

FRUIT AND PAPPUS TRAITS OF *DOELLINGERIA* INCLUDING *EUCEPHALUS* (ASTERACEAE: ASTEREAE)

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ABSTRACT

The pappus of all species in *Doellingeria* including *Eucephalus* is similar and consists of four distinct whorls of bristles. These are described and illustrated. *Doellingeria* s.l. includes two distinct groups of species: 3 eastern (*Doellingeria* s.s.) and 10 western North American species (*Eucephalus*).

Allen et al. (2019) proposed the merger of the eastern North American genus *Doellingeria* with the western North American genus *Eucephalus* based on the results of molecular analyses. The three eastern species are *D. umbellata* Mill. (Fig. 1A), *D. infirma* (Michx.) E.L. Greene, *D. sericocarpoides* Small. The 10 western species are *D. elegans* (Nutt.) Semple, Brouillet, & Allen (Fig. 1B), *D. breweri* (A. Gray) Semple, Brouillet, & Allen, *D. engelmannii* (D.C. Eaton) Semple, Brouillet, & Allen (Fig. 1C), *D. glabrata* (Greene) Semple, Brouillet, & Allen, *D. glaucescens* (A. Gray) Semple, Brouillet, & Allen, *D. gormanii* (Piper) Semple, Brouillet, & Allen, *D. ledophylla* (A. Gray) Semple, Brouillet, & Allen, *D. paucicapitata* (Robins.) Semple, Brouillet, & Allen, *D. tomentella* (Greene) Semple, Brouillet, & Allen, and *D. vialis* (Bradshaw) Semple, Brouillet, & Allen. The genera were treated as separate in Flora North America (Semple & Chmielewski 2006; Allen 2006) and recently (Nesom 2022). Allen et al. (2019) reviewed the various historical treatments and limits of the two genera. Morphologically, the two groups of species have been separated on the basis of involucre traits: presence of “keeled” phyllaries (with a thickened midrib) in *Eucephalus* (Figs. 2B-C) but not in *Doellingeria* (Fig 2A). The keel can be obscure in some specimens. Nesom (2022) noted the following achene differences: “achenes broadly columnar with 5-9 resinous veins (*Doellingeria*) or strongly flattened 2-nerved (*Eucephalus*),” as well as differences in disk corolla and disk styles (Nesom, pers. comm.).

