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**IDENTIFICATION OF BLACK,  
RED AND WHITE SPRUCE SEEDLINGS**

by

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Résumé en français

DEPARTMENT OF FORESTRY PUBLICATION No. 1039

1964

## ABSTRACT

Three stages in the morphogenesis of red, white and black spruce seedlings are briefly described. For each of these stages, morphological descriptions are presented. The descriptions were tested and found to be reliable for species identification of all but the most juvenile of the three stages for New Brunswick and Nova Scotia provenances. It is emphasized that the descriptions might not be as valid for other provenances.

## RÉSUMÉ

L'auteur décrit trois phases de la morphogénèse des semis d'épinettes rouge, blanche et noire. Il présente des descriptions morphologiques de chaque phase. Sur vérification, les descriptions se sont révélées justes pour l'identification des essences, dans tous les cas, sauf dans celui de la première des trois phases, en ce qui concerne les semis provenant du Nouveau-Brunswick et de la Nouvelle-Ecosse. L'auteur souligne que les descriptions ne sont peut-être pas valables pour les semis d'autres provenances.

Published under the authority of  
The Honourable Maurice Sauvé, P.C., M.P.  
Minister of Forestry  
Ottawa  
1964

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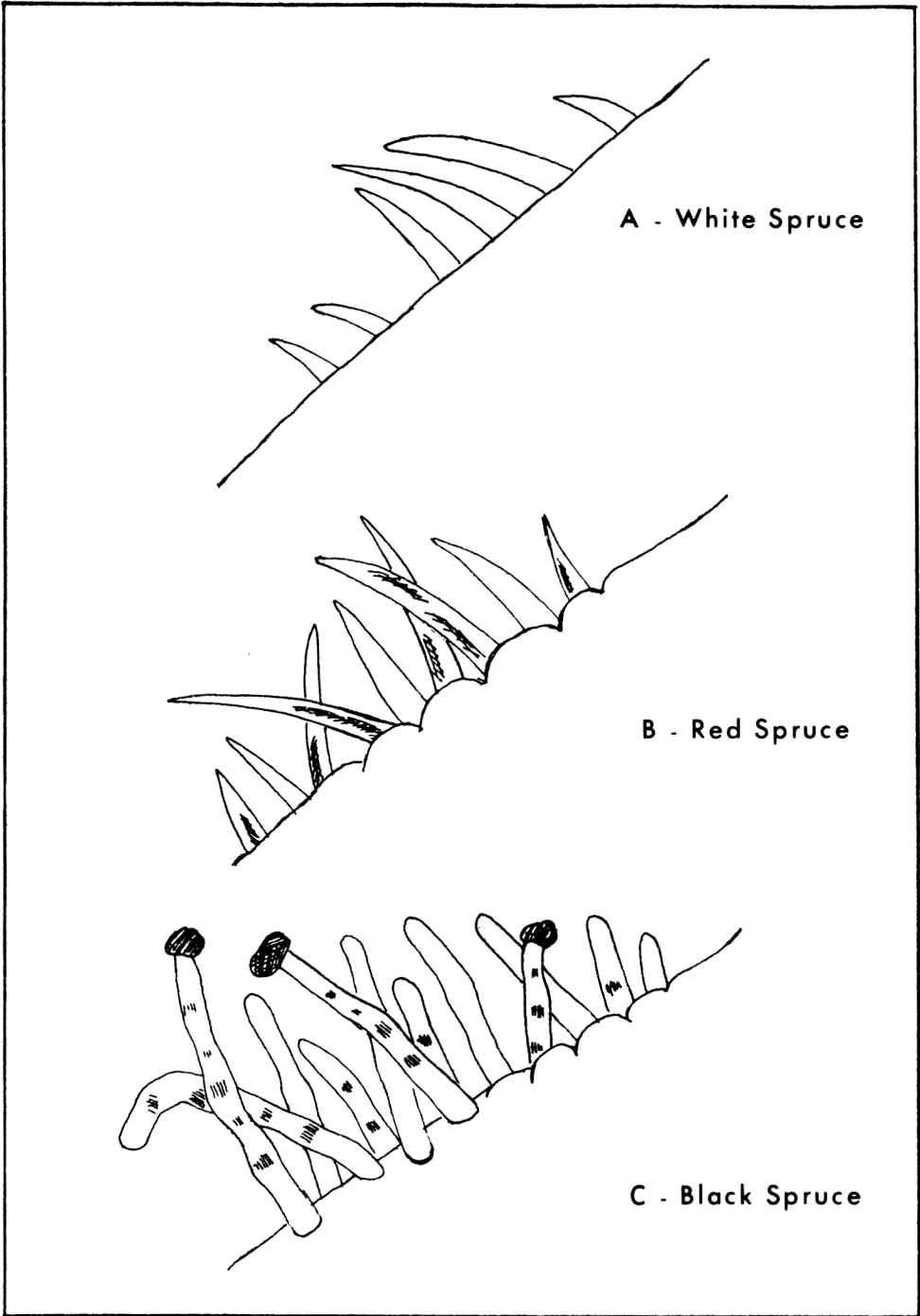


