TEST PLANTINGS OF POPLAR CULTIVARS IN MANITOBA

Project MS 004

by

K. J. Roller and D. H. Thibault

FOREST RESEARCH LABORATORY

WINNIPEG, MANITOBA

INTERNAL REPORT MS-101

October 1969

TEST PLANTINGS OF POPLAR CULTIVARS[1] IN MANITOBA

by

K. J. Roller and D. H. Thibault[2]

INTRODUCTION

In 1965 the authors began to establish test plantings of poplar cultivars in various areas throughout the province of Manitoba. The aim of the project was the selection of those clones, hybrids and species which give greater promise of value for use in the production of wood and in the plantations of unforested lands. In addition, the trials may extend knowledge of poplar genetics and breeding methods and improve poplar cultivation under prairie conditions. Desirable features of trees for these conditions are inherent rapid growth rate, wind resistance, tolerance to winter and late frost, ability to survive the frequent summer drought and water deficiency in poorly drained soils.

For farm planting the breeding of male and sterile female clones may be a need. The fluffy cotton of productive female trees falls to the ground after ripening, covering it fully, making it difficult to keep the farmyard clean.

A progress report (MS-29, 1966) presented by the above authors has given information after one growing season about the results of the trials established in 1965. The present report offers the latest information about the location, activity and measurement data of test plantings established in various parts of Manitoba since 1965 (Table 1). The authors do not make an effort to evaluate the measurement data taken from the trials because the past five years are not sufficient to draw conclusions on any characteristics mentioned above. The only purpose of this report is to record a case history and observations and list the test plantings for future information to those who will deal with the cultivars in use in the prairie provinces.

MATERIAL AND METHODS

During a three-year period commenced in 1965, 845 two-year-old rooted cuttings were set out. The cuttings represent 22 different cultivars (Table 2) originated or assembled by the P.F.R.A. Forest Tree Nursery at Indian Head, Saskatchewan.

---

[1] Cultivar means abbreviation of 'cultivated variety'. In this report, all clones, hybrids and species in use are concerned under this abbreviation.

[2] Research Scientist and Technician respectively, Department of Fisheries and Forestry, Canadian Forestry Service, Manitoba-Saskatchewan Region.

In all test plantings, the rooted cuttings were planted into pits, 50 cms in depth and 30 cms in diameter. Before planting, lateral roots, mainly long hair roots, were cut off to about eight inches in length. The treated cuttings were placed into the pits so that one or two buds remained beneath the ground surface. After planting, the stems were cut back near the ground.

Rooted cuttings in the test plantings were arranged in randomized blocks. Number of replications varied among trials. Each replication (or block) contains one cutting of each clone. The location of trees were mapped in each test planting and stakes marked with a code number (Table 2) were used at each plot for identification.

Survival and growth records were taken three times in each year: in July, August and October. In the 1965 plantation at Riding Mountain height was measured every 10 days in August from 1966 to 1968 to determine the growth cessation date of the clones planted.

PLANTATION CASE HISTORIES

Clonal test: 1965 RM

Time of planting: May 26

Methods:

The site was cleared of a good stand of spruce-aspen in 1960. Before planting, the area was bulldozed and raw humus was removed from the soil surface. At the time of planting the soil was soaked with moisture and wet snow covered the ground.

Twelve clones were planted at four feet by four feet spacing in five replications and a total of 60 plants were set out.

The planted area was fenced with barbed wire to protect the trial against damage by deer, elk and moose.

Weeding was provided by rototiller twice yearly in July and August in each consecutive growing season from 1965 to 1968.

Results:

Survival data are presented in Figure 1. Figure 1 shows also the four-year height growth of surviving trees.

Dates of bud burst, height growth cessation, defoliation and the response to winter and late frost were assessed from 1966 to 1968. The list of assessment shows yearly variability of phenological characteristics within each clone obviously due to the different climatic conditions in each growing season. For preliminary information, the authors consider to be worthwhile the presentation of Table 3.

Frost hardiness is associated with defoliation. Clones *P.* x cv. 'gelrica' and *P.*? cv. 'FNS #44-52' had the latest defoliation and suffered almost each

year from early frost while P. x cvs. 'Saskatchewan', 'Northwest' and 'Brooks #1' had the earliest defoliation and appeared to be hardy.

The greatest growth rate of the trees at Riding Mountain occurred in 1967 and the lowest in 1968. The correlation of mean plantation growth with climatic data such as rainfall, dew fall, sunshine and solar radiation, suggests that height growth responds to total solar radiation which was abundant in 1967. Observations indicate that solar radiation is more important than precipitation under the conditions at Riding Mountain where moisture of air and soil provide sufficient water supply to the growing trees for all seasons.

Clonal test: 1965 H

Time of planting: May 15

Location:

The trial is located in the northeastern corner of the Pineland Tree Nursery, Hadashville, along the Whitemouth River adjacent to a block of about 50 trees of Populus tristis. It is a severe hazard area of Septoria musiva. The canker infected the trees of P. tristis that had been planted nearby in 1960 (Zalasky 1968).

Method:

Soil was ploughed and harrowed for producing seedlings.

Weather condition was warm and dry at the time of planting.

