ASSESSMENT OF TRIPLOID ASPEN PLANTINGS IN SASKATCHEWAN

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ABSTRACT

Triploid trembling aspen (*Populus tremuloides* Michx.) transplants were artificially propagated from root sprouts and out-planted on a bulldozed log landing and on an aspen cut-over in boreal Saskatchewan. Survival and growth for the first five year period were measured annually. Heights were compared with naturally regenerated aspen in neighboring five year old sucker stands.

Under the two relatively severe site conditions tested, good to excellent survival was shown and growth improved markedly in the third growing season. Heights attained at the end of five growing seasons were about half that of natural regenerated suckers. Various biotic factors, particularly aspen shoot blight (*Venturia macularis* (Fr.) E. Muell and Arx.) and animal browse damage at one plantation area adversely affected growth and tree form.

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INTRODUCTION

Trembling aspen (*Populus tremuloides* Michx.) is the most widely distributed tree in North America as well as being commercially the most valuable native poplar species (Maini, 1968). The raw material is used for a variety of wood products such as pulpwood, plywood, veneer, particle board and wafer board. Numerous other uses are presently being considered as well, such as fuel for energy, cattle feed and certain chemicals (Schneider, 1977: Young 1977).

Occasionaly, as in European aspen populations (*Populus tremula* L.), trees are found which possess three sets (triploid number) of chromosomes as compared to the normal diploid individuals which have two sets of chromosomes per cell (Muntzing, 1936). Naturally occurring triploids are usually distinguished from diploids by their unusually large tree size and large leaves. It is reported that in volume growth they can exceed neighboring diploids by as much as 64 percent (van Buijtenen et al, 1957). By comparison, they have a higher specific gravity, similar levels of cellulose and lignin, and fiber lengths 25 to 30 percent longer (van Buijtenen et al, 1957; Einspahr et al, 1967b).

The discovery of a triploid aspen clone in Riding Mountain National Park prompted the Canadian Forestry Service (CFS) to investigate this natural aspen phenomenon with two objectives in mind. One was to ascertain whether or not the use of root cuttings was a viable method of propagation; the other was to observe initial out-planting survival and growth characteristics in relation to natural diploid aspen suckers.

This report describes 5-year survival and growth performance of this material set out on two Saskatchewan sites in the Mixedwood (B.18a) section of the Boreal Forest Region (Rowe, 1972).

METHODS AND MATERIALS

In the fall 1973, young root segments (2.5 cm in diameter) were collected from a fully matured (94 year old) triploid aspen[1] clone located within Riding Mountain National Park (lat. 50°46'W, long. 99°59'W). Propagation of the material was carried out at the Northern Forest Research Centre (NFRC) in Edmonton, Alberta. Approximately 100 root sprouts were successfully rooted in the greenhouse by using techniques similar to those described by Benson and Schwalbach (1970), and Zufa (1971). The sprouts were potted in 450 cm^3 plastic flower pots using 1:1:1 mixture of peat, loam and sand for the potting medium.

Out-planting took place in early summer 1974 at two locations in Saskatchewan, at which time the seedlings ranged from 6 - 27 cm in height (average 15cm). The first planting site was selected near Hudson Bay (lat. 53°15'N, long. 102°7'W) where half of the transplants (40 seedlings) were set out on a bulldozed log landing adjacent to a recently logged (winter 1974) aspen stand. Clearing of the landing had effectively removed most of the organic mantle to bare mineral soil. The soil is a relatively shallow clay (pH 7.6) of glacial till origin overlying gravel and sands. Soil moisture regime (Hills, 1955) was rated 3 (moderately moist). On June 7, 1974 the 8 month old container seedlings were removed from the plastic pots and hole planted into holes which were bored 45 cm deep with a 15.2 cm power auger bit. The holes were set 4.6 m apart within 5 rows and those in alternate rows were staggered in respect with the ones adjacent.

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1. The triploidy of this clone was confirmed by the Institute of Paper Chemistry, Appleton, Wis. (Einspahr et al, 1963).

The second planting site was established July 14, 1978 near Candle Lake (lat. 53°38'N, long. 105°18'W) on a clear felled aspen cutover that had been logged in the spring. The soil is a fluvial-lacustrine loam (pH 5.2) overlying glacial till. Soil moisture regime (Hills, 1955) was rated 2 (fresh). Here the 9 month old seedlings (40 transplants), after removal from the containers, were hold planted with a spade in 4 rows at 3.0 x 3.0 m spacing. Immediately following planting in both of the areas, each individual seedling was fenced with a wire mesh cage (1.2 m high) to protect the transplants from animal damage.

Height growth measurements and condition of seedling survivors were recorded annually in the fall for the first five years (1974-1978). Weeding during this period was very minimal until the fifth summer when all vegetative competition surrounding seedling survivors was cut and removed. Also, height of natural regenerated trembling aspen in those stands bordering the plantations were measured for comparative purposes.

Height growth differences at 5 years between the two plantation sites were compared and analyzed by the t-test. The general condition of surviving seedlings in the plantations was also described.

RESULTS

Survival

Survival of the planted seedlings at the end of five years was better at the Candle Lake plot (95% vs 85% at Hudson Bay). Mortality was usually restricted to seedlings of low vigor. Damage from ungulates contributed to lower survival rate at Hudson Bay.

Height Growth

Virtually no shoot growth occurred after outplanting in the first season mainly because the potted transplants had become dormant during the

hardening off period prior to planting. By the third season though, an improved growth rate became more apparent (Figure 1). Overall growth at the end of the first five years was somewhat greater at the Candle Lake plot. Average total height was 131 cm as compared to 111 cm for seedlings at Hudson Bay. However, this difference was not significant at the 95% level as indicated by the t-test. In general, terminal browsing and soil compaction of the log landing at Hudson Bay were partly responsible for the comparatively reduced height growth. Average height of vegetatively regenerated aspen, as determined from transect line sample measurements in the adjacent five year old sucker stands, showed their heights (both areas combined) were nearly twice that of the planted triploids (241 cm vs 122 cm). The sucker stand stocking densities were 29,653 and 19,768 stems/ha at the Hudson Bay and Candle Lake sites respectively.

Biotic Factors

In both of the plantation areas, aspen shoot blight, *Venturia macularis* (Fr.) E. Muell and V. Arx., and a foliage disease from aspen ink spot, *Ciborinia whetzellii* (Seav.), were the principal pathological agents affecting the triploid seedlings. Both persisted annually, the shoot blight with the resultant "shepherd's crooks" was responsible for a considerable amount of terminal dieback (Table 1). Leaf losses and early defoliation were often noticeable on those infected with ink spot. Observations showed that these two disease agents usually prevailed in the neighboring natural regenerated aspen stands as well. Unidentified fungus galls, more noticeably at Candle Lake, appeared on stems and branchwood of some seedlings. At Hudson Bay, browsing damages occurred from ungulates.

