

# A Comparative study of seed coat micromorphology and seed anatomy in Alaskan *Oxytropis* (Loco-weed, Fabaceae) using SEM, and their Taxonomic Significance

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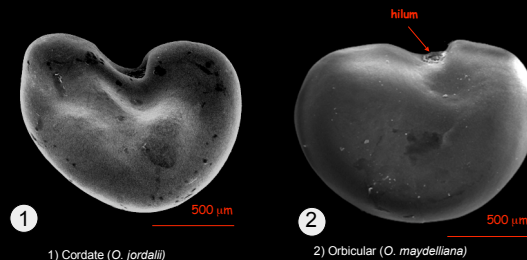


## Introduction

*Oxytropis* (loco-weed, Fabaceae) are typical members of the Arctic flora and include 20 taxa in Alaska, occurring in a wide range of habitats (e.g. forest, meadow, tundra) with some species being narrow endemics. Botanists in Alaska have long noticed a high degree of morphological variation within well-established taxa. This has resulted in taxonomic controversy and species delimitation in *Oxytropis*. This project seeks to determine differences in surface features and anatomy of seeds of 15 species of *Oxytropis* that occur in Alaska. This study is based on dry herbarium specimens from the University of Alaska Museum Herbarium (ALA).

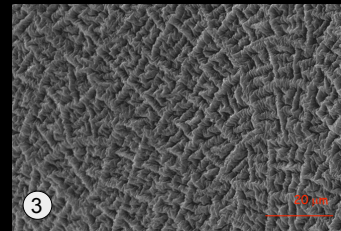
## Methods

Dry specimens were sputter-coated and viewed with an ISI-SR-50 SEM at 20 kV at 1000x. Anatomical sections were made from seeds soaked in a mixture of equal parts water, glycerol, and ethyl alcohol for 30 hours, then sectioned with a razor blade (Lobova et al. 2003). Measurements given are the mean of 10 seeds.

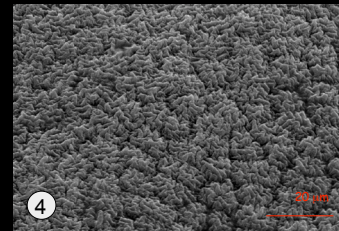


## Results

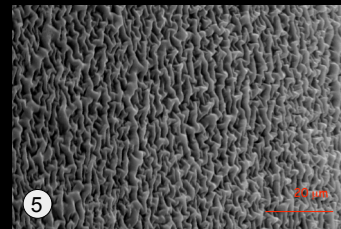
Seeds are commonly cordate or orbiculate and measure from 1.3-2.1 mm (Figs. 1-2, Table 1). Seed coat micromorphology in *Oxytropis* is primarily rugulate (Figs. 3-6). Three secondary patterns can be recognized: 1) multi-reticulate with heavy ridges (Fig. 3), 2) multi-reticulate finely interwoven (Fig. 5), or 3) multi-reticulate coarsely interwoven (Fig. 6). Rarely, a lophate pattern was observed (Fig. 4, Table 1). The seed coat is well differentiated and exotestal with the outer integument providing the mechanical layer of the seed (Figs. 7-11). An uniseriate epidermis is covered by a cuticle on upper anticlinal walls (Fig. 8), and is composed of prominent macrosclereids (Figs. 8, 11), followed by a single row of osteosclereids (hypodermis) and 5-8 rows of compressed tangentially elongate parenchyma cells of the nucellus (Figs. 8-9).



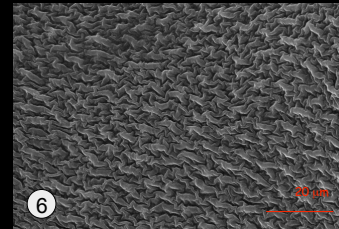
3) Multi-reticulate w/ heavy ridges (*O. jordalii*)



4) Lophate (*O. campestris*)



5) Multi-reticulate finely interwoven (*O. huddelsonii*)



6) Multi-reticulate coarsely interwoven (*O. kokrinensis*)