Twelve clones were planted at four feet by four feet spacing in five replications and a total of 60 plants were set out.

Soil cultivation between rows was not provided during the four years. Hand tools were used casually to eliminate weed competition in area around the trees.

In the fourth year those trees, which were severely infected by canker, had been removed from the trial. About 15 of the 60 planted trees were selected to maintain for further demonstration. The remainder were trimmed to one straight stem.

Results:

Because of the great number of heavily damaged trees found in 1968 it was decided to analyse the height growth of the clones as the assessment of 1967 when a proper number of trees were still available as effective for measurement.

Figure 2 presents data of height and survival measured in 1967 after three growing seasons. Failures for all clones with the exception of P. x cv. 'gelrica' occurred by July 23 of the first growing season (1965) probably due

to the shock of transplanting. Immediately after planting some of the rooted cuttings started to sprout weakly from the base but died during that summer.

During the four growing seasons it was observed that leaf-rust, freeze-back and canker infection occurred at many plots causing serious detriments in the trial. The injuries repeatedly killed back the trees reducing them to shrubly individuals. The disastrous effects in the trial culminated in 1968 and a few trees remained only in fair shape. A complete report was presented by Zalasky et al (1968) on kind of damage suffered by each cultivar.

Survival and growth were best in the block closest to the Whitemouth River. It is shown on Figure 4 by a tree of P. x cv. 'FNS #44-52'. The trees there were probably supplied with sufficient capillary moisture from the river during the dry summer periods.

In 1967, P.? cv. 'cordeniensis' has shown the best result of all. Five plots survived and appeared to pass the severe infections. This clone, however, is highly susceptible to deformation by wind (Figure 6), and those which are located in the exposed blocks of the trial, in the western half of the planting area strongly bent toward their lee side.

On the basis of assessments in 1967, a comparison was made between the average heights of clones planted at Riding Mountain and Hadashville in 1965. The diagram in Figure 3 demonstrates that P.? cv. 'FNS #44-52', P. x cvs. 'gelrica' and 'robusta vernirubens', all from the group of Aigieiros or its hybrids have grown faster at Hadashville than at Riding Mountain while clones P. x cv. 'Saskatchewan' and P. x Petrowskyana did not perform differences in growth rate either at Hadashville or at Riding Mountain. P.? cv. 'cordeniensis', a promising hardy clone, was third best at Riding Mountain, a less productive site, while exhibited fairly good result in Hadashville.

The trial at Hadashville is inadequate for further test because of the numerous missing plots. It is therefore qualified as inactive and should be maintained only for demonstration purposes.

Clonal test: 1965 G

Time of planting: May 20

Location:

The planting site is located in a recreation area at Birch Lodge on the beach of Lake St. George.

Method:

The planting site was cleared of a poor stand of aspen for picnic place in 1958. The ground was covered with grasses and Ledum. No soil cultivation was provided and the rooted cuttings were set out in the rough. Humus soil from the nearby aspen forest was placed into the pits beneath the root system of cuttings to improve the conditions of heavy soil.

Weather was warm and dry at the time of planting. Wet snow had fallen however in the following days after planting.

Twelve clones were planted at four feet by four feet spacing in five replications and a total of 60 plants were set out.

In 1965 and 1966, hand tools were used casually to eliminate weed competition in the immediate surroundings of trees. Although the plots were marked with posts and with a line of barbed wire around the planted area the trees were heavily harmed by picnickers and cut accidentally by lawn mower in the maintenance of picnic ground.

Results:

With the exception of P. x cv. 'Saskatchewan' and P.? cv. 'cordeniensis', three and four survivals respectively, all clones failed by the end of three years largely as a result of injury by people and freeze-back.

The average height of those individuals escaping detriments averaged 111 cms for P. x cv. 'Saskatchewan' and 147 cms for P.? cv. 'cordeniensis'.

Because of the great numbers of failure the trial was discontinued in 1967.

Clonal test: 1966 RM

Time of planting: May 22

Methods:

The area used for this trial was cleared of a good spruce-aspen stand nearby a test planting of aspen clones conducted by the Silviculture Section. The ground was completely prepared for planting in 1965 and after the soil was weeded and cultivated by rototiller regularly.

The whole area about 20 acres, which includes both the hybrids and the aspen clone test was fenced with barbed wire. The fence does not seal the area completely therefore the protection against browsing of deer and elk is not effective.

Rooted cuttings of 17 hybrid poplars listed in Table 4, and aspen produced of open-pollinated seed were planted in five by five foot spacing and in 10 replications.

Results:

Table 4 presents data measured in October 1968. There was a wide range of variation concerning survival and growth rate among the clones tested.

The average survival was 57 per cent for all the 180 trees tested at the end of the first growing season and it has not changed substantially since. Dry weather conditions and great weed competition, at the beginning of the growing season in 1966, may explain the high percentage of mortality.

In the first year the range of average growth rate was from 50 cms to 90 cms, in the second year from 40 cms to 50 cms, and the third year from 35 cms to 120 cms.

Clonal test: 1966 H

Time of planting: May 20

Location:

The test planting area is situated in the first shelter-strip west of the Pineland Forest Tree Nursery office in a southwest direction.

Method:

The site was cleared of some aspen trees and of dense cover of hazels and grasses. No soil cultivation was provided before planting, only the immediate surrounding of the plots were hoed at the time of set-out.

Unusual warm days followed the planting and the mercury arose to 80° and 85° for a few days in the end of May.

The same clones were planted here as in Project 1966 RM at four feet by four feet spacing in 10 replications and a total of 180 rooted cuttings were set out.

Weeding was provided by rototiller first in June of the first year then each consecutive year in July. However, the weeding without soil cultivation was insufficient against the dense grass cover which induced tremendous competition for the planted trees in the poorly drained soil.

Results:

At the end of the first growing season (1966) average survival was 53 per cent for the total and it steadily declined to 30 per cent until the end of the third growing season. Only four clones survived 70 per cent or better: P. x cv. 'Griffin' and P. x cv. 'Brooks #7'--70 per cent; P. x cv. 'Saskatchewan'--80 per cent; P. x Petrowskyana--100 per cent.

Those which failed, about two-thirds of the trees, suffered from heavy weed competition and frost, and died back frequently.

The best growth was made by clone P. cv. 'Volunteer'--238 cms, next highest P.? cv. 'cordeniensis'--231 cms, and P. x Petrowskyana--220 cms. P. tristis and P. nigra var. betulifolia exhibited about 100 cms in height. Complete data are listed in Table 4.

Some of the clones produced better growth rate here than those at Riding Mountain in the simultaneous trial established in the same year. Table 4 presents the self-explanatory comparison between the two test plantings. Only P. x Petrowskyana has shown definite promise in both plantations. This clone has high survival, good growth and form, and so far has been free of canker and freezing injury. Some of the other lots had relatively good survival but less growth or vice versa.

Because of continuous mortality in the test planting at Hadashville no further assessment will be expected and the project is qualified as inactive.

Clonal test: 1967 PO

Time of planting: May 5

Location:

The test planting is situated in the flat area of an abandoned farm land previously used for wheat production.

Method:

The soil was ploughed and disked in the proceeding year.

Wet snow fell at the time of planting activity and the soil was saturated with moisture.

Fifteen clones, a total of 150 rooted cuttings, were planted (Table 5) at eight by ten feet spacing in 10 replications.

A soil test, taken after planting, suggested the application of fertilizer. Eight ounces of No. 11-48-0 were added to the soil, dispersed around trees of each lot in every second replication. This arrangement resulted a randomized block design of 15 lots in five replications, i.e., five fertilized blocks and five control blocks.

Weeding and soil cultivation have been done regularly in June, July and August by tractor-drawn disk.

Results:

After the second growing season the clones have shown promising results. The survival and average heights of living trees are listed in Table 5.

Neither freeze-back nor canker caused serious detriments, probably due to the complete ground preparation. Canker might have entered the picture if the clones had developed longer. However, aspen and balsam poplars in the surroundings are heavily infected by leaf rust and canker.

The effects of the application of fertilizer may become of greater importance in a later stage of experiment after the test planting will be well-established. No effect on the survival or growth of the trees can be found yet.

Clonal test: 1967 SL

Time of planting: May 20

Location:

The trial is situated in the area of an abandoned farm land and surrounded with a plantation of hybrid poplars, especially P.? cv. 'FNS #44-52' which was established by the Department of Mines and Natural Resources, Manitoba, in the same year as the present project.

Method:

Soil was cultivated by plough and disk in the fall preceding the planting activity for producing of wheat and corn.

The same clones were planted as in Project 1967 PO. at five by five feet spacing in five replications. A total of 75 rooted cuttings was set out.

Soil cultivation and weeding were made regularly by rototiller between rows and by hand tools in the immediate surroundings of the lots.

Results:

Survival and heights are listed in Table 5.

In the early June of 1967, after the cuttings started to sprout, late frost damaged the tender leaves and terminal shoots, then heavy browsing was observed during the summer. In spite of these detriments the growth rate of the clones reached satisfactory results at the end of the second growing season. An efficient evaluation of this trial is suggested in a later stage after the trees will be recovered from the damages caused by frost and browsing at the first year of planting.

DISCUSSION

Observations taken from the test plantings resulted in a number of suggestions. These suggestions may present ideas on which the method and technique of planting operation shall be developed.

Different spacings were used in the trials. Close spacing apparently results problems in the soil cultivation and after several years in the thinning operations. Spacing of eight feet by ten feet seems to be relevant. Wide spacing such as eight feet by ten feet makes possible the use of tractor-drawn cultivator which reduces the cost of maintenance. Furthermore, it provides a close canopy eight or ten years after planting when thinning should be profitable.

Single-tree plot design does not produce adequate data for statistical analyses because of the great number of possible missing plots. In this case, because of high variability in growth within cultivar, interpolation between

heights plotted in the different blocks does not sufficiently represent true value of heights for the missing plots. The use of from four to nine individuals of one cultivar per block would be appropriate.

