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# SEED PROPAGATION OF THE ROAN MOUNTAIN BLUET[1]

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## ABSTRACT

Freshly collected seed of *Houstonia purpurea* var *montana* (Small) germinated slowly under temperature regimes ranging from 7°-16°C to 24°-29°C but required four to eight weeks' stratification (i.e., moist chilling at 3°C) for rapid germination. Dry storage at 3°C reduced germination. Seedlings were grown to flowering in containers.

## INTRODUCTION

The Roan Mountain bluet, *Houstonia purpurea* var *montana* (Small) (Terrell, 1959), is a perennial high-elevation, southern Appalachian endemic with a range presently restricted to the summit area of Roan Mountain (latitude, 36°05′35″N; longitude, 82°08′44″W; elevation, 2,000 m) on the Tennessee/North Carolina border. Originally described as a distinct species (*H. montana* Small), it was later considered by Terrell (1959) and Radford et al. (1964) to be a variant of *Houstonia purpurea* L. Yelton (1974) was unable to make experimental crosses between *H. purpurea* var *montana* and *H. purpurea* and suggested that a breeding barrier exists.

The Roan Mountain bluet occurs as a population of several hundred plants at one of the most popular high-elevation recreation sites in the eastern United States. The bulk of the population occurs in the Cloudland Trail area and on the cliffs at Roan Mountain High Overlook, where it is an attractive part of the summer flora. It is found only occasionally at two other summit sites which appear to offer suitable habitat but which are highly impacted by picnicking and camping. While no demographic studies have been conducted, it is probable that the bluet is not expanding its range. Whether it is being impacted by human activity or has other fitness difficulties cannot be determined from existing published information. The objective of this study was to develop information on seed germination and establishment characteristics which will be useful in maintaining and expanding the population.

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## GERMINATION

A small number of seed capsules was collected from plants near Cloudland Trail and Roan Mountain High Overlook on October 6, 1974, at which time some capsules were dispersing seed. Capsules were dried on a laboratory bench at 21°C for several days; then, seed were easily removed.

Three 10-seed replicates of freshly extracted seed were germinated on moist filter paper in each of the six light-temperature regimes outlined in Table 1. The remainder of the seed was divided into two lots, one of which was stratified (stored moist at 3°C) and the other stored dry in sealed vials at 3°C. After four and eight weeks, seed in these storage treatments were removed, and three 10-seed replicates from each were germinated in each of the environments noted above. Germination (radical 3 mm long) was recorded at three-day intervals until it was completed. Arc sin transformations of final germination percentages were subjected to a factorial analysis of variance. Chi-square tests were also used to evaluate treatment differences; they confirmed the significance of differences noted below. "Germination value" (Czbator, 1962), a measure of germination vigor combining completeness and speed of germination, was computed from average curves of germination over time for treatments.

Freshly collected seed exhibited almost complete germination under light in all three temperature regimes, and there was significantly ($P<.05$) lower dark germination (Table 1). However, germination at 7°-16°C and 16°-24°C was relatively slow, as "germination values" indicate. Dry storage of seed at 3°C subsequently resulted in (1) a significant reduction of germination after eight weeks and (2) dark germination significantly lower than germination under light at 7°-16°C. Stratification (1) maintained high germination percentages; (2) significantly reduced germination time, with a resulting increase in "germination value"; and (3) eliminated the light requirement noted at low temperature for dry-stored seed. However, dark germination continued to be slower than light germination, with lower "germination values" under all temperature regimes (Figure 1, Table 1). At 24°-29°C, germination was completed in 10 days, resulting in a "germination value" of over 100.

These data indicate that while stratification is not an absolute requirement for germination of the Roan Mountain bluet, it does increase germination speed and, therefore, the likelihood of establishment success. In fact, under natural conditions, it is unlikely that germination of unstratified seed (with their low "germination value") takes place under all temperatures on Roan Mountain, which are commonly below 0°C at night shortly after dispersal.

Light appears not to be a major determinant of seed germination, except for unstratified seed at low temperatures; even then, a substantial proportion of the population has the capability of dark germination. Thus, the Roan Mountain bluet has simple germination characteristics adapted to its high elevation habitat and which should present no major barriers to expansion of the population.

TABLE 1. *Germination percent and germination value of* Houstonia montana *under several environments after 0, 4, and 8 weeks' storage.*

| Germination Temperature | Storage Condition | Light Treatment | Germination Percent 0 | 4 | 8 | Germination Value 0 | 4 | 8 |
|---|---|---|---|---|---|---|---|---|
| 24°-29°C | 3°C, dry | Light | 100 | 97 | 70 | 27 | 17 | 16 |
| | | Dark | 90 | 97 | 60 | 7 | 13 | 9 |
| | 3°C, moist | Light | | 90 | 90 | | 100 | 225 |
| | | Dark | | 90 | 94 | | 30 | 121 |
| 16°-24°C | 3°C, dry | Light | 87 | 97 | 50 | 12 | 20 | 6 |
| | | Dark | 77 | 27 | 47 | 15 | 2 | 4 |
| | 3°C, moist | Light | | 88 | 91 | | 22 | 82 |
| | | Dark | | 91 | 70 | | 41 | 35 |
| 7°-16°C | 3°C, dry | Light | 93 | 49 | 37 | 7 | 2 | 1 |
| | | Dark | 60 | 13 | 20 | 2 | <1 | <1 |
| | 3°C, moist | Light | | 97 | 90 | | 29 | 28 |
| | | Dark | | 88 | 90 | | 11 | 13 |