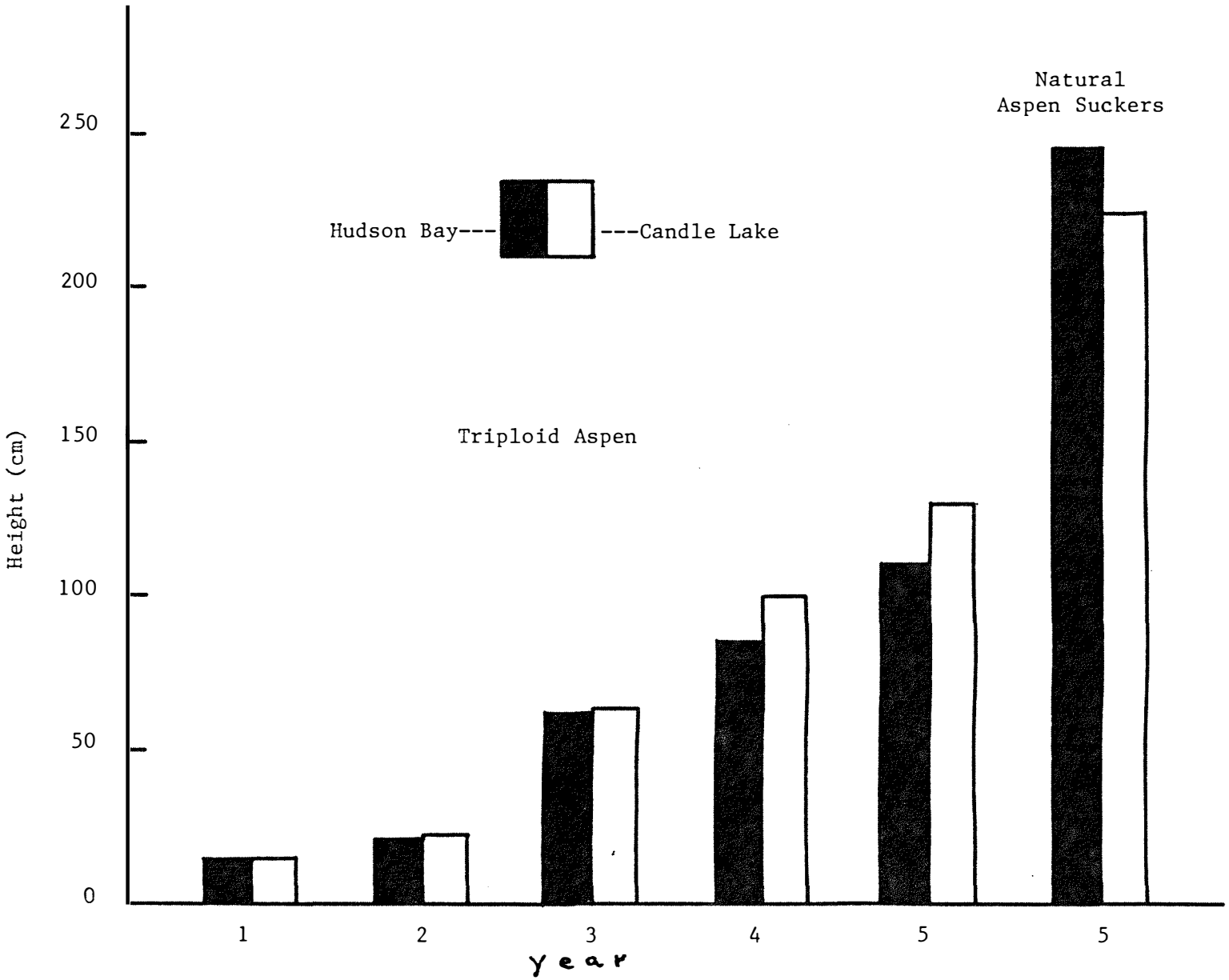

Figure 1. Average height of triploid seedlings over five growing seasons.

Table 1. Biotic factors affecting surviving triploids and natural aspen suckers in the fifth growing season.

Seedling condition	Hudson Bay		Candle Lake	
	Planted[1] triploids (%)	Natural[2] suckers (%)	Planted[3] triploids (%)	Natural[4] suckers (%)
Shoot blight and dieback	29.4	38.3	24.2	35.0
Shoot blight and Stem gall	--	--	5.3	--
Stem gall	2.9	1.7	10.6	5.0
Leaf-Ink spot	17.6	10.0	5.2	7.5
Browse damage	11.8	--	--	--
Undamaged	38.3	51.0	55.2	52.5

1,2,3 & 4: Based on 34, 60, 38 and 40 seedlings respectively.

Tree Form

Ocular estimation of tree stem and crown quality rated nearly half of the seedlings (47% in both areas) as having acceptably good tree form (Table 2). The remaining ones were categorized intermediate and poor. Generally, they displayed crooked and kinky stems or malformed and forked crowns. The degree of crown fork was often found to be a reflection of damage sustained by the lateral branch and terminal shoots from infections of shoot blight. Browse damage of branchwood was responsible for reducing the quality of some seedlings at Hudson Bay.

Table 2. Tree form development of triploid seedlings after five growing seasons.

Tree form description	Form Class (percent)[1]					
	Good		Intermediate		Poor	
	Hudson Bay	Candle Lake	Hudson Bay	Candle Lake	Hudson Bay	Candle Lake
Straight stem	38.2	42.0	--	--	--	--
Top forked (only)	8.8	5.3	11.8	13.2	8.8	7.9
Crooked & Kinky stem	--	--	11.8	13.2	--	--
Crooked & Forked	--	--	2.9	7.9	5.9	2.6
Browse Damaged	--	--	5.9	--	5.9	7.9
ALL	47.0	47.3	32.4	34.3	20.6	18.4

1. Data based on 34 and 38 surviving seedlings at Hudson Bay and Candle Lake respectively.

Vegetative Competition

At the Hudson Bay plot, vegetative competition remained relatively light over the first five year period and did not appear to affect seedlings adversely (Figure 2). Most notable were the invasion of common horsetail[1], strawberry, sow thistle, fireweed and wheat grass. Suckering from aspen and reinvasion of dogwood, willow and prickly rose shrub remained light.

In contrast, seedlings on the undisturbed cutover at the Candle Lake plot were becoming overtopped by natural aspen and green alder shrubs by the fifth summer (Figure 3). Other less abundant shrubs were: lowbush cranberry, beaked hazelnut, snowberry, wild current and prickly rose. Herbaceous plants in the lower stratum included a moderate abundance of wild sarasparilla, lungwort, bunchberry, wintergreen, fireweed, vetchling and some reed grass. It was noted that the wire-mesh fence enclosures often afforded some protection to the seedlings from smothering by encroaching vegetation.

