



# MINNESOTA FORESTRY NOTES

OCT 12 1970

No. 144

April 15, 1964

## NATURAL POLYPLOIDY IN JUVENILE WHITE AND BLACK SPRUCE<sup>1/</sup>

Lawson L. Winton<sup>2/</sup>

In the summer of 1960, a preliminary survey was made to determine the natural variation in chromosome number involving entire chromosome sets (polyploidy) that may occur in unculled juvenile white and black spruce nursery populations and estimate their frequency. On June 7-8, 1961, all plants in 16 beds of recently transplanted 2-0 white spruce were inspected in the Blandin Nursery, Grand Rapids, Minnesota. Needle meristems were collected from normal and putative polyploid plants, pretreated 9 hours with 0.2% colchicine at 24° C., fixed for 24 hours in a 1:3 solution of propionic acid-ethanol, and stored in 70% ethanol at 3° C. for later examination.

During the period May 15-19, 1962, 20 beds of 2-1 white spruce, as well as 18 beds of 2-1 black spruce and 20 beds of 1-2 stock from the same seed source, were inspected in the Blandin Nursery. All putative polyploids found in 1962, together with confirmed polyploids examined in 1961, and normal plants from each population were lifted and taken to the School of Forestry where they were individually potted and arranged in the greenhouse. Needle meristems were collected in May and June, as well as during subsequent flushes of growth from July to November. In 1960, needle meristems were prepared for cytological examination by an adaptation of the acetolacmoid methods of Mikaelson (1952) and Johnsson (1953). Better results were obtained in 1961 and 1962, however, by substituting acetocarmine for acetolacmoid.

The Table shows the number of confirmed polyploids of white and black spruce as well as the frequencies of polyploidy estimated for each population. About 1 in 13,000 (0.008 percent) white spruce and about 1 in 23,000 (0.004 percent) black spruce were found to be polyploids. Most polyploids were tetraploid ( $4X = 48$ , i.e., 4 times the basic set ( $X$ ) of 12 chromosomes), probably caused by chromosome doubling in proembryo initials. However, sectional chimeras found for both species appear to be the result of doubling at later stages of seedling development. The few triploids ( $3X = 36$ ) found among white spruce may have originated from the fertilization of reduced and unreduced gametes. One octoploid ( $8X = 96$ ) white spruce was discovered in 1960.

The polyploids of white and black spruce found in the nursery during this study were stunted and had long internodes. The leaves were shorter and thicker than those of diploid plants. Polyploid spruce trees have not been found in natural forests, and in all probability would not survive unless protected from competition with other plants. Thus, the use of polyploidy in future spruce improvement cannot be recommended without further studies.

<sup>1/</sup> This report is based on a portion of the author's M.S. thesis (Winton, 1963). Support of this research was provided by the Charles K. Blandin Foundation, Grand Rapids, Minnesota.

<sup>2/</sup> Research Assistant, School of Forestry, University of Minnesota.

Table. The number of confirmed polyploids and their frequencies among populations of juvenile white spruce (w.s.) and black spruce (b.s.) in the Blandin Nursery.

Population	No. plants per population	Confirmed polyploids		
		type	number	percent <sup>5/</sup>
1960, 2-1 w.s.	322,802± 6,358	8X	1	0.0003± 0.0000
		4X	15	0.0046± 0.0001
		3X	2	0.0006± 0.0000
		p.c. <sup>3/</sup>	1	0.0003± 0.0000
		total	19	0.0059± 0.0001
1961, 2-1 w.s.	185,744± 5,143	4X	10	0.0054± 0.0002
		3X	3	0.0016± 0.0000
		total	13	0.0070± 0.0002
1962, 2-1 w.s.	213,360± 6,103	4X	19	0.0089± 0.0002
		3X	1	0.0005± 0.0000
		s.c. <sup>4/</sup>	1	0.0005± 0.0000
		total	21	0.0098± 0.0002
1962, 2-1 b.s.	206,113± 4,395	4X	9	0.0044± 0.0001
		s.c.	1	0.0005± 0.0000
		total	10	0.0049± 0.0001
1962, 1-2 b.s.	205,380± 9,390	4X	8	0.0039± 0.0001
		s.c.	1	0.0005± 0.0000
		total	9	0.0044± 0.0001

<sup>3/</sup> Periclinal chimera: 2X and 4X cells in the same tissue.

<sup>4/</sup> Sectional chimera: separate stems of 2X and 4X tissue joined to the same root system.

<sup>5/</sup> Totals may not equal the sum of the parts because of rounding off.

#### Literature Cited

- Johnsson, H. 1953. The oxyquinoline method--a useful method for chromosome studies in conifers. *Tree Genetics News Letter* Vol. 2, No. 2.
- Mikaelsen, K. 1952. (Rapid squash methods for chromosome studies in vegetative buds of spruce and birch). *Medd. fra Det Norske Skogforsoksvesen* nr 40, 11:3.
- Winton, L. 1963. Natural polyploidy in juvenile white spruce (*Picea glauca* (Moench) Voss) and black spruce (*P. mariana* (Miller) B.S.P.). M.S. thesis, Univ. of Minn.