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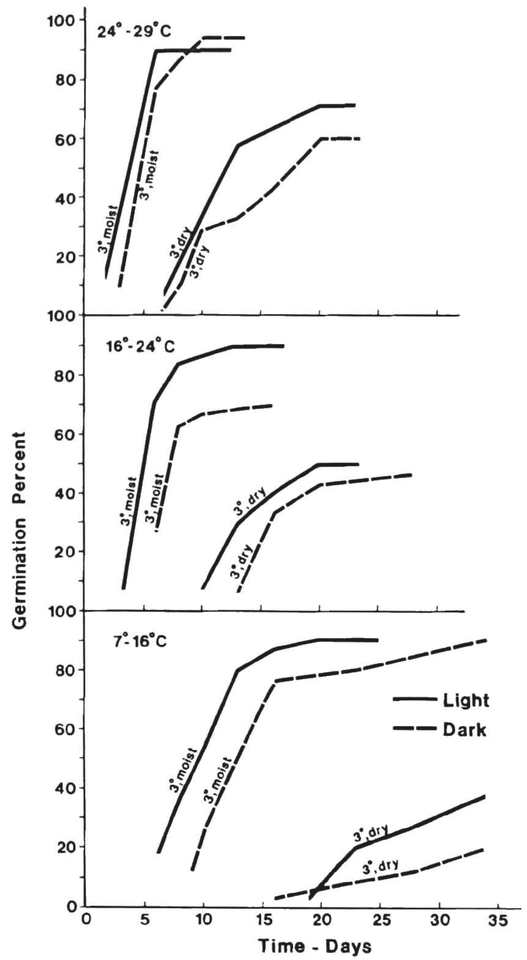


FIG. 1: *Germination pattern of* Houstonia montana *as influenced by temperature and light after eight weeks of moist or dry chilling at 3°C.*

## ESTABLISHMENT AND EARLY GROWTH

Following the germination test, a small number of plants were grown in a peat:perlite medium (1:1) at three soil temperatures (13°, 19°, and 27°C) under greenhouse ambient air temperature (18°-24°C) and 18-hour photoperiods for 98 days. During this time, harvests were made every four weeks beginning 41 days after germination. Oven-dry weight and leaf area determined from these samples were used to compute Relative Growth Rate, Net Assimilation Rate, and Leaf Area Ratio (Evans, 1972).

Because of small sample size (4-7 plants/harvest/soil temperature) and wide variation among seedlings, differences in growth of plants in the several soil temperature regimes were not statistically significant. However, these data (Table 2) do indicate that establishment and early growth of this high elevation species is possible at a range of soil temperatures and moderate air temperatures. Leaf Area Ratios were initially high (200-300 $cm^2/g$) but were reduced to around 100 $cm^2/g$ at the end of the 3-month growth period. There were substantial root systems (length, 5-6 cm; weight, 8 mg) at the final harvest, and shoot/root ratios were 4-5 during the latter half of the test. Relative Growth Rates decreased from 400-500 mg/g/wk during the first sampling period to 200-300 mg/g/wk in the second period, but there was not a concomitant decrease in Net Assimilation Rate. During the test period, plants formed tight rosettes of up to 20-30 leaves. When some of these plants were transferred to a high-humidity controlled environment chamber, programmed for 16°C nights and 24°C days (14 hours), rosettes expanded, and shoots elongated 1 to 2 cm.

TABLE 2. *Early growth characteristics of* Houstonia montana *under greenhouse conditions. Means based on combined data from 15-20 plants growing at soil temperature of 13°, 19°, 21°C, and air temperature of 16°-24°C.*

| Character | Days from Germination 41 | 70 | 98 |
|---|---|---|---|
| Oven-dry weight, mg. | 2 | 14 | 40 |
| Leaf area, $cm^2$ | 0.5 | 2.0 | 3.9 |
| Leaf area ratio, $cm^2/g$ | 243 | 139 | 97 |
| Shoot/root ratio | | 4.9 | 4.2 |
| Relative Growth Rate, mg/g/wk | 475 | 262 | |
| Net Assimilation Rate, $g/m^2/wk$ | 28 | 24 | |

Plants grown in controlled environment chambers were subsequently over-wintered in 5 cm pots in a lathhouse near Norris, Tennessee (elevation, 400 m). In the spring of 1976, they all bolted and flowered. They were subsequently transplanted to 15 cm pots of peat:perlite supplemented with Hoagland's solution and grown at Norris in open and shaded areas with air temperature of around 16°-20°C. Flowering continued into July, but no fertilization took place. Development of elongated (15-20 cm) shoots bearing flowers was followed by formation of a basal rosette of short shoots which elongated and bore flowers after winter chilling. A small number of seed was also collected in the fall

of 1975, stratified in December, and planted in a 16°-24°C growth chamber in late February. These plants developed tight rosettes, were transplanted to 15 cm pots in May 1976, and were grown in a lathhouse (30 percent of full sunlight) where rosettes expanded to a diameter of 4 to 5 cm by September. Shoot elongation and flowering began in May 1977. Thus, it appears that flowering follows vernalization after an initial season of vegetative growth.

Though very little is yet known about the relationship of growth to light and temperature, the sum of these preliminary observations indicates that the Roan Mountain bluet can be grown easily as container stock. Populations could be expanded by transplanting this container stock to suitable high elevation sites. Some of these planted sites could subsequently be used as cultivated seed production areas.

## ACKNOWLEDGEMENT

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