



## Butler University Botanical Studies

Volume 13

Article 18

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Jeanette S. Pelton

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### Recommended Citation

Pelton, Jeanette S. (1956) "Growth Responses of Alpine *Potentilla diversifolia* and *Achillea lanulosa* to Gibberellic Acid," *Butler University Botanical Studies*: Vol. 13, Article 18.

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**Butler University**  
**Botanical Studies**  
(1929-1964)

*Edited by*

**J. E. Potzger**

The *Butler University Botanical Studies* journal was published by the Botany Department of Butler University, Indianapolis, Indiana, from 1929 to 1964. The scientific journal featured original papers primarily on plant ecology, taxonomy, and microbiology. The papers contain valuable historical studies, especially floristic surveys that document Indiana's vegetation in past decades. Authors were Butler faculty, current and former master's degree students and undergraduates, and other Indiana botanists. The journal was started by Stanley Cain, noted conservation biologist, and edited through most of its years of production by Ray C. Friesner, Butler's first botanist and founder of the department in 1919. The journal was distributed to learned societies and libraries through exchange.

During the years of the journal's publication, the Butler University Botany Department had an active program of research and student training. 201 bachelor's degrees and 75 master's degrees in Botany were conferred during this period. Thirty-five of these graduates went on to earn doctorates at other institutions.

The Botany Department attracted many notable faculty members and students. Distinguished faculty, in addition to Cain and Friesner, included John E. Potzger, a forest ecologist and palynologist, Willard Nelson Clute, co-founder of the American Fern Society, Marion T. Hall, former director of the Morton Arboretum, C. Mervin Palmer, Rex Webster, and John Pelton. Some of the former undergraduate and master's students who made active contributions to the fields of botany and ecology include Dwight W. Billings, Fay Kenoyer Daily, William A. Daily, Rexford Daudenmire, Francis Hueber, Frank McCormick, Scott McCoy, Robert Petty, Potzger, Helene Starcs, and Theodore Sperry. Cain, Daudenmire, Potzger, and Billings served as Presidents of the Ecological Society of America.

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# GROWTH RESPONSES OF ALPINE *POTENTILLA* *DIVERSIFOLIA* AND *ACHILLEA LANULOSA* TO GIBBERELIC ACID

JEANETTE S. PELTON  
*Butler University*  
*Indianapolis, Indiana*

Applications of gibberellic acid have been shown to alter the growth patterns of genetic dwarfs in maize (Phinney 1956) and in peas (Brain and Hemming 1955). Since the dwarf alpine habits of some native species have been demonstrated also to be genetically conditioned, among which are included certain species of *Potentilla* and *Achillea* (Clausen, Keck, and Hiesey 1940), the present study was an attempt to investigate the possibility of growth alterations of alpine *Achillea lanulosa alpicola* (Rydb.) Keck and *Potentilla diversifolia* Lehm. when treated with gibberellic acid. Voucher specimens of these species are in the personal herbarium of the author.

## METHODS

Plants of *P. diversifolia* and *A. lanulosa* were transplanted to cans, using the soil in which they were growing, on July 11, 1957, at Cumberland Pass in Gunnison County, Colorado, at an elevation of 12,015 feet and transferred to the Rocky Mountain Biological Laboratory (also in Gunnison County) at 9,500 feet. Two plants of each species were sprayed daily with a 0.01 per cent aqueous solution of gibberellic acid, while two untreated plants of each species were kept as controls. At the beginning of the experiment on July 15, 1957, measurements of total height were taken for all plants. On August 17, 1957, measurements of maximum height were again recorded, and the plants photographed at this time (Fig. 1). All the plants included in the experiment were then preserved in formalin-acetic acid-alcohol, and measurements were made on comparable leaves. A collection of additional plants of *A. lanulosa* and *P. diversifolia* was made on August 19, 1957, at the same alpine locality, in order to compare growth of undisturbed alpine plants with the transplanted material.

## RESULTS

During the 34 days of the experiment, treatment with gibberellic acid increased growth of *Potentilla* by 120 per cent and *Achillea* 89 per cent over that of the controls. Although the root systems were not studied quantitatively, the treated plants bore noticeably more roots than did the controls

(Fig. 1). In *Potentilla* total length of the earlier formed leaf of the treated plant was 55.0 per cent greater than that of the control. Ninety-nine and six-tenths per cent of this increased length was the result of a longer petiole in the treated plant as compared to the control. Length of the treated subsequently formed leaf was 72.5 per cent more than that of the control. The petiole contributed 76.2 per cent of this increase. In *Achillea*, on the other hand, total length of the earlier formed leaf of the control plant was 0.02 per cent more than that of the treated leaf. Although this difference in total length is negligible, petiole and blade proportions differed, in that the petiole was 10.4 per cent more of the total leaf length in the treated plant than in the control. The subsequently formed leaf of the treated plant grew 21.6 per cent more than did the comparable leaf of the control. Of this difference 54.9 per cent was due to the greater petiole length in the treated plant than in the control.