Cutting back of the leader of tree to one or two lateral buds after planting retards early growth during the first year and reduces the overtaxing of the root system. On the other hand, the retarded early growth decreases the possibility of frost damage usually ensuing in late May in Manitoba. Furthermore, the lateral bud of short stub above ground may be tied to vertical splint to obtain single, straight-stemmed sprout.

For soil cultivation, best success should come with these practices: (1) complete plowing and fitting; (2) careful cultivation at least for the first three years. In addition, planting of proper cultivars into adequate soil and area is suggested. Good poplar soils are: sandy loam, silt loam and alluvial soil along river banks and lake beaches.

The test plantings analysed in the above report indicate that better cultivars should still be sought. While not all the cultivars have proven successful, some of them showed sufficiently good growth and form to warrant their use in further breeding work. Species native to this region should be used in good share of their crosses. However, there are a number of other poplar cultivars developed in the northern hemisphere which are frost-hardy and resistant enough and should be tested in this region also.

REFERENCES

Cumming, W. A. 1966. Personal communication.

Maini, S. S. and J. H. Cayford. 1968. Growth and utilization of poplars in Canada. Can. Dep. Forestry and Rural Development, Publ. No. 1205.

Roller, K. J. 1966. Tree improvement in the Manitoba-Saskatchewan Region. Proc. 10th meeting of the C.F.T.B., Vancouver, B.C., Sept. 7-10, pp. 129-135.

Zalasky, H., O. K. Fenn and C. H. Lindquist. 1968. Reactions of poplars to infection by Septoria musiva and Diplodia tumefaciens and to injury by frost in Manitoba and Saskatchewan. Plant Disease Reporter, vol. 52, No. 11.

Table 1. Establishment data of test plantings. Project number: TBL MS 004.

Year and location index	Location	Soil type	No. of clones	No. of rooted cutting	Spacing	Remarks
1965 H	Hadashville Nursery NE ¼, S.9; Tp. 8; R.12 Elev. 980'	Very fine sandy loam on gleyed dark grey wooded. Imperfectly drained. pH 7.1 - 7.5	12	60	4' x 4'	Inactive
1965 G	Lake St. George NW ¼, S.4; Tp. 32; R. 1E Elev. 730'	Gleyed degraded brown wooded. Imperfectly drained. pH 6.8 - 7.2	12	60	4' x 4'	Inactive
1965 RM	Riding Mountain Res. Station SE ¼, S.25; Tp. 20; R.19 Elev. 2300'	Grey wooded. Clay loam over shale. Imperfectly drained. pH 7.7	12	60	4' x 4'	Active
1966 H	Hadashville Nursery NE ¼, S.9; Tp. 8; R.12 Elev. 980'	Moderately calcareous sand deposit. Poor drainage. pH 7.1 - 7.8	22	220	4' x 4'	Inactive
1966 RM	Riding Mountain Res. Station NE ¼, S.31; Tp. 20; R.18 Elev. 2300'	Grey wooded. Clay loam over shale. Imperfectly drained. pH 7.7	18	220	5' x 5'	Active
1967 PO	Polonia SW ¼, S.23; Tp. 16; R.16 Elev. 2000'	Grey wooded clay loam. Medium textured till of dominantly shale origin. Well drained. pH 6.4	15	150	8' x 10'	Active
1967 SL	Piney (Sandilands) NE ¼, S.28; Tp. 1; R.12 Elev. 1150'	Orthic grey wooded. Good drainage. Slightly stony. pH 6.6	15	75	5' x 5'	Active

Table 2. List of cultivars in use for test plantings in Manitoba.

Code No.	Common name	Botanical name	Parentage; Source; Originator; Reference
SECTION: AIGEIROS			
6	Gelrica	P. x euramericana (Dode) Guinier cv. 'Gelrica'	P. nigra L. x P. deltoides Marsh.; Netherlands; Unknown; Anon. 1958.
9	Plains cottonwood	P. Sargentii Dode	P. deltoides occidentalis Rydb.; S. Sask. and S. Alta.; Little, Jr. 1953.
10	Robust poplar	P. x euramericana (Dode) Guinier cv. 'Robusta vernirubens'	P. nigra L. x P. deltoides Marsh.; England; Henry, 1914; Anon. 1958.
19	Unknown	P. nigra L. var. betulifolia (Pursh) Torr.	P. nigra L.; U.S.A.; Pursh 1800; Rehder 1951.
24	Siouxland	P. x deltoides Marsh cv. 'Siouxland' Nagel	P. deltoides Bartr.; S. Dakota 1945; C.M. Nagel; Nagel 1955.
25	Unknown	P. x euramericana (Dode) Guinier cv. 'Angulata de Chautagne erecta'	P. angulata Ait.; Kew; Unknown; Little, Jr. 1953.
SECTION: TACAMAHACA			
2	Asiatic balsam	P. tristis Fish.	P. tristis Fish.; C. Asia; Species; Rehder 1951.
14	Simonii poplar	P. simonii Carr. var. cv. 'Fastigiata' Schneid.	P. simonii Carr.; Germany; Schneider 1910; Rehder 1951.
21	Asiatic balsam #1	P. x tristis Fish. cv. 'Tristis #1' Skinner	P. tristis Fish.; Dropmore, Man.; Skinner; Roller 1966.
23	P38. P38	P. x tacamahaca Mill. cv. 'P38. P38'	P. balsamifera L. x P. simonii Carr.; Saskatchewan; Smith; Cram 1960.
HYBRIDS BETWEEN AIGEIROS AND TACAMAHACA			
1	Northwest	P. x deltoides Marsh. cv. 'Northwest'	P. deltoides Marsh. x ?; U.S.A.; Unknown; Maini 1968.
4	Saskatchewan	P. x deltoides Marsh. cv. 'Saskatchewan'	P. deltoides Marsh. x ?; Saskatoon; Unknown; Maini 1968.
5	Berlin poplar	P. x Berolinensis Dipp.	P. laurifolia Ledeb. x nigra var. italica Muenchh.; Berlin; Dippel 1880; Rehder 1951.