Figure 1. — Shape and arrangement of hairs on terminal shoots at the hard seedling stage.

# Identification of Black, Red and White Spruce Seedlings<sup>1</sup>

by  
A. JABLANCZY<sup>2</sup>

## INTRODUCTION

Morphological descriptions of plants are usually based on mature specimens. Descriptions of tree species are no exception and there is little published information on the taxonomy of seedlings. Yet foresters in both research and management are finding an increasing need for reliable means of seedling identification. In assessing the results of silvicultural cutting experiments in King's and Guysborough Counties in Nova Scotia, the writer found it necessary to distinguish between seedlings of black spruce *Picea mariana* (Mill.) BSP., red spruce *P. rubens* Sarg. and white spruce *P. glauca* (Moench) Voss. New methods were devised for identification of seedlings at early stages of development and are described in this report. Although these methods seem reliable for identification of the spruce found in New Brunswick as well as Nova Scotia, they may have certain geographical limitations owing to variations within species associated with provenance.

## BACKGROUND INFORMATION AND METHODS

The following three stages are recognized in the morphogenesis of spruce seedlings:

*Plumulous stage*: From germination until bursting of the primordial bud. This stage lasts a few weeks.

*Soft seedling stage*: Beginning with the development of the epicotyl and primary needles in the first year and ending with the production of hard mature buds and normal annual growth rings. On the undisturbed forest floor, roots are confined in this stage to the humus. This phase normally lasts from three to six years but it may last longer.

*Hard seedling stage*: The stage in development between the soft seedling stage and the sapling stage. Morphological characteristics are beginning to resemble those of mature trees.

No entirely reliable basis for species identification at any of the three seedling stages is provided by authoritative botanical works including Anon (1961), Dallimore and Jackson (1931), Fernald (1950), Roland (1947). Place (1955) recognized the problem of identifying spruce seedlings and examined the reliability of several morphological features as means of distinguishing between species. He considered the "presence or absence of pubescence on the stem, and the flatness or rounding of stem ridging" unreliable aids to identification. It is well to add here that Gordon (1952), while apparently working with adult material, had shown the characteristics of the ridges of twig surfaces to be useful means of distinguishing between black, red and white spruce. Place further observed, and the present writer agrees, that the margins of needles appearing immediately above the cotyledons of red and black spruce are smooth whereas those of white spruce are not.

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TABLE 1. — DISTINGUISHING CHARACTERISTICS OF SPRUCE SEEDLINGS  
IN THE HARD SEEDLING STAGE.

	SPECIES	WHITE SPRUCE <i>Picea glauca</i> (Moench) Voss	RED SPRUCE <i>Picea rubens</i> Sarg.	BLACK SPRUCE <i>Picea mariana</i> (Mill.) BSP.
Needle margins	Generally	smooth	smooth	smooth
	Needle bases in bud clusters	smooth	slightly ciliate	slightly ciliate
Degree of pubescence of terminal shoots	Main stem	near apex	not pubescent	may or may not be pubescent
		near base	not pubescent	pubescent
	Primary branch	may or may not be pubescent	not pubescent	may or may not be pubescent
	Secondary branch	pubescent	may or may not be pubescent	pubescent
Hair	Form	horn-like sharp-pointed, rarely gland tipped	mostly in furrows; angle to axis of twig, somewhat irregular; sometimes gland tipped	mostly on ridges; angle to axis of twig, very irregular; often gland tipped
	Length	usually shorter than 10 times the diameter	same as white spruce	some longer than 10 times the diameter of the hair-base and some very short
	Colour	light, shiny stainless, translucent	light, shiny, one or two longitudinal dark stains inside	grey or brownish, more irregular, traverse dark stains inside
Ridges	Form	circular in cross-section, straight longitudinally	circular in cross-section, undulating longitudinally	flattened or indented in cross-section, more or less straight longitudinally
	Surface	smooth, sometimes muricate	series of nodules forming distinct beads	usually shredded, and often finely muricate
	Colour	yellowish shiny	yellowish-brown shiny	variable, brown or reddish sometimes shiny