In *Potentilla* comparable leaves of the control transplanted from the alpine to the subalpine location grew 57.5 per cent and 142.0 per cent more than those of the alpine control. These differences were the result of 47.6 per cent more petiole in the earlier formed subalpine control leaf and 87.3 per cent increased petiole in the subsequently formed leaf of the subalpine control plant as compared to the alpine control. Comparable leaves of the subalpine control plant of *Achillea* had increased lengths of 168.9 per cent and 132.2 per cent more than those of the alpine control plant. In the earlier formed leaf 21.8 per cent of this increase in the subalpine control over that of the alpine control was due to petiole increase, while in the subsequently formed leaf 36.0 per cent of the subalpine control increases resulted from petiole length greater than that in the alpine control.

## DISCUSSION

Applications of gibberellic acid, then, appear to alter the growth pattern of dwarfed alpine *A. lanulosa* and *P. diversifolia*. Root growth appears to be more abundant in the treated plants as compared to the controls in both species, especially in *Achillea*. Total height as compared to the increase in the controls is also greater with the addition of gibberellic acid (Fig. 1). Most of the leaves of the treated plants are longer than those of the controls. This increased length seems mainly the result of greater petiole length in the treated plants as compared to the controls. It is of interest that transfer to the subalpine environment produced leaf length considerably greater than that of plants remaining in the alpine habitat, an effect similar to that of gibberellic acid. It can be hypothesized that environmental change accentuates expression of the growth pattern restricted by the alpine environment and that application of gibberellic acid pushes further an expression normally blocked by gene action affecting growth hormones.

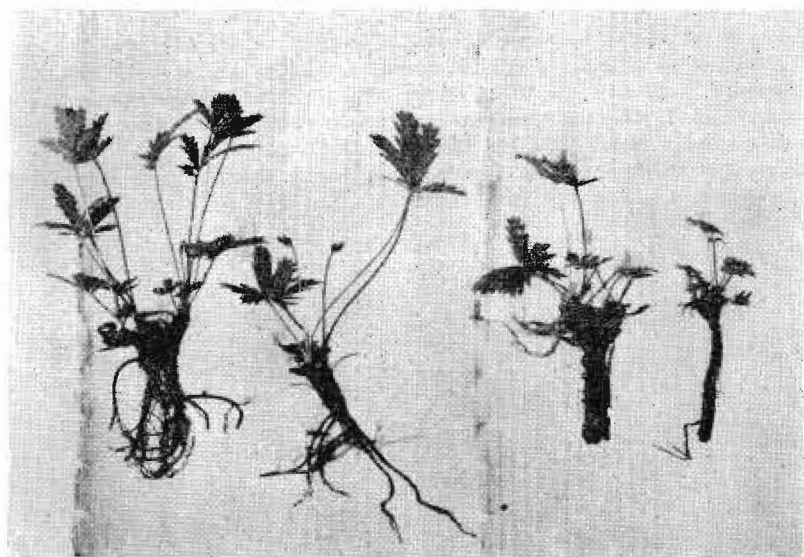
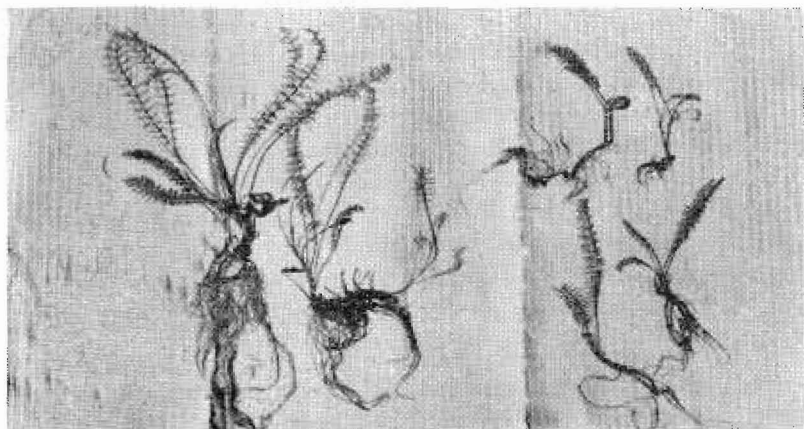


Fig. 1 (Above) *Achillea lanulosa alpicola* (Below) *Potentilla diversifolia*. Plants at the left in each species have been sprayed daily with a 0.01 per cent aqueous solution of gibberellic acid for 54 days, while those at the right in each case are the untreated controls. The two control plants of *Achillea* have split to form four units.

## SUMMARY

Alpine plants of *Achillea lanulosa alpicola* (Rydb.) Keck and *Potentilla diversifolia* Lehm. were transplanted to a lower altitude in Gunnison County, Colorado, and treated with a 0.01 per cent aqueous solution of gibberellic acid. Measurements of total height show increases of 120 per cent in *Potentilla* and 89 per cent in *Achillea* in the treated plants as compared to the controls. Leaf lengths in plants of both species are longer after applications of gibberellic acid, this increase being mainly the result of greater petiole length in the treated leaves as compared to the controls.

## ACKNOWLEDGMENTS

The author is indebted to Dr. Frederick Kavanagh for suggesting a study of this nature, to Dr. John Pelton for aid throughout the study, and to Dr. Shirley Tucker for criticism of the manuscript. Dr. Curt Lebea of Eli Lilly and Co. kindly supplied the gibberellic acid. In addition, the author is grateful for the use of facilities of the Rocky Mountain Biological Laboratory.

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