Orchardgrass Breeding and Genetics

Forage and Range Research Laboratory

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PLANTS FOR THE WEST

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Orchardgrass

Grazing

Mechanical harvest

Seed production

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FRRL orchardgrass improvement – molecular and traditional approaches

EST-SSR markers (Bushman et al., 2011, TAG)

Genetic diversity (Bushman et al., 2011, TAG)

Linkage map & QTL (Xie et al., 2012, Genome)

Germplasm Evaluation / Population Improvement

- Tetraploid and diploid accessions (Bushman et al., 2012, Crop Science)
- Morphology and maturity (Robins et al., 2012a, Crop Science)
- Combining ability of dry matter yield (Robins et al., 2012b, Euphytica)
- Nutritive value, water-soluble carbohydrates, and performance in legume mixtures

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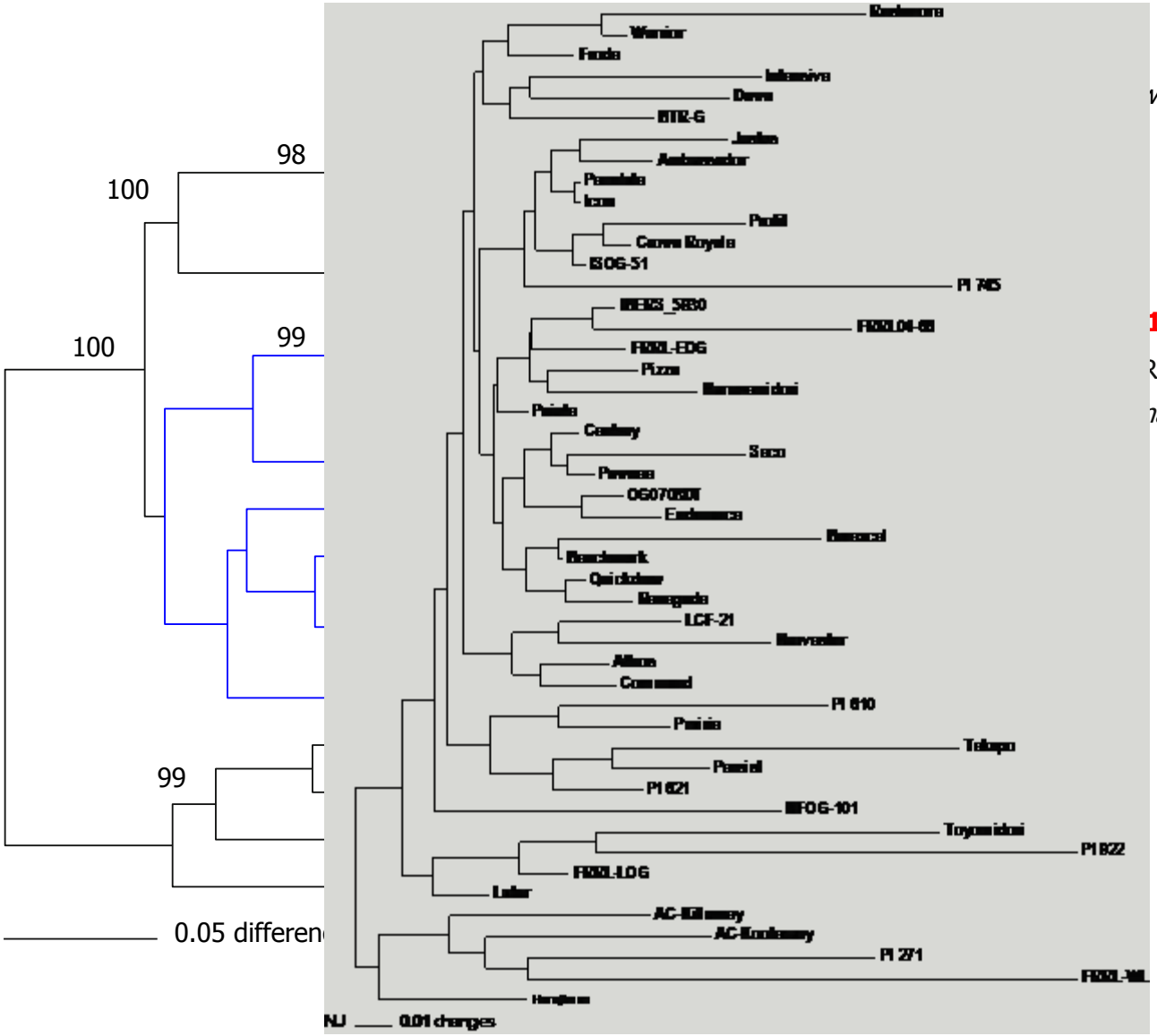
Dactylis genetic diversity