Careful examination of seedlings on the experimental areas suggested that the ridging of the stem cork or phellem (sensu Gordon, 1952), the ciliate nature of the needle margins, and other features could provide for identification of the three species. A total of 315 seedlings were then collected for microscopic examination of morphological features. On the basis of subsequent examinations, new descriptions of species characteristics were prepared. The descriptions were then tested for reliability by means of 82 seedlings which had been grown in nurseries from seed of known identity.

## DISTINGUISHING CHARACTERISTICS

The leaf margin is the most reliable means of distinguishing between seedlings, which have not lived through at least one winter. Needles of white spruce are ciliate and this characteristic provides for sure identification of the species as the needles of both black and red spruce are smooth. Numbers of cotyledons although not nearly as definite are somewhat helpful in distinguishing black spruce from red and white (Place, 1955 and Brayshaw, 1959). Place who used material from New Brunswick states that the modal number of cotyledons is four for black spruce and six for red and white. He further states that the cotyledons of red spruce tend to be longer and stouter than those of black.

Soft seedlings in the second and subsequent years may be identified by their needles and by their terminal shoots as follows :

1. Terminal shoot, pubescent. Needle margins including those of the cotyledons, ciliate.  
White Spruce
2. Terminal shoot, glabrous. Needle clustered about the terminal bud, ciliate at the base. Other needles smooth.  
Red Spruce
3. Terminal shoot, glabrous toward the tip and somewhat pubescent toward the base. Needles clustered about the terminal bud, ciliate at the base. Other needles smooth.  
Black Spruce

Details of differences between species in the hard seedling stage are given in Table 1. Differences have at this stage become pronounced and the characteristics useful in identification more numerous. Details of pubescence, its presence or absence, and characteristics of ridges of the stem cork become distinguishing features at this stage.

Figure 1 illustrates for each of the three species the shape of individual hair and the arrangement of the hairs with respect to each other and to the ridges of the stem cork as described in Table 1. A further definitive feature of the hair is also illustrated by Figure 1. White spruce hairs are uniformly translucent whereas many of the hairs of the other two species have opaque markings. These markings are regular and longitudinal with red spruce and irregular and transverse with black.

The degree of pubescence of terminal shoots changes with increasing maturity, Figure 2 illustrates these changes from the plumulous through soft and hard seedling stages to saplings. All three species lack pubescence in the plumulous stage.

TABLE 2. — DETAILS OF TESTS OF THE SPECIES DESCRIPTIONS

SPECIES		WHITE SPRUCE				RED SPRUCE				BLACK SPRUCE			
PROVENANCE		Lake Paul, N.S. Acadia F.E.S., N.B. Various locations, N.S. Acadia F.E.S., N.B.				Acadia F.E.S., N.B. Salmon River, N.B. Napodogan, N.B. Acadia F.E.S., N.B.				Geary, N.B. Acadia F.E.S., N.B. Acadia F.E.S., N.B.			
Number of specimens		12	22	4	4	7	5	5	3	10	7	3	
Stage		SS	SS	HS	HS	SS	HS	HS	HS	SS	HS	HS	
Age		2	2	4	6	2	3	3	6	2	4	6	
Needle margin		X	X	X	X	X	X	X	X	X	X	X	
Degree of pubescence of terminal shoots	Main stem	near apex	X	X	X	X	X	X	X	X	X	X	X
		near base	X	X	X	X	X	X	X	X	X	X	X
	Primary branch	X	X	X	X	X	X	X	X	X	X	X	
	Secondary branch			X	X		X	X	X		X	X	
Hair	Arrangement			X	X		X	X	X		X	X	
	Form			X	X		X	X	X		X	X	
	Length			X	X		X	X	X		X	X	
	Colour			X	X		X	X	X		X	X	
Ridges	Form			X	X		X	X	X		X	X	
	Surface			X	X		X	X	X		X	X	
	Colour			X	X		X	X	X		X	X	

Legend : Acadia F.E.S. — Acadia Forest Experiment Station.  
 X — Reliability of characteristic has been tested.  
 SS — soft seedling.  
 HS — hard seedling.



Stage of development	White spruce				Red spruce				Black spruce			
	Main stem		Primary branch	Secondary branch	Main stem		Primary branch	Secondary branch	Main stem		Primary branch	Secondary branch
	near apex	near base			near apex	near base			near apex	near base		
Sapling												
Hard seedling												
Soft seedling												
Plumulous												

NOTE: The thickness of the bars indicates the degree of pubescence.

Figure 2. — Pubescence of terminal shoots by stages of development.

In the soft seedling stage only the white spruce is pubescent and it is in this stage that the species attains its maximum pubescence. Red and black spruce on the other hand become pubescent in the hard seedling stage and increasingly so with maturity.

Characteristics of terminal buds were found to be too variable to provide reliable means of species identification at the seedling stages. Variability however decreases with increasing maturity and by the hard seedling stage three distinct forms prevail (Figure 3). At this stage terminal buds of white spruce are typically blunt with irregularly curved "bracts". Those of black spruce are mostly sharp pointed with concavely converging "bracts" whereas those of red spruce are rounded with "bracts" which converge convexly.

Brayshaw (1960) mentions odour of crushed needles as a characteristic which may be used as an aid in distinguishing one spruce from another. The writer has also found this characteristic useful and the odour of dry needles has proved consistent for a species at all seedling stages. The odour emitted by black spruce needles is fragrant and by white spruce needles sharp and spicy, whereas red spruce needles are odourless.

### RELIABILITY OF DESCRIPTIONS

Table 2 illustrates the degree of checking undertaken to test the constancy of the characteristics attributed to the different stages of the three species. A total of 51 specimens at the soft seedling stage and 31 at the hard seedling stage were used. In each instance all aspects of the descriptions were found to be valid. No seedlings in the plumulous stage were used. It is emphasized that all provenances were from Nova Scotia or New Brunswick, and it is conceivable that different results might have been achieved had a greater variety of provenances been used. It is also emphasized that the species descriptions are based on healthy specimens and that unhealthy specimens are sometimes atypical. For example, white spruce of low vitality may have terminal shoots which remain fully pubescent into the hard seedling stage.

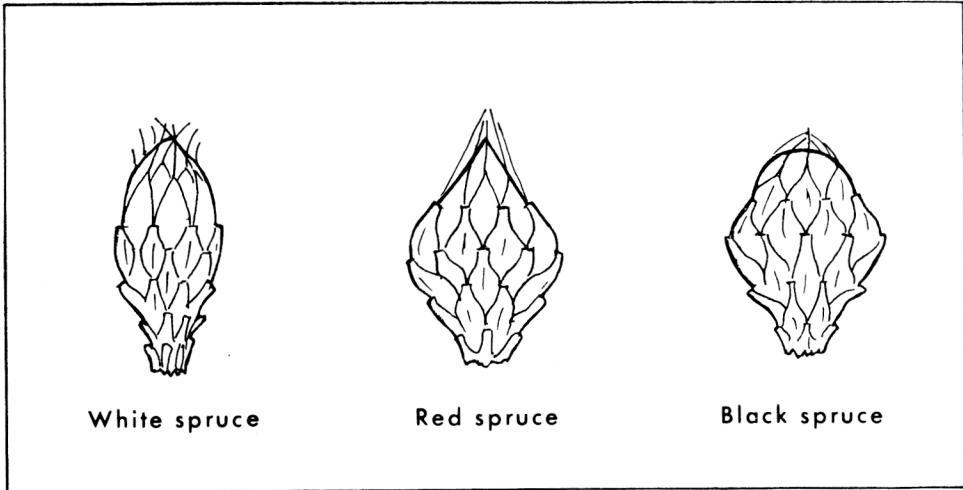


Figure 3. — The common types of terminal buds on spruce seedlings at their hard seedling stage.

## APPENDIX

### Glossary

CILIATE	-	-	-	-	-	-	Marginally fringed with fine hairs.
COTYLEDON	-	-	-	-	-	-	Primordial leaf of a germinant.
EPICOTYL	-	-	-	-	-	-	First year stem emerging from the plumule.
GLABROUS	-	-	-	-	-	-	Not hairy.
MURICATE	-	-	-	-	-	-	Surface roughened by minute nodules.
PLUMULE	-	-	-	-	-	-	Primordial bud of a germinant.
PRIMARY NEEDLES	-	-	-	-	-	-	First year needles growing from the epicotyl.
PUBESCENT	-	-	-	-	-	-	Hairy.

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