Table 2 (cont'd)

Code No.	Common name	Botanical name	Parentage; Source; Originator; Reference
12	Petrowskyana	*P.* x *Petrowskyana* Schneid.	? *P. laurifolia* Ledeb. x *deltoides* Marsh.; Germany; Schneider 1922; Rehder 1951.
13	Brooks #1	*P.* x *deltoides* Marsh. cv. 'Brooks #1'	*P. deltoides* Marsh. x ?; Brooks; Griffin; Cram 1960.
16	Griffin	*P.* x *deltoides* Marsh. cv. 'Griffin'	*P. deltoides* Marsh. x ?; Brooks, Alta.; Griffin; Cram 1960.
17	Skinner #2	*P.* x *deltoides* var. *monilifera* Henry cv. 'Skinner #2'	*P. deltoides* var. *monilifera* Henry; Dropmore; Skinner; Roller 1966.
18	Brooks #7	*P.* x *deltoides* Marsh. cv. 'Brooks #7'	*P. deltoides* Marsh. x ?; Brooks, Alta.; Griffin; Cram 1960.
UNIDENTIFIED CULTIVARS			
3	44-52	*P.*? cv. 'FNS #44-52'	*P. deltoides* Marsh. x ?; Indian Head; Walker; Maini 1968.
7	Dunlop	*P.*? cv. 'Dunlop'	*P. deltoides* Marsh. x ?; Conquest, Sask.; Dunlop; Maini 1968.
8	Volunteer	*P.*? cv. 'Volunteer'	? *P. laurifolia* Ledeb. x ?; Sutherland; Kerr; Maini 1968.
11	Unknown	P.? cv. 'Cordeniensis'	? *P. balsamifera* x ?; Ottawa 1939; Unknown; Cumming 1966.

Note: The botanical names of cultivars conform to the International code of Nomenclature for Cultivated Plants and accordingly have been placed in single quotation marks.

Table 3. Time of bud burst, height growth cessation and defoliation, response to late and early frost (tolerant = 0; moderately tolerant = 1; not tolerant = 2). Dates are based on three-year observation at Riding Mountain from 1966 to 1968.

Cultivar	Time of			Frost resistance
	Bud burst	Height growth cessation	Defoliation	
'Brooks #1'	May 15	Aug. 15	Oct. 1	0
Petrowskyana	May 15	Sept. 20	Oct. 10	0
'Volunteer'	May 15	Aug. 25	Oct. 15	0
'Saskatchewan'	June 5	Aug. 15	Oct. 1	0
Tristis	June 1	Sept. 5	Oct. 10	0
'Northwest'	May 15	Aug. 15	Oct. 1	0
'Cordeniensis'	May 15	Sept. 5	Oct. 10	1
'Vernirubens'	May 25	Sept. 25	Oct. 5	1
Sargentii	May 20	Sept. 20	Oct. 15	1
'FNS #44-52'	May 20	Sept. 10	Oct. 20	1
'Gelrica'	June 5	Aug. 10	Oct. 20	2
'Berolinensis'	June 1	Aug. 20	Oct. 15	2

Table 4. Results of poplar cultivars planted in 1966 at Riding Mountain and at Hadashville. Assessment of October 1968.

Code No.	Clone	Riding Mountain		Hadashville	
		Survival no. (out of ten)	Height ± $S_{\bar{x}}$ cm	Survival no. (out of ten)	Height ± $S_{\bar{x}}$ cm
1	'Northwest'	10	161 ± 16	3	166 ± 56
2	Tristis	5	115 ± 58	3	109 ± 30
3	'FNS #44-52'	3	186 ± 82	4	166 ± 22
4	'Saskatchewan'	9	184 ± 23	8	167 ± 12
5	'Berolinensis'	0	-	0	-
6	'Gelrica'	4	122 ± 48	0	-
7	'Dunlop'	3	114 ± 90	0	-
8	'Volunteer'	2	160 ± 114	3	223 ± 52
10	'Robusta vernirubens'	0	-	0	-
11	'Cordeniensis'	6	167 ± 33	3	231 ± 56
12	Petrowskyana	10	145 ± 25	10	220 ± 41
14	'Simonii cv., fastigiata'	1	97 ± 0	0	-
16	'Griffin'	9	154 ± 23	7	151 ± 22
17	'Skinner #2'	9	106 ± 16	4	136 ± 60
18	'Brooks #7'	8	143 ± 19	7	168 ± 42
19	'Nigra betulifolia'	9	135 ± 18	4	107 ± 35
21	'Tristis #1'	4	162 ± 32	4	147 ± 32
0	Tremuloides	7	89 ± 20	0	-

Legend: $S_{\bar{x}}$ = standard error.