vii

1 *himalayensis*

R 667 *aschersoniana*

na

237601 *juncinella*

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Germplasm evaluation

Incorporate new germplasm

Phenotypic evaluation of germplasm

- Diploid and tetraploid accessions
- Breeding populations
- Cultivars

Phenotypes

- Heading date / morphology
- Forage yield
- Winter survival / freezing tolerance

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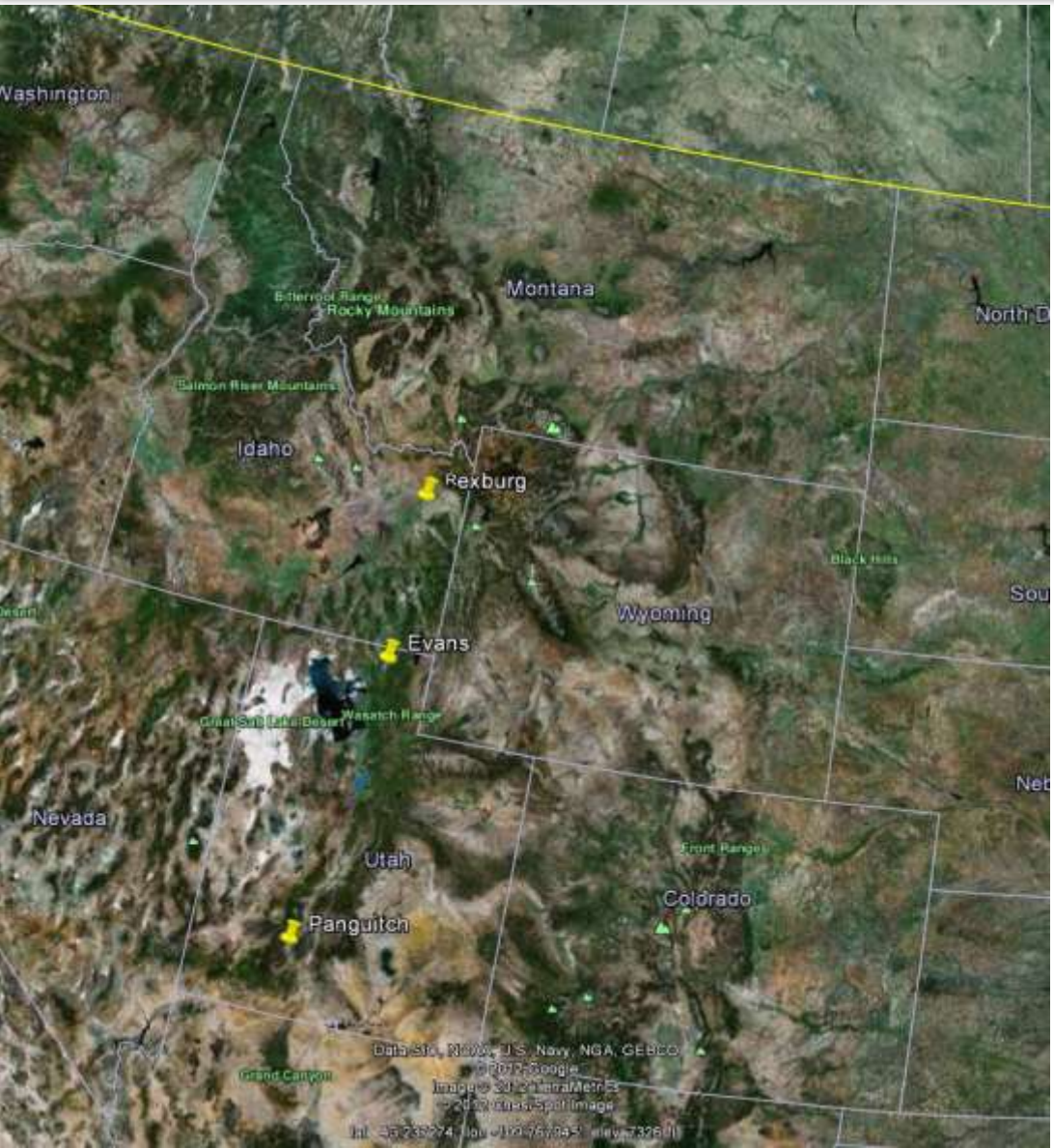
Evaluation and selection locations



Rexburg, ID (BYU-ID Hillview Farm)
- 43.63° N, 111.67° W
- 1481 mas
- 356 mm annual precipitation
- silt loam soil

Millville, UT (USU Evans Farm)
- 41.68° N, 111.83° W
- 1378 mas
- 432 mm annual precipitation
- silty clay loam soil

Panguitch, UT (USU Panguitch Farm)
- 37.87° N, 112.44° W
- 1993 mas
- 247 mm annual precipitation
- loam soil

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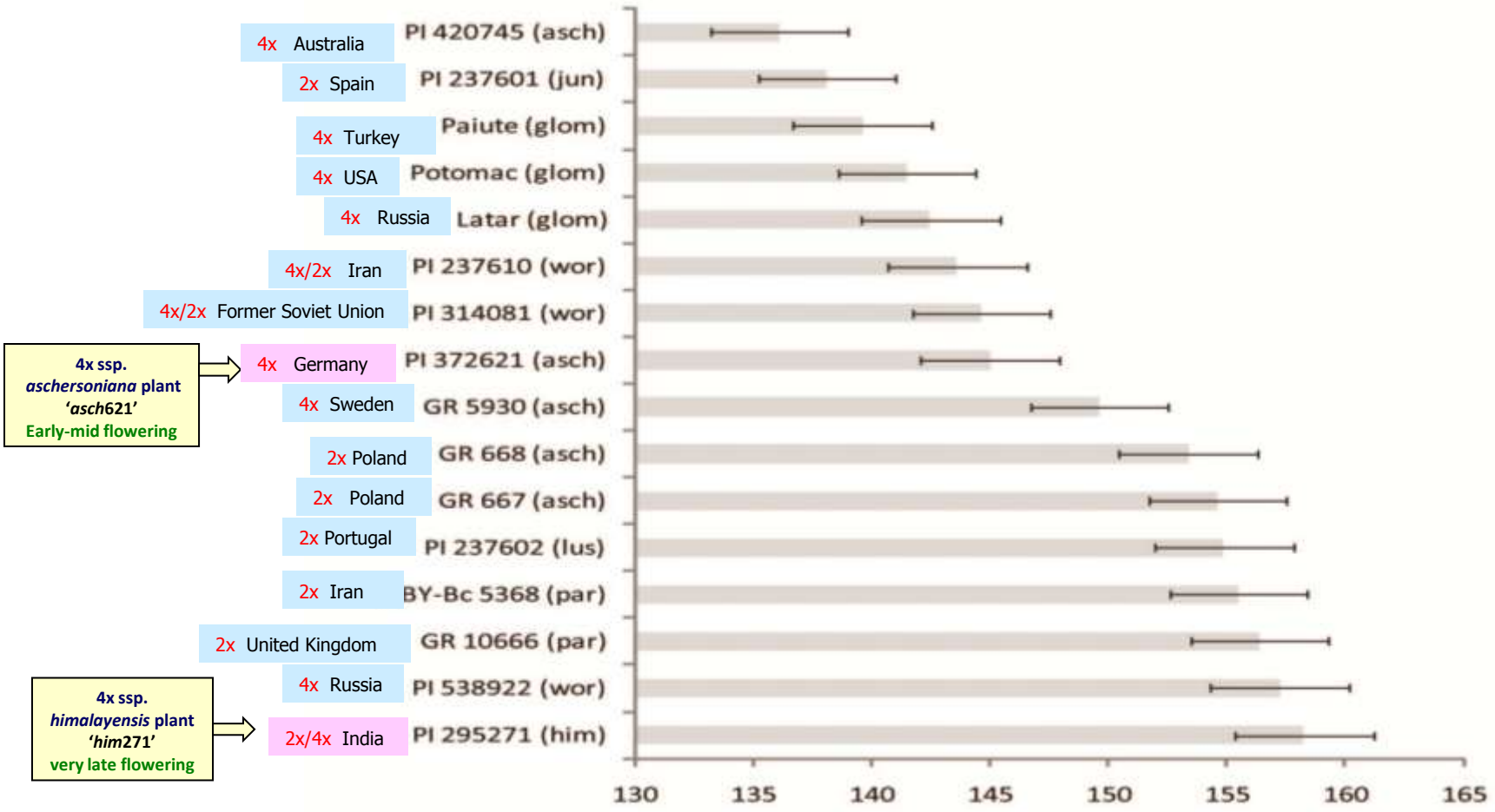
Heading date



