario, they are applicable to aspen across the continent unless otherwise specified.

While abundant seed production in both aspens occurs every second or third year, the conditions required for seedling establishment, a constantly moist, bare mineral soil, are seldom present. Most of the present stands originated vegetatively, that is from root suckers, the first year after a major disturbance to the site. Sucker development after a disturbance is promoted by the presence of cytokins in the root tips. These are normally held in balance by the auxins, developed in the tree crown, which inhibit sucker growth. With the source of the auxins removed, the cytokins prevail. Initial sucker density may vary from 20,000 to 70,000 stems per ha; the larger figure is more likely after summer logging especially if slash cover is light. However, whatever the initial density, Bella (1983) has shown that by year 6, the stand will average around 25,000 stems per ha. At this age in Ontario, average stem height would be 4 metres and woody biomass from 5-10 tons per ha.

Aspens are intolerant and harvesting is best performed through a true or silvicultural clearcut (all trees harvested including culls) by full tree or tree-length skidding to landing. The full tree system is preferable as much of the understorey of shrubs is thus destroyed and slash accumulation is minimized. Site preparation, if any, should be very light.

There are three alternatives under which stands with an aspen component can be managed. These can be applied to relatively pure stands of aspen, to mixed stands of aspen in association with spruce and fir, or to mixtures of aspen, pine and the tolerant hardwoods. Site class I with a loam silt or clay soil, should be managed for aspen; site class II with a fresh moist regime (MR 2-3) should have a true clearcut and be managed as a mixedwood stand. Site class III, if with a sandy soil and MR 0-1 should be converted to conifers; if with a clay soil and high moisture regime (MR 4) it should be treated as a protection forest or wildlife habitat.

Aspen is a relatively shortlived species, very prone to decay with increasing age. For this reason, combined with its rapid growth rate, it should be managed on a short rotation. Thus at age 55, aspen may show a gross merchantable volume of 300 m³ per ha with a cull rate of 7.9%. Black spruce by contrast at a rotation age of 105 shows a volume of 250 m³ per ha with a cull rate less than half that of aspen.

Aspen Use

Waferboard and its variants, oriented strandboard (OSB), are the fastest growing wood composite boards in the world; its growing use (25 mills in production in North America and many others in the planning stage) has been by far the major factor in stimulating demand for aspen. Small wafers, similar in appearance to pieces of veneer, are interleaved together in a thick mat, mixed with phenolic resin and bonded together under heat and pressure. The product is an engineered, uniform solid structural board with high strength and water resistance.

Waferboard is rapidly replacing softwood plywood for all major construction uses such as wall and roof sheathing, subflooring and underlayment, claddings and soffits. Three factors have played a part in the rapid expansion of use of this board; good market acceptance, a diminishing supply of good peeler logs for plywood, and perhaps most important, a plentiful supply of low cost, small diameter aspen logs.

Poplar plywood still commands a steady market, particularly in furniture. The problem is of course the high grading of a stand required to get logs of adequate quality. Survival of the industry will depend largely on integrated operations on wood complexes where veneer operations will be tied in with those of waferboard or other products requiring a lower grade of wood.

There is a small continuing use for poplar timber for construction, but there are better opportunities in recovery in the framing field. Studies by Environment Canada (1974) indicate that a satisfactory recovery of 2-inch lumber is attainable from at least 75% of the merchantable volume of most trembling aspen stands in the Prairie Provinces. In strength, 'northern aspen' (which may also include balsam poplar) is similar to that of the 'spruce-pine-fir' group. Kiln-drying of aspen does present some problems due to the presence of 'wet pockets'; however at least one commercial schedule has been developed that can handle this problem. Because aspen lacks highly toxic extractives, it is susceptible to decay under conditions favouring fungal growth. However, if properly dried and treated with regular preservatives such as CCA, aspen can compete with similarly treated softwood lumber. Another area is a process under development by Forintek mentioned by Morley (1984). This is the SLAT (Sawing/Slicing, Lumber, Assembled, Trimmed) program. Basically, this consists of sawing or slicing thin lumber (probably 5/8" from small dimension aspen trees of 4 to 6 inches in diameter). After drying, assembling, trimming and gluing, any desired lengths, widths and thicknesses can be produced. The program was developed as an answer to the shortage of sawlog material in eastern Ontario. If found commercially feasible, SLAT might prove useful in many parts of the world where there is an increasing shortage of good-quality, large-dimension trees.

Poplar pulpwood has had only limited use in Canada, much more so in the United States. Poplar kraft pulp is an excellent furnish for fine paper giving good sheet formation, high opacity, good bulk and good printability. Due to shortness of fibre, it lacks the strength of spruce kraft pulp, and for this reason is usually combined with it, in proportions depending on the end proposed use. Aspen is well suited as furnish for chemimechanical pulping, having a low energy requirement, and the defibration process does not remove the lignin present. Einspahr (1985) believes that aspen is particularly attractive in the newly emerging sulfite anthraquinone pulping

process, which gives high yields and viscosity and is easily bleachable. In the Lake States, it has been used for producing groundwood, thermomechanical, chemimechanical, sulfite and kraft pulp.

Perhaps the most innovative use for aspen is described by Tenszen (1985). Wang Park, formerly from South Korea, has a plant on the outskirts of Regina which produces 400 000 disposable chopsticks per day. "Saskatchewan poplar is the finest chopstick wood I have ever seen" said Park. "The Soviet wood came to us too dry and hard, and the Korean poplar, even first grade, is too dark." Ninety five percent of the present production goes to Korea and Japan (countries where disposable chopsticks have always been the fashion). Ultimately when the plant reaches its million a day capacity, it is hoped to supply 50% of the production to Japanese and Korean restaurants in North America. Chinese restaurants tend to use the more expensive washable chopsticks.

There are many other potential industrial uses for aspen, biomass as an energy source, furnish for animal feed, even as chemical feedstock for conversion to products normally produced from petroleum (Gambles 1984). There are at least three companies in this field making use of a conversion technology that treats wood by superheated steam at high pressure. The result is a pulp which contains dissociated fractions of cellulose, lignin and xylose sugars, that can be separated with solvents. Using this method and a continuous rather than a batch process for treating the wood chips, one company, Stake Technology, now operates a full-scale commercial plant in Minnesota for cattle feed production and is building another to produce alcohol from wood. In the long run such plants will probably be based on plantations, rather than natural stands. Such plantations would logically be established using hybrid poplars rather than native aspen.

Aspen in Ontario

The Englehart Management Unit is still in the early stages of becoming active in aspen management, a process greatly accelerated by the presence of the Grant waferboard mill at Englehart, which went into production in July 1982. Certain sites, the loams and the clay and silt loams in site classes, I and II, and the silts and clay loams in site class III, have been left to regenerate naturally to aspen after clearcutting followed by no site preparation. Thinning trials will be conducted at some time during the 50-year rotation, but only on the best sites. Galloway (1985) says that 21 000 ha or 25% of the production area is in aspen.

The Minden District policy is aimed at converting mixed stands of largetooth aspen (the predominant species there), red maple, balsam fir, trembling aspen, white birch and white pine into relatively pure, even-aged, even-structured largetooth aspen stands. Soils in this district are of variable depth but typically shallow, acid to slightly calcareous, silty, fine sand over bedrock. The moisture regimes are variable but generally considerably higher than would normally be expected of upland, shallow, sandy soils. Harvesting is by commercial clearcut, followed by immediate felling or frilling and poisoning of all living residual trees. The poplar management plan (Hynard 1980) is based on a cutting operation that make complete utilization of the poplar (20 cm on the stump) and other species (25 cm on the stump). Incomplete utilization renders the cutover untreatable and further cutting improbable. Stands treated under this management plan have responded well. Within three years, the dominant aspen averages 3 to 5 m high and competing

regeneration is confined to the understorey.

There are now five waferboard mills in Ontario and although the pulp and paper industry is still the largest user of aspen, the growth in use is in waferboard. According to Ed Marcus, head of the Timber Sales Branch of the Ontario Ministry of Natural Resources, he now finds himself in the unusual position of having to referee fights over poplar allotments. In the last decade, utilization of aspen has gone from 0.9 million m³ in 1973-74 to 2.6 million m³ in 1984-85, and at present there are five greenfield projects, based on using aspen, awaiting a decision by Cabinet. One of the waferboard plants, that is operated by Mallette in Timmins, also has two particleboard lines. This is an interesting development as particleboard is normally furnished from sawmill and other wood residues. Mallette, however, has found that he can make a better and stronger board by using a combination of aspen wafers, residue from his sawmill located across the road, and fines screened out from the waferboard line. The thin (1/8") particleboard thus produced, is then upgraded for use as panelling by means of a vinyl overlay at another mill at New Liskeard.

Aspen in the Prairie Provinces

Aspen which forms over 40% of the forest cover in Manitoba, Saskatchewan and Alberta or 290 million cunits, is even more underutilized than in Ontario, at most 5% of the annual allowable cut. Yet aspen came very much to the fore in the early days, when this species was planted extensively to provide farm shelterbelts. From 1903 on, raising barefoot stock of aspen for shelterbelts was one of the main functions of a federal nursery established at Indian Head, Saskatchewan. Although aspen production continued to grow over the years, many of the early plantings suffered severely from frost, insects and disease. After 1965, native aspen was supplanted by rooted cuttings from hybrid poplars with clonal characteristics that were found to be better suited to this purpose.

Trembling aspen in the Prairie Provinces (largetooth is normally only found in southeastern Manitoba), like its eastern counterpart can colonize a variety of habitats, invading burns and cutovers, but showing greatest success on well drained sites. The treatment prescription as proposed by Steneker (1965), Bella and others calls for clearcutting followed by felling of all cull and unwanted trees and their removal to roadside, together with logging slash. General management policy summarized in one of Environment Canada's (1974) forestry reports recommends clearcutting of all poplar sites but with a size limitation on acreage clearcut; utilization to a minimum top diameter (4") with logs with crook, sweep and up to 50% rot to be harvested; integrated use of all species present in a mixedwood stand with insistence on the development of manufacturing plants capable of using both deciduous and coniferous species.

Again it will be waferboard that will largely determine how successfully these practices can be applied. At present there are only three mills in operation, one of which at Hudson Bay, Saskatchewan, is the grandfather of all waferboard plants in North America. Its product under the trade name of 'Aspenite' was first marketed in 1962. Another at Edson, Alberta is the only oriented strandboard mill now operating in Canada. This variant of waferboard has its wafers or strands deliberately aligned in the parallel to grain direction, giving greater strength to what is usually the long axis of the panel.

Aspen in the Lake States

Much of the management techniques now in effect in Canada were based on experience gained in the Lake States where aspen distribution and harvesting exceeds that of softwood (Einspahr 1985).

Aspen occupies about 5.45 million acres in Minnesota, 3.67 million in Wisconsin and 4.13 million in Michigan for a total of 13.25 million acres. Wisconsin's annual harvest is now exceeding growth and it is having to import about 25% of its aspen requirement; Michigan is approximately in balance, while Minnesota is still harvesting considerably less than its annual allowable cut. However for the Lake States as a whole, the present age class distribution provides the key to future aspen supply. For the short term, the supply is adequate because of the availability of older age classes (40 years and older). For the longer term (the year 2000 and later), supply problems will arise because of a serious age class imbalance. In Wisconsin for example, there are shortages in age classes 11-20, 21-30 and 31-40 while there are over 650 000 acres in stands 50 years and older. These older stands have a low growth rate, are deteriorating rapidly and their ability to regenerate through suckers is decreasing.

This brings up the second problem, which Einspahr refers to as 'timeliness of cut', that is particularly important in a shortlived species such as aspen. To obtain adequate regeneration and a proper age class balance, timely harvesting requires the opportunity for appropriate and complete utilization. The Lake States, as elsewhere in North America, have experienced a slowdown in the pulp and paper industry and in the building trade. The fear is that either through incomplete utilization or through absence of cutting, many of the aspen stands will move into the older age classes, thus adding to the imbalance at a later date.

The greatest use for aspen in these states is still for pulp and paper, with 38 mills. There are eight flakeboard (particleboard, waferboard and oriented strandboard) plants which in 1982 took 28% of the aspen production.

Envoi

The first president of the Poplar Council of Canada, Russell Johnson, cautioned the membership that "The first objective of this Council is to advance knowledge of *all poplar*, not only the hybrids". It was a point well made and only serves to confirm Environment Canada's Forestry Report (1974) "If ever there was a tree that could boast of being a 'true champion' of multiple use, it is the versatile poplar. In addition to serving a wide variety of man's needs, it provides home and food for wildlife, heals quickly our scarred landscape and provides a bright splash of fall colour to dazzle the eye".

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