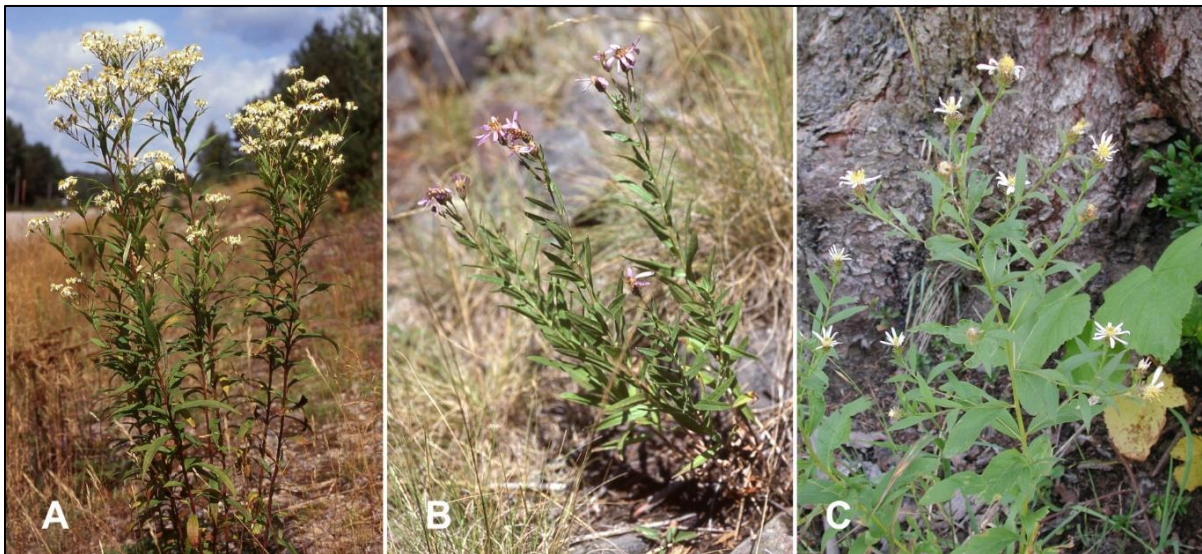


Figure 1. Shoots of *Doellingeria umbellata* (Ontario), *D. elegans* (Semple & Brouillet 7034 WAT, Idaho), and *D. engelmannii* (Semple & B. Semple 11282 WAT, Wyoming).

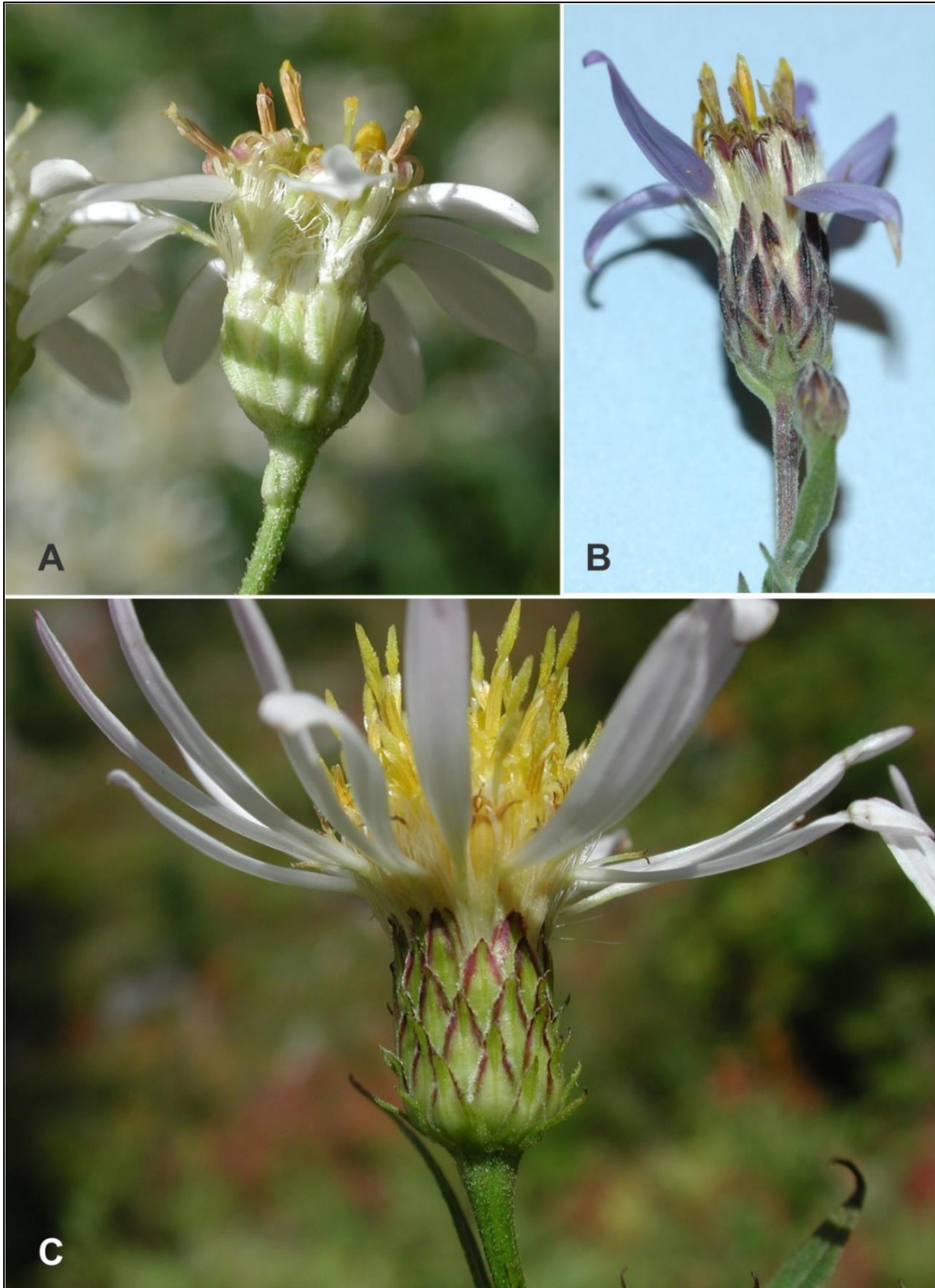


Figure 2. Flowering heads of *Doellingeria umbellata* (Ontario), *D. elegans* (Semple & B. Semple 11365 WAT, Idaho), and *D. engelmannii* (Semple & B. Semple 11282 WAT, Wyoming).

The molecular results in Allen et al. (2019) indicate that *Eucephalus elegans* belongs in the subclade 1 with the three eastern *Doellingeria* species, while the remaining *Eucephalus* species belonged in a separate subclade 2. Thus, the type species of *Eucephalus* is genetically more closely related to the eastern *Doellingeria* species than to the 9 western species and the two genera were merged nomenclaturally. Nesom (2022) rejected this conclusion as being premature and suggested that a possible more complex evolutionary history involving species of subtribe Baccharidinae (see Nesom 2020) might actually be involved with *Doellingeria* and *Eucephalus* evolving independently from a shared South American ancestral complex. Phylogenomic studies of the New World Astereae are currently underway (Allen, pers. comm.) to further clarify the evolutionary history of the origins of North American clade and the *Doellingeria-Eucephalus* complex.

The purpose of this paper is to show the close similarities of pappus traits of the eastern and western species. The choice of examples illustrated was the result of the availability of samples ideal for imaging whole fruits and individual pappus bristles. The pappus traits of other species are similar. Fruits of *Doellingeria seriocarpoides* (Semple & Surlito 9780 WAT; Fig. 3) and *D. (Eucephalus) engelmannii* (Semple & Chmielewski 8877 WAT and Semple et al. 5786 WAT; Fig. 4) provided ideal material for imaging with a dissecting scope and a compound microscope using a Nikon CoolPix 990 digital camera for whole fruit (front lighting) and pappus bristle detail images (back lit). Individual pappus bristles were mounted in water under a coverslip for imaging of distal portions of bristles on the compound microscope.

The pappus of all species in *Doellingeria* including *Eucephalus* is similar and consists of four distinct whorls of bristles. The inner most whorl (1° inner) is the longest and consists of bristles with obviously flattened clavate tips. The middle two whorls consist of bristles that taper to the apex and are not at all clavate. The 2° inner bristles are mostly 80-95% the length of the 1° inner clavate bristles. The 2° outer bristles are much shorter and range from 25-60% in length of the longest inner bristles. The outer most whorl (1° outer) is short and ranges from narrow flattened bristles to broader scales.

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This research was in part supported by Natural Sciences and Engineering Research Council of Canada Discovery Grants to the author. Geraldine Allen and Luc Brouillet are thanked for helpful comments on a draft of this manuscript.

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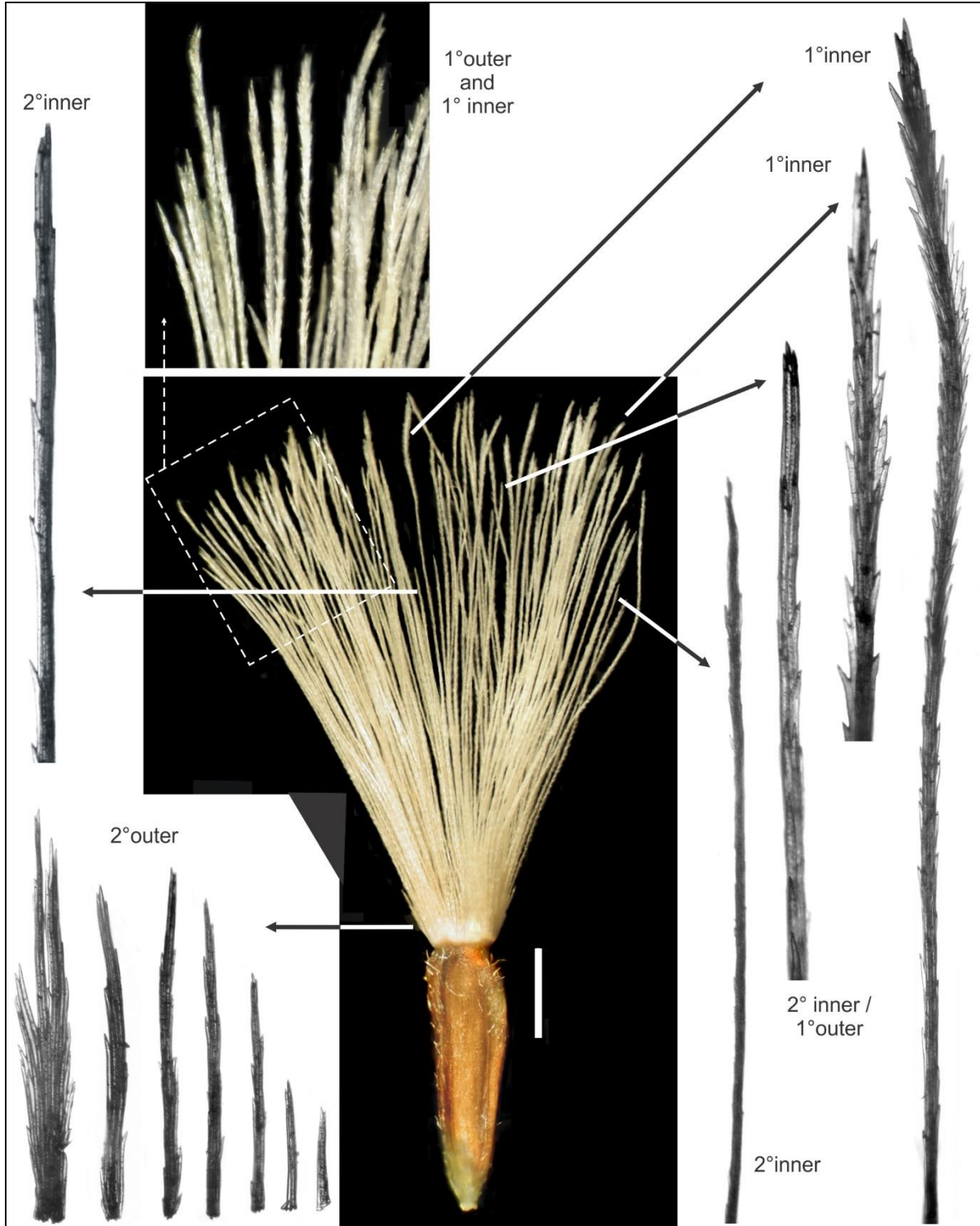


Figure 1. *Doellingeria seriocarpoides* (Simple & Suropto 9780 WAT); scale bar = 1 mm. Figure created from one cypsela; arrows indicate approximate source locations of excised scales and bristle tips.



Figure 2. *Doellingeria* (*Eucephalus*) *engelmannii* (Semple & Chmielewski 8877 WAT; broken line insert, Semple et al. 5786 WAT).