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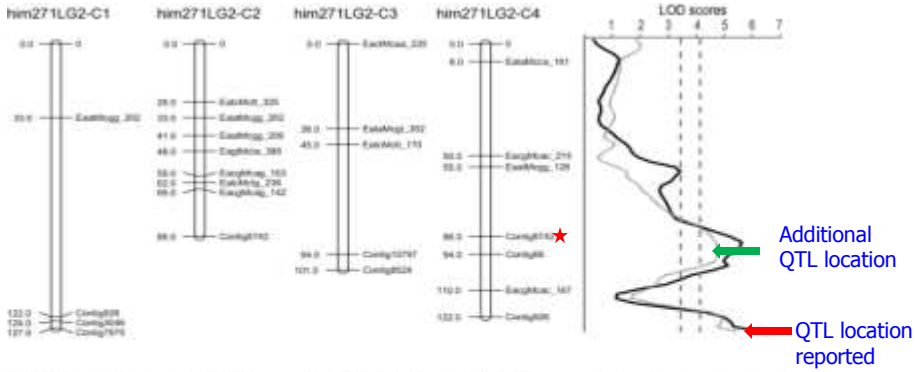
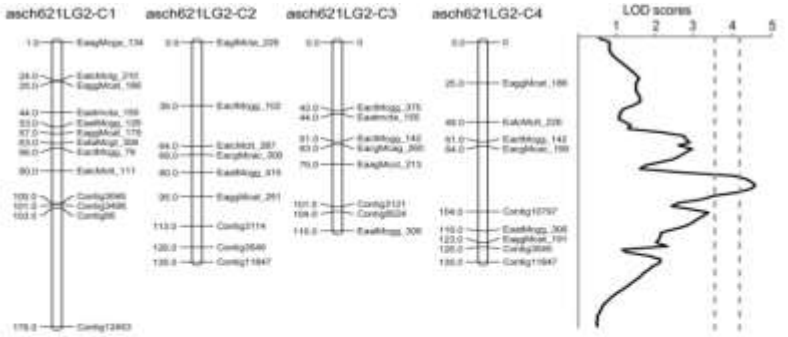
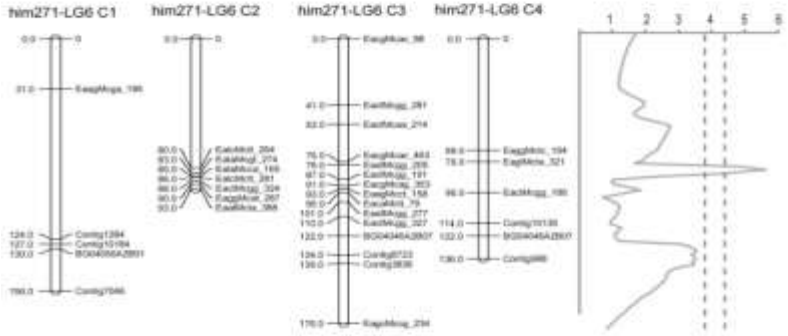
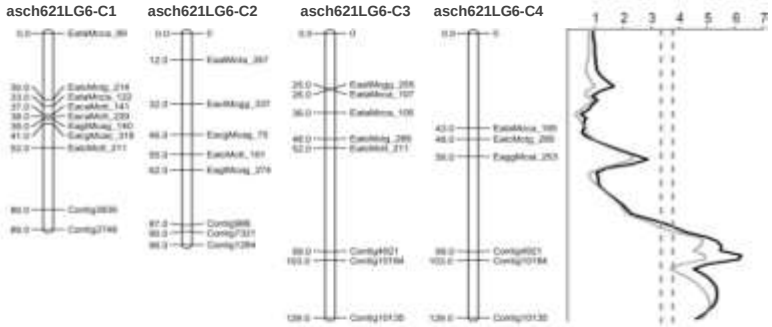
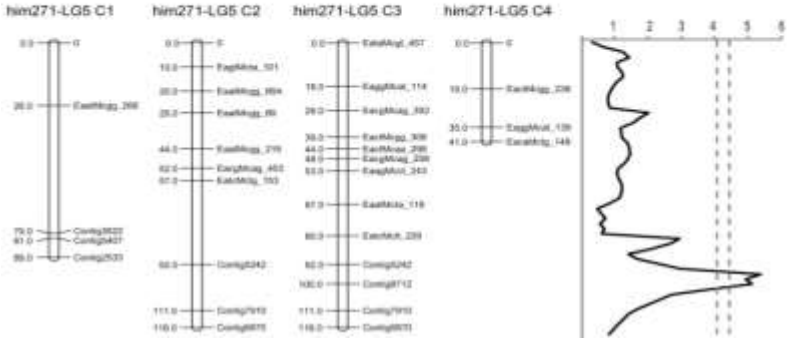
Heading Date QTL Results











