An Assessment of Genetic Variation of Whitebark Pine Populations from Oregon and Washington in Relation to Height Increment, Phenology, and Form.

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A complementary study to a planned rust evaluation experiment at the Dorena Genetic Resource Center was undertaken in order to evaluate genetic variation of height growth increment. The study sample included a total of 94 families from 6 provenances located in Oregon and Washington. A set of serial measurements were taken throughout the growing season in order to quantify the phenology patterns, relative growth rates, and total growth increment during the third growing season of the planned experiment. In addition, stem form was assessed. A few preliminary findings from the study are presented.

Eight cumulative height measurements were taken during the course of the growing season in order to assess the relative rates of shoot elongation, phenology, and growing season increment; where time of measurements were designated as days from 1 January, 2006. Least square means for all measured height increments (at days 91, 107, 122, 136, 150, 165, 178 and 201) differed significantly ($P < .05$) among provenances. The cumulative height increment changed rank among provenances until the third periodic measure (day 122 measure), wherein after the provenances general ranking remained the same throughout the rest of the growing season. The more northwestern provenances (Mt. Hood, Mt. Rainier, Warm Springs) formed a general group with the maximum height. The Umatilla provenance was intermediate in height followed by the Malheur and Crater Lake provenance grouping.

Significant genetic (family) variability was also detected at each measurement period for height. Family heritabilities were moderate and ranged from 0.40 – 0.65 for the respective measurement dates. The relationship (Pearson correlation coefficient) between family mean cumulative height increment (day 201 measure) and parent tree source environmental variables of elevation, longitude, and latitude were assessed. Moderate correlations existed between final height and elevation (- 0.46, lesser height with higher elevation), longitude (0.43, greater height with a more western source) and latitude (0.41, greater height with a more northern source).

In addition to height measurements, the percentage of the seasonal growth completed at each measurement date was computed. This variable provides a viewpoint relative to initiation of shoot elongation and/or relative growth rate (in early season growth) and to growth cessation (in late season growth).

Least square means for the derived percent of growth completion differed significantly among provenances for the first two measurement dates in the early season (day 91, 107), and for the last two measurement dates in the late season (day 165, 178). Day 201 was considered to represent 100% of growth completion for all seedlings, and thus there is no comparison among provenances for that measurement date. In the initial two measurement periods, the Warm Springs and Mt. Hood provenances exhibited the lowest percentage of growth completion values. The Malheur provenance exhibited the highest or second highest percentage of growth completion from the second measurement (day 107) on to the end of the growing season. There existed two major sub-sets of provenances at the latter part of the late season measurements (day 150, 165, 178) that were closely aligned. The Malheur and Umatilla provenances exhibited the highest percentage of growth completion, while Mt. Rainier, Mt. Hood, Warm Springs, and Crater Lake exhibited the lesser percentage of growth completion overall. The differences among provenances in both the early and late season would seem to indicate potential differences in either initial shoot elongation, cessation of growth, relative growth rate, or some variable combinations of these attributes.

Significant genetic (family) variability was also detected in all but the last (day 178) measurement for the percent of growth completion. Family heritabilities for this derived trait were low to moderate (range from 0.28 – 0.53) for the first six measurement dates.

The general form of the trees was scored in a subjective manner, where trees were scored as being in one of three form classes:

1. single stem form
2. forked form
3. numerous multi-stems/bush-like form.

Least square means for the transformed class variable differed significantly among provenances. The rank order of the more desirable tree form class to the less desirable tree form class was closely aligned with the rank order (from tallest to shortest) of the final cumulative heights per respective provenance. The northwestern provenances (Mt. Rainier, Mt. Hood, Warm Springs) expressed a more desirable mean tree form class than that of the remaining provenances.

Significant genetic (family) variability was also detected for form class, where the estimated family heritability was 0.67. The relationship (Pearson correlation coefficient) between family mean form class and final cumulative height was – 0.63 (greater mean height associated with a more desirable form class). The correlation between family mean form class and parent tree source environmental variables of elevation, longitude, and latitude were also assessed. Low to moderate correlations existed between form class and elevation (0.33, less desirable form with higher elevation), longitude (-0.32, less desirable form with a more eastern source) and latitude (-0.42, less desirable form with a more southern source).

The preliminary findings from this study will be posted on the Dorena webpage: http://www.fs.fed.us/r6/Dorena. Further detailed analyses will be conducted on this study data, and all results will be posted on the webpage in Spring, 2007.