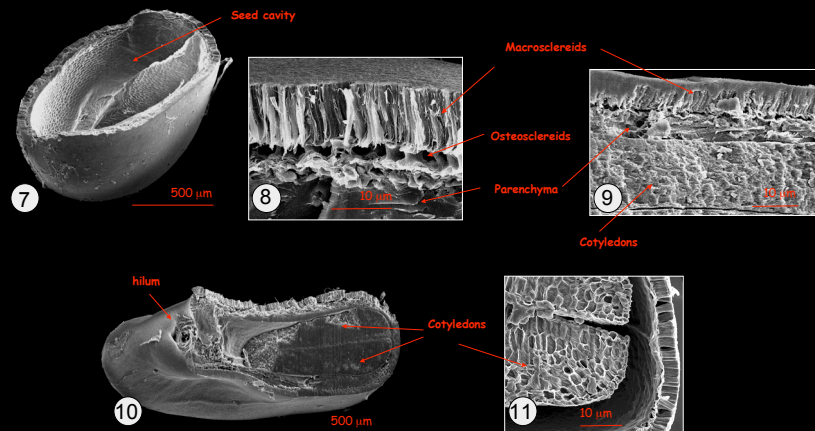


Table 1: Comparisons of characters measured within Alaskan *Oxytropis*

| Classification*            | Species                                  | Seed       |        |       |           | Distribution                         | Chromosome number (2n)?    |          |
|----------------------------|--|------------|--------|-------|-----------|--------------------------------------|----------------------------|----------|
|                            |  | shape      | length | width | L/W ratio |                                      |                            |          |
| Subgen. Phacocorypsis      |  |            |        |       |           |                                      |                            |          |
| Sect. Mesogaea (1 of 13)   | <i>O. deflexa</i>                        | orbiculate | 1.45   | 2.10  | 1.25      | multi-reticulate w/ heavy ridges     | Alaska & North America     | 10       |
| Subgen. Oxytropis          |  |            |        |       |           |                                      |                            |          |
| Sect. Arctobia (9 of 13)   | <i>O. nigrescens</i>                     | orbiculate | 1.26   | 2.05  | 1.43      | multi-reticulate w/ heavy ridges     | North Asia                 | 10       |
|                            | <i>O. huddelsonii</i>                    | orbiculate | 1.59   | 2.32  | 1.37      | multi-reticulate finely interwoven   | Alaska & Yukon             | n.s.     |
|                            | <i>O. bryophila</i>                      | orbiculate | 1.79   | 2.17  | 1.21      | multi-reticulate coarsely interwoven | Alaska                     | 10       |
|                            | <i>O. kokrinensis</i>                    | orbiculate | 1.37   | 2.06  | 1.51      | multi-reticulate coarsely interwoven | Alaskan endemics           | 16       |
|                            | <i>O. scammaniana</i>                    | orbiculate | 2.20   | 2.71  | 1.23      | multi-reticulate coarsely interwoven | Alaska                     | 16-32    |
| Sect. Orobia (6 of 28)     |  |            |        |       |           |                                      |                            |          |
|                            | <i>O. maydelliana</i>                    | orbiculate | 1.78   | 2.06  | 1.10      | Multi-reticulate finely interwoven   | Alaska                     | 90       |
|                            | <i>O. arctica</i>                        | orbiculate | 1.31   | 1.82  | 1.39      | multi-reticulate w/ heavy ridges     | American barterian         | 48,80,96 |
|                            | <i>O. arctica</i> var. <i>canadensis</i> | orbiculate | 1.30   | 1.37  | 1.04      | multi-reticulate w/ heavy ridges     | American barterian         | 48,80,96 |
|                            | <i>O. jordalii</i>                       | orbiculate | 1.67   | 1.70  | 1.02      | multi-reticulate w/ heavy ridges     | American barterian         | 32       |
|                            | <i>O. kokrinensis</i>                    | bean       | 1.63   | 1.95  | 1.19      | lophate                              | Alaskan endemics           | 80       |
|                            | <i>O. campestris</i>                     | orbiculate | 1.43   | 1.88  | 1.16      | multi-reticulate coarsely interwoven | Europe, Asia, & N. America | n.s.     |
| Sect. Glocephala (2 of 10) |  |            |        |       |           |                                      |                            |          |
|                            | <i>O. borealis</i>                       | orbiculate | 1.53   | 1.55  | 1.02      | multi-reticulate w/ heavy ridges     | Alaska                     | 48-96    |
|                            | <i>O. glaberrima</i>                     | orbiculate | 1.85   | 2.24  | 1.15      | multi-reticulate finely interwoven   | Alaska                     | 16       |
| Sect. Balcalia (1 of 8)    |  |            |        |       |           |                                      |                            |          |
|                            | <i>O. splendens</i>                      | orbiculate | 1.34   | 1.66  | 1.19      | multi-reticulate finely interwoven   | North America              | 10       |

\*Following Murray and Elven (2008), and Bunge (1874). Parenthesis indicate number of species surveyed of total number of species in section.  
\* Terminology following Leston (1981), Solum and Lockerman (1991), and Gupta (1993).  
† Murray and Elven (2008) and internal citations.

## Discussion/Conclusion

Seed surface micromorphology in surveyed *Oxytropis* is relatively homogenous being mostly rugulate and infrequently lophate as previously demonstrated for *O. campestris* and *O. riparia* (Solum and Lockerman 1991). In contrast, previous studies have found that *Astragalus* seeds exhibit a levigate pattern with shallow ridges and furrows (Solum and Lockerman 1991). Interestingly, in *Oxytropis* sect. Orobia two thirds of the species surveyed are consistently found to be multi-reticulate with heavy ridges (Fig. 3, Table 1). Otherwise, seed coat patterns do not reflect current taxonomy (Table 1). Anatomically, seeds of *Oxytropis* show a typical leguminous organization with prominent macrosclereids in the epidermis (exotestal *sensu* Corner 1951). In summary, *Oxytropis* seed coat micromorphology and anatomy can be used to distinguish *Oxytropis* from its sister taxon *Astragalus*. Additional characters are needed to help differentiate species of Alaskan *Oxytropis* and evaluate diversification within the Arctic.

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