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Heading date

- 162 HSFs evaluated for morphology and heading date
  - H^2 (heading date) = 0.74
  - H^2 (morphology) = 0.26 - 0.64
  - Significant differences among HSFs and cultivars
  - Early genotypes → tall with short and narrow flag leaves
  - Late genotypes → short with long, wide flag leaves
  - UTDG101 extremely late

Heading date association

Candidate gene approach to identify genetic determinants

Field data from 2010 and 2011

192 genotypes

Intent to map 15 candidate genes

(FT, HD, VRN, CONSTANS)

Association with candidate genes

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Forage yield – combining ability

Population hybrids among 9 population sources

GCA/SCA at harvests 1 and 3 and total

3 to 4 heterotic groups

Population hybrids with higher dry matter yield than cultivars

UTDG102 possessed high GCA

UTDG101 possessed high SCA, but low GCA

Forage yield - germplasm

HSFs

- Low to moderate H^2
  - 0.50 for yearly total across locations
- HSFs with higher dry matter yield than cultivars

Accessions

- Subsp. *woronowii* possessed high DMY, late heading, and limited mortality

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Winter survival

Fall 2010

Spring 2011

Freezing tolerance

Candidate gene approach to identify genetic determinants

- Freezing tolerance in freezing chamber at several temperatures

- Association of candidate genes

Other traits

Choke resistance

- Willamette Valley orchardgrass seed growers

Water-soluble carbohydrates

- Abiotic stress resistance and improved nutritive value

Seed production

- Increase seed production – late heading

Conclusions

Based on initial genotyping and phenotyping a number of promising germplasm sources were identified

Strategic use of markers to aid in selection process

Developed several breeding populations that are now being evaluated and selected

Working to develop improved populations that can be released with increased abiotic stress tolerance and agronomic performance