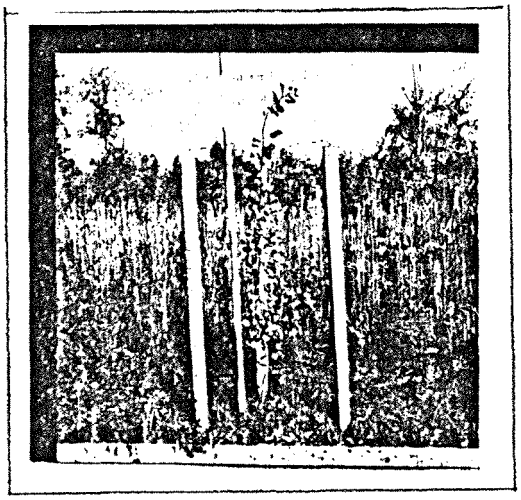

Figure 2. Vegetation condition at five years on Hudson Bay plot.

Figure 3. Vegetation condition at five years on Candle Lake plot.

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1. See Appendix I for Botanical names of plants.

DISCUSSION AND CONCLUSIONS

This trial gave a good indication of the behaviour of triploid trembling aspen transplants set out in field conditions that are normally associated with logging--as in contrast to those which would be expected under a controlled tree nursery environment. Therefore, perhaps most revealing was the high seedling survival rate (85% and 95%, Hudson Bay and Candle Lake respectively) at the end of the first five year period. This is encouraging in view of the fact that some of the conditions were considered adverse for seedling growth, such as the soil compaction on the log landing at Hudson Bay and the considerable vegetative competition which transplants were subjected to on the clear-felled area at Candle Lake.

Initial height growth was understandably slower than that shown for naturally occurring diploid aspen in the five year old sucker stands (overall average 241 cm vs 122 cm, both areas combined). Day (1944) indicates this is the case with natural aspen seedlings originating from seed as well. The suckers have an advantage in that they are initially sustained by the established parent tree root system from which they originated (Day, 1944; Sandberg and Schneider, 1953; Maini, 1968). Nonetheless, evidences of significant early growth gains by the triploid aspen were shown by certain individual seedlings in both areas. Height measurements showed some had exceeded 200 cm by the end of the fifth growing season.

Difference in height growth between the two planting sites tested were slight. Seedlings on the clear felled site at Candle Lake were somewhat taller than those on the log landing at Hudson Bay. The seedlings on the landing were often noted to be under a certain degree of stress and reduced vigor. This was attributed largely to a depletion of the soil nutrients through removal of the surface organic matter by bulldozing plus compaction of the soil. As a result, it was concluded that planting directly on the clear-felled logging site was more favourable than on the prepared landing.

Because infection sources are usually present in associate stands, it is unlikely that pathological and entomological factors could be effectively controlled within a plantation. Nevertheless, certain control measures such as sanitation, pesticide treatments and fencing from animals would be very much in order for improving tree development at least during the juvenile stage. This has been evident through the growth observed on 20 of these triploid seedlings which were field planted at the NFRC. They are presently 3 m tall at five years.

In conclusion, it is pointed out that five years is too short a period to evaluate the degree of any inherent growth potentiality of the triploid aspen tested. On the other hand, the encouraging survival results demonstrate, for forest management purposes, the feasibility of introducing superior-clone material to the boreal forest zone of the prairie provinces.

APPENDIX 1

List of common and botanical names of plants referred to in text.

Beaked hazelnut	*Corylus cornuta* Marsh
Common horsetail	*Equisetum arvense* L.
Bunchberry	*Cornus canadensis* L.
Dogwood	*Cornus stolonifera* Michx.
Fireweed	*Epilobium angustifolium* L.
Green alder	*Alnus crispa* (Ait.) Pursh
Lowbush cranberry	*Viburnum edule* (Michx.) Raf.
Lungwort	*Mertensia paniculata* (Ait.) G. Don
Reed grass	*Calamagrostis* sp.
Prickly rose	*Rosa acicularis* Lindl.
Snowberry	*Symphoricarpos albus* (L.)
Sow thistle	*Sonchus arvensis* L.
Strawberry	*Fragaria virginiana* Duchesne
Trembling aspen	*Populus tremuloides* Michx.
Vetchling	*Lathyrus ochroleucus* Hook.
Wheat grass	*Agropyron* sp.
Wild currant	*Ribes* sp.
Willow	*Salix* sp.
Wild sarsaparilla	*Aralia nudicaulis* L.
Wintergreen	*Pyrola asarifolia* Michx.

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