Table 5. Results of poplar cultivars planted in 1967 at Polonia and Piney. Assessment of October 1968.

Code No.	Clone	Polonia		Piney	
		Survival no. (out of ten)	Height $\pm$ $S_{\bar{x}}$ cm	Survival no. (out of ten)	Height $\pm$ $S_{\bar{x}}$ cm
1	'Northwest'	6	109 $\pm$ 23	5	116 $\pm$ 11
2	Tristis	8	93 $\pm$ 28	2	142 $\pm$ 24
3	'FNS #44-52'	10	143 $\pm$ 20	5	142 $\pm$ 14
4	'Saskatchewan'	9	97 $\pm$ 16	4	92 $\pm$ 13
5	'Berolinensis'	10	116 $\pm$ 23	5	134 $\pm$ 5
6	'Gelrica'	10	125 $\pm$ 25	5	110 $\pm$ 20
7	'Dunlop'	9	125 $\pm$ 23	5	147 $\pm$ 15
8	'Volunteer'	7	120 $\pm$ 22	5	140 $\pm$ 18
11	'Cordeniensis'	10	122 $\pm$ 9	5	136 $\pm$ 20
12	Petrowskyana	10	105 $\pm$ 16	5	99 $\pm$ 23
13	'Brooks #1'	9	126 $\pm$ 23	5	143 $\pm$ 25
17	'Skinner #2'	8	84 $\pm$ 12	5	104 $\pm$ 14
18	'Brooks #7'	5	110 $\pm$ 22	3	97 $\pm$ 14
19	'Nigra betulifolia'	10	100 $\pm$ 14	5	87 $\pm$ 29
23	'P38. P38'	3	110 $\pm$ 56	2	175 $\pm$ 3

Legend: $S_{\bar{x}}$ = standard error.

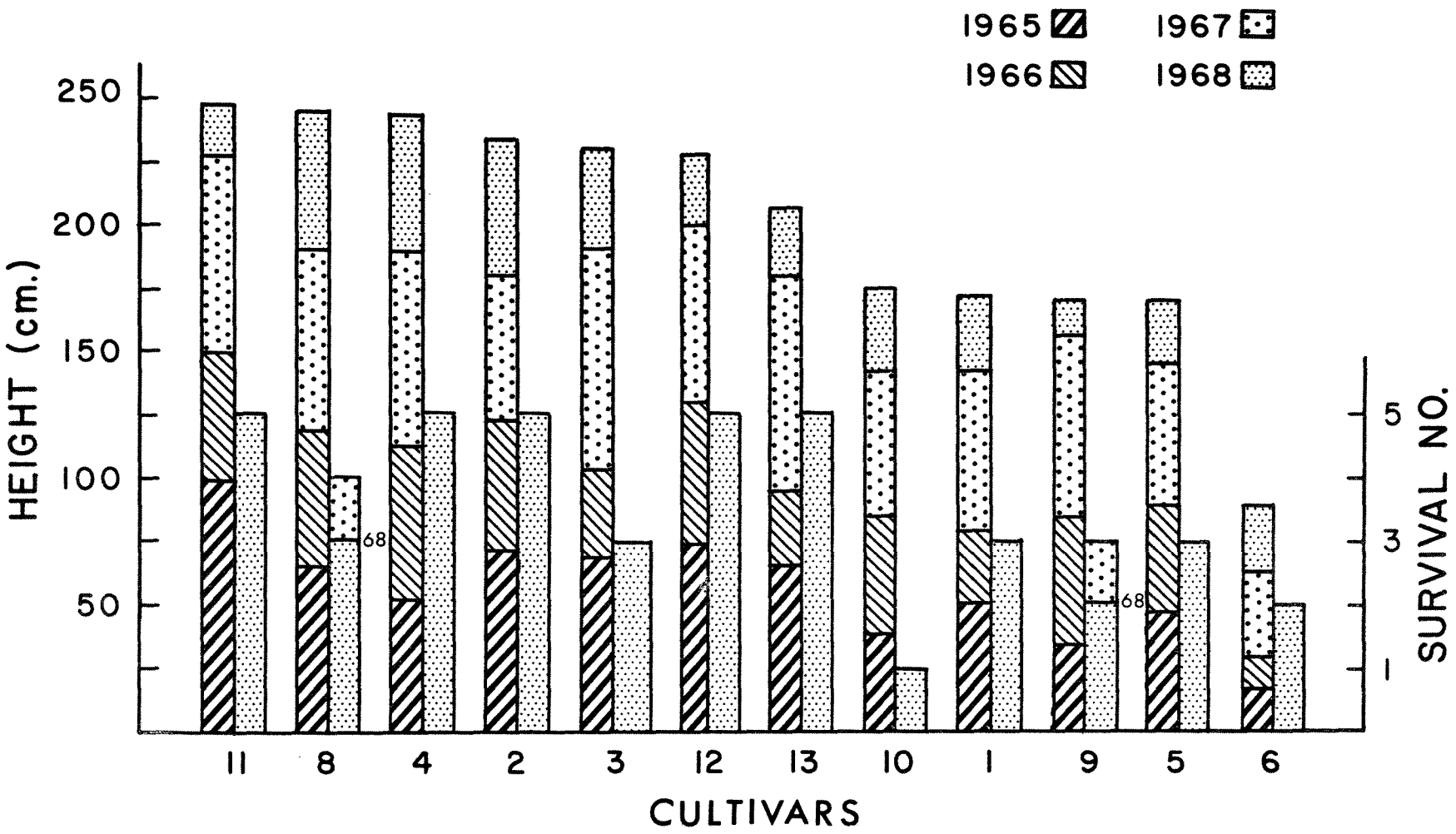

Figure 1. Mean heights and survival of cultivars planted at Riding Mountain in 1965. Survival is shown by the right hand bar for each cultivar.

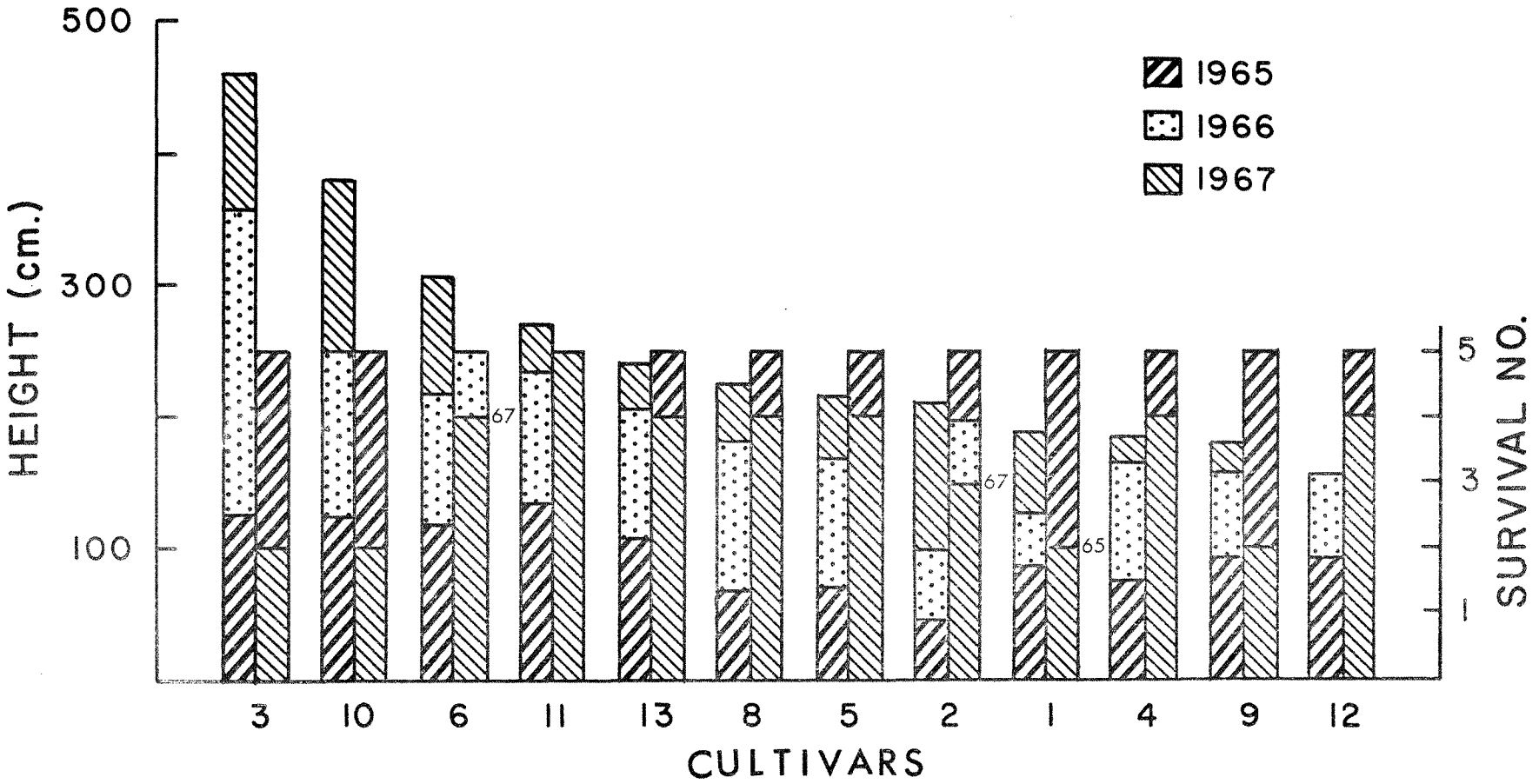

Figure 2. Mean heights and survival of cultivars to age three planted at Hadashville in 1965. Height of left hand bars shows tree height, right hand bars show survival.

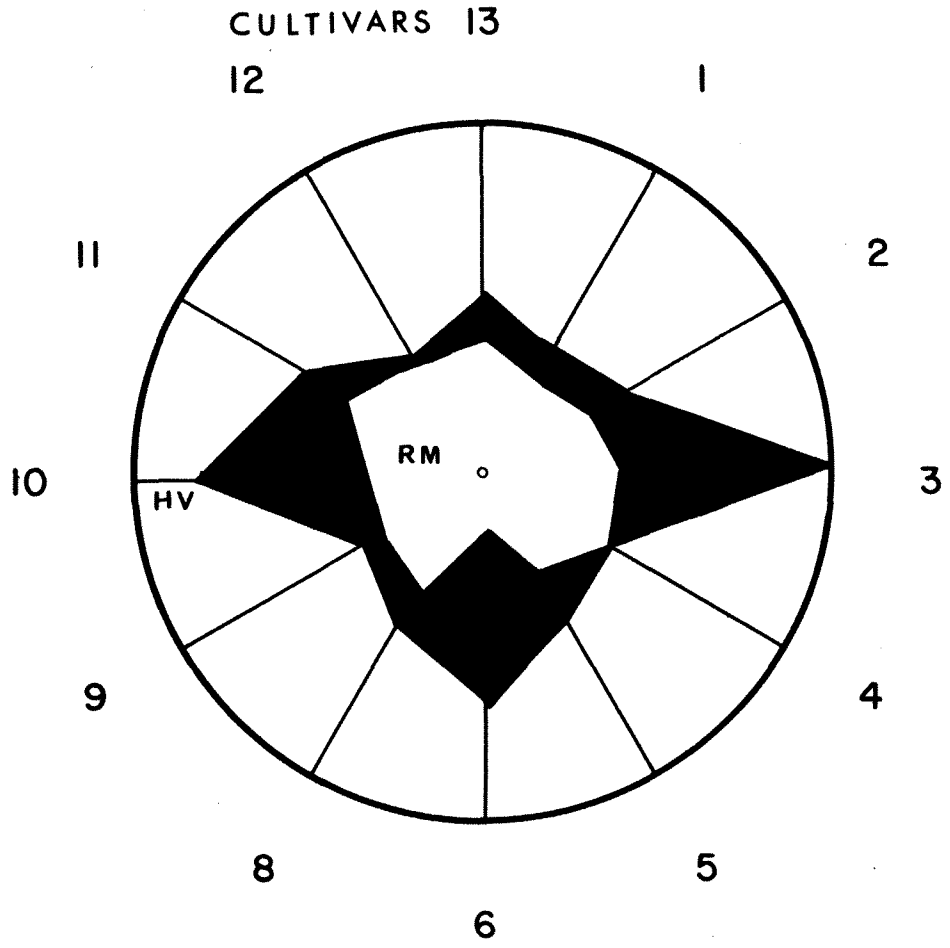

Figure 3: Comparison of the means of growth-rates among cultivars tested at Riding Mountain and Hadashville from 1965 to 1967.

Legend: The inner polygon represents the growth at Riding Mountain (RM), the outer at Hadashville (HV). Black color shows the difference of growth-rate.

Figure 4. Three-year-old P.? cv. 'FNS #44-52' at Hadashville 1965 H. The rod beside the tree is 12 feet in height.

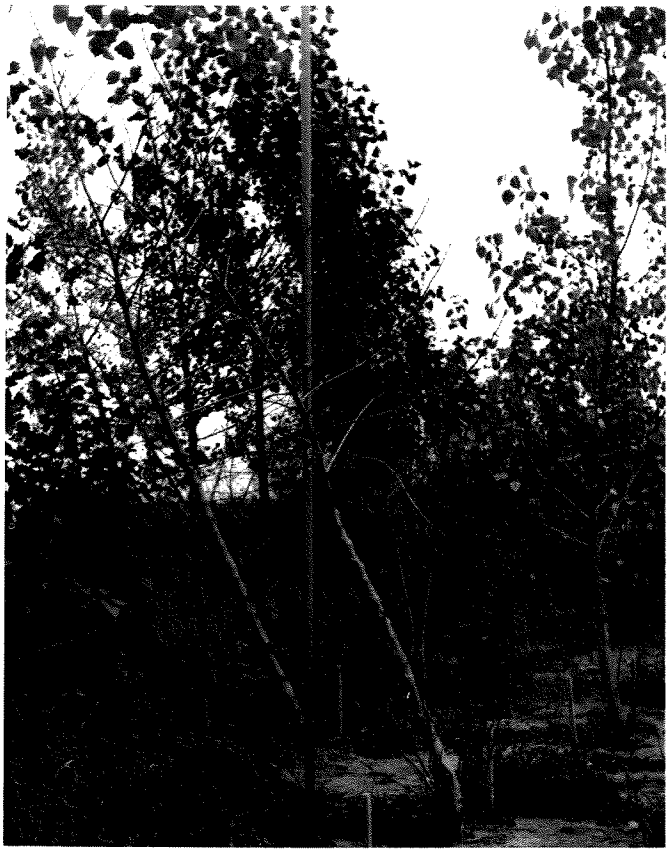

Figure 5. P.? cv. 'cordeniensis' at Hadashville, 1965 H; bending growth caused by wind.