

FACTORS CONTROLLING FLAVONOID CONCENTRATION IN FLOWERS

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Objectives

Flavonoid compounds in flowers serve two presently known functions: (1) they act as floral pigments which attract pollinators and (2) they function as a screen for potentially damaging ultraviolet (UV) wavelength radiation. The research I performed at the Research Center seeks to evaluate the relative importance of these two functions between alpine and Jackson Lake-level elevations in Grand Teton National Park.

The operating hypothesis is that the UV-screening function will be of overriding importance at high elevations (where UV-radiation is more intense) and therefore, higher concentrations of petal flavonoids would be expected at these elevations. By contrast, at lower elevations where insect pollinators (which are visually sensitive to UV light) are more numerous, pollinator attraction by UV reflection would dictate lower flavonoid concentrations in petals.

Materials and Methods

The following parameters were determined for floral tissue of sample specials: (1) flavone/flavonol concentration, (2) anthocyanin concentration, and (3) percentage UV reflectance.

Petals were exhaustively extracted with acidified methanol from freshly collected and weighed floral materials. Flavone/flavonol and anthocyanin concentrations were then determined spectrophotometrically. The visible and UV reflectance spectrum was determined on freshly collected floral material by performing reflectance spectroscopy using a recording spectrophotometer with an integrating sphere attachment.

Plant materials were collected on Rendezvous Peak for alpine samples and in lodgepole pine woodland for lower elevation samples. Two groups were selected for comparison: (1) species which co-occurred at both elevations and (2) genera in which a closely related congener pair occurred with one species at each elevation.

Results

Seven species (see Table 1) were examined which co-occurred at alpine and

Table 1. Plant species examined for floral flavonoid concentration.

A. Species co-occurring at alpine and lower elevation

Achillea millefolium
Aquilegia flavescens
Geranium viscosissimum
Linum perenne
Mertinsia ciliata
Phacelia sericea
Senecio crassulus

B. Species pairs occurring at alpine and lower elevation

Alpine species

Astragalus kentrophylla
Aster alpigenus
Castilleja sulfurea
Delphinium nuttallianum
Erigeron leiomersus
Pedicularis groenlandica

Lower elevation species

Astragalus miser
Aster perelegans
Castilleja rhexifolia
Delphinium occidentale
Erigeron speciosus
Pedicularis racemosa

conifer forest elevations. Additionally, six species pairs were studied (Table 1), of which pairs one was alpine and the alternate occurring at lower elevation.

Among the taxa co-occurring at high and low elevation, the ratio of flavonoid concentrations (conc hi elev/conc low elev) ranged from 2.13 for sepals of Aquilegia flavescens to 0.58 for Mertinsia ciliata. The similar ratio for congener pairs ranged from 1.26 for Astragalus kentrophylla-A. miser to 0.36 for Delphinium nuttallianum-D. occidentale.

Conclusions

The range of flavonoid concentration ratio values from substantially greater than one to much less than one within each sample group argues that the operational hypothesis is incorrect. High concentrations of flavonoid are not consistently induced in flowers by exposure to intense UV radiation at alpine elevations. The concentration of floral flavonoids in a particular taxon is apparently delicately regulated by a complex interation of environmental and biotic-interaction factors and must be under carefully regulated genetic control. A detailed study of individual taxa will be required in order to identify the balance of factors controlling the concentration of floral flavonoids.