Uncovering Adapted Germplasm for the Great Basin: Tapertip Onion and Friends

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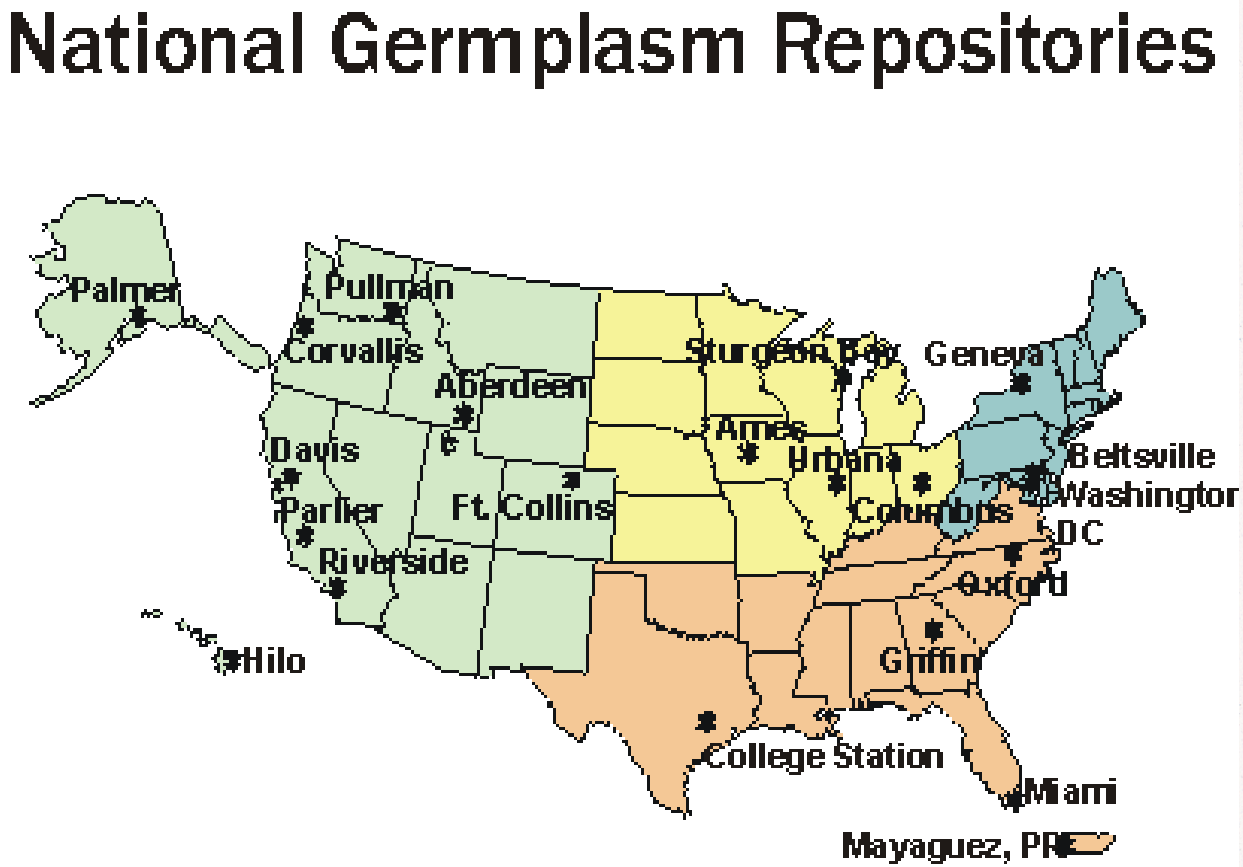
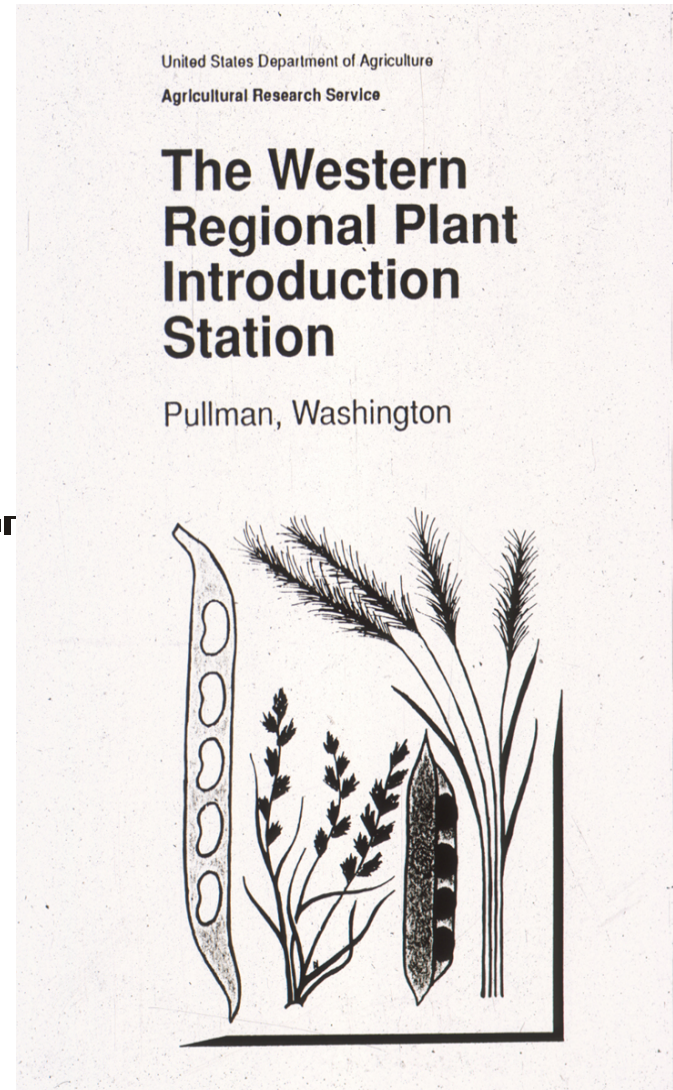
USDA ARS Agricultural Research Service

FOREST SERVICE US DEPARTMENT OF AGRICULTURE

U.S. DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT

National Plant Germplasm System




United States Department of Agriculture

Agricultural Research Service

The Western Regional Plant Introduction Station

Pullman, Washington

Our Interest in Natives

- **Longstanding role of NPGS in conservation of natives**
- **Increasing, native plant material is preferred for restoration and revegetation by federal agencies**
- