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# Influence of Mountain Avens (Dryas Drummondii) on Growth of Young Cottonwoods (Populus Trichocarpa) at Glacier Bay, Alaska

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**BOTANY**

# Influence of Mountain Avens *(Dryas Drummondii)* on Growth of Young Cottonwoods *(Populus Trichocarpa)* at Glacier Bay, Alaska

*Dryas drummondii,* mountain avens, as was pointed out by Cooper (1931), is the first of the pioneer vascular species on newly deglaciated calcareous till and outwash surfaces to attain a nearly complete ground cover at Glacier Bay, Alaska. The remarkable colonizing behavior of this subarctic, woody, mat-forming member of the Rose family is due largely to its seed mobility, vigorous growth, and to its profuse flowering and fruiting, both of which begin as early as the fourth year after germination. The deep blue-green foliage color and rapid growth rate of this species stand out in sharp contrast to most other woody pioneers which have yellowish foliage color, stunted condition, and non-fruiting behavior.

Crocker and Major (1955) have shown that the fresh till in which *Dryas* grows most rapidly at Glacier Bay has a pH range of 7.8 to 8.5 and a calcium carbonate content of at least one percent of the fine earth fraction; furthermore the nitrogen content and organic carbon content are very low amounting to only 3.3g and 4.3g per square meter in the uppermost 6 inches.

The discovery on the roots of three species of *Dryas* in 1952 of fleshy brown coralloid nodule clusters, morphologically similar to those found on Sitka alder (*Alnus crispa sinuata*), suggested to Lawrence (1953) the possibility that they also contained micro-organisms which may be able to fix nitrogen as has been demonstrated for some non-leguminous species including alders (Lawrence 1951, Lawrence and Hulbert 1950, Bond 1956.) Since then, Crocker and Major (1955) have shown that accumulation of nitrogen in the *Dryas* mat was 1.04 to 1.33 percent of dry weight, which was approximately half as great as in litter beneath alder (2.08 percent).

Since Lawrence (1950) had demonstrated a strong stimulating effect of alder on adjacent young cottonwoods (*Populus trichocarpa*)

at Glacier Bay, it was the purpose of the present study to ascertain whether *Dryas* brought about a similar stimulating effect. Investigations were carried out in the Muir Inlet area of Glacier Bay in August 1955, when the writer was a member of the University of Minnesota Graduate School Expedition led by Dr. D. B. Lawrence. In this study 22 cottonwood saplings were sampled, ranging in height from 25 to 50 inches, and in age from 11 to 24 years. Eleven of these were located in areas dominated by *Dryas*; eleven others grew in areas free of *Dryas* and other root nodule-bearing plants.

Field data obtained from each cottonwood included total height, age, height growth for each year, basal diameter, number of live branches, number of leaves on the 1955 terminal shoot, and maximum size of leaves. For laboratory analysis collections were made from the latest three years height growth of the leading shoot to obtain dry weight and nitrogen content. *Dryas* samples were also collected for age determinations, dry weight, and nitrogen content.

The height measurements showed that *Dryas*-associated cottonwoods grew faster than those growing away from *Dryas* mats. Calculations of mean annual height growth based on total age and height showed that cottonwoods in *Dryas* areas averaged 2.43 inches per year as compared with 2.02 inches in *Dryas*-free areas. For the 1955 growth year, the corresponding figures were more marked, 4.64 inches and 2.95 inches.

No consistent differences were evident in basal diameter growth, in numbers of live branches, or in size of leaves between cottonwoods growing in association with or away from *Dryas* colonies. On the leading shoot the 1955 growth of cottonwoods associated with *Dryas* averaged 9.9 leaves per plant, those without Dryas 8.1 leaves. Dry weight of the leaf and stem material of the leading shoot for the growth period 1953-1955 averaged 10.2 grams per plant for *Dryas*-associated cottonwoods; for those without Dryas, 7.0 grams.

Analysis of the nitrogen content of the leaves by the Kjeldahl method was made by Markley Laboratories of Minneapolis. Leaves of the *Dryas* plants themselves contained 1.84 per cent nitrogen, based on oven dry weight, as compared with 2.56 to 3.65 percent for alder leaves. Leaves from *Dryas*-associated and *Dryas*-absent cottonwoods

showed little difference percentage-wise, the mean values being 1.88 and 2.02 percent, respectively. Total nitrogen by weight, however, was 30 percent greater in the leaves of plants growing with *Dryas*, the corresponding mean values being 0.13 and 0.10 grams per plant for the 1955 leaves on the portion of the leading shoot formed in the latest three years.

It is concluded that colonies of *Dryas drummondii* do stimulate height growth in young cottonwood saplings although the effect is much less than that produced by alder.

The genus *Dryas* includes about ten species all confined to the north temperate regions. *Dryas drummondii* has a scattered distribution (Porsild 1947); its main occurrence is in western North America where it is found from central Alaska to Oregon and as far east as Great Slave Lake. Scattered colonies have also been found along the north shore of Lake Superior and on both sides of the Gulf of St. Lawrence. This peculiar distribution pattern together with its known present-day affinity for recently glaciated areas suggests that *Dryas drummondii* may have had a widespread distribution during the Pleistocene, possibly occurring extensively in Minnesota as a pioneer on calcareous till and outwash surfaces following glacier recession. If this was so, careful examination of the lowest levels of bog deposits might reveal leaf fragments of this species as has been shown for a related species in parts of Europe (Charlesworth 1957). Since Dryas pollen is not wind-dispersed, the pollen has been only rarely found in peat.

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