Adaptive Genetic Variation of *Elymus glaucus* (Blue Wildrye) in Northeast Oregon: Implications for Seed Collection and Management

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Introduction

Blue wildrye (*Elymus glaucus*) is a short-lived perennial bunchgrass native to the Blue Mountains of northeast Oregon and southeast Washington where it occurs over a wide range of ecological conditions. Blue wildrye is increasingly being used in restoration and re-vegetation projects due to its extreme drought tolerance, ability to persist on severely disturbed sites, and rapid germination and stand establishment. This study was initiated to examine adaptive patterns of variation in blue wildrye and develop local guidelines for seed collection and deployment.

Materials and Methods

In 1994, seed collections were made from two subspecies of blue wildrye at 154 locations in northeast Oregon and southeast Washington. Each location was represented by one or two families, for a total of 189 families. Seventy six-of the source plants were field-identified as ssp. *jepsonii*, and 78 families were identified as ssp. *glaucus*.

Seeds were sown in greenhouse containers at the NRCS Plant Materials Center in Pullman, WA. After 8 weeks, the grass plugs were transplanted to field plots in a RCB design with 4 replications of two-seedling family row plots in each of two contrasting environments (irrigated and non-irrigated). Measurements of plant vigor, reproductive performance, timing of reproductive and vegetative growth, along with a number of other floral and stem/leaf characteristics were recorded over three growing seasons. A germination trial of seeds harvested from the study plants was also conducted to provide geographic information on the timing and uniformity of seed germination.

Genetic variation was analyzed using methods from Campbell (1986) and Sorensen and Weber (1994). Traits with significant location variance were used in a principal component analysis (PCA). Factor scores were calculated for each family and fitted to regression models that included geographic, topographic, and climatic location

variables. Analysis of variance was used to examine the adequacy of several site classification variables, including seed zone, watershed, river sub-basin, and 400-meter elevation band, for explaining location-related variance of factor scores.

Results

The location variance for both subspecies was highly significant and explained an average of 35% of the total variation. The pooled within-location variance accounted for 11.0% of the total. The first three factors in PCA explained 67% of the source-related variance in 14 traits. These factors appear to describe different growth and reproductive strategies present among the sources. Regression of PCA scores for ssp. *jepsonii* on geographic and climatic variables accounted for 43-63% of the source-related variation. The predominant trend was for plant size and seed production to increase with increasing longitude, latitude, and precipitation, while germination and floral phenology were delayed. In the ssp. *glaucus*, regression models were far less satisfactory, explaining only 27% of the source variation in factor 1, and less than 10% in factors 2 and 3.

The only significant effect in classification models was river sub-basin, which explained 46-59% of the source-related variance in the first three factors of ssp. *jepsonii*. Lack of fit was highly significant for all factors, however, suggesting that other local effects were missing from the model.

Practical Applications

The high degree of differentiation observed among source locations is similar to that found in other studies of blue wildrye (Knapp and Rice 1996, Kitzmiller, 1997). In the ssp. *jepsonii*, these differences were related to geographic and climatic variables that described the seed source, indicating adaptive variation to local conditions within the Blue Mountains. In the ssp. glaucus, variation patterns were less obvious, perhaps because important local factors or microsite conditions have not been adequately measured. Alternatively, the differentiation among locations may result from random rather than adaptive processes in ssp. *glaucus*, which may require a separate approach to seed zoning.

Ideally, one set of seed transfer guidelines will be developed for both subspecies of blue wildrye in the Blue Mountains. From the preliminary results presented here, these guidelines will be based primarily on latitude, longitude, precipitation and other variables that measure moisture availability, and possibly also river sub-basin boundaries. Elevation restrictions for seed collection and transfer in most areas will likely be relaxed from those currently in use.

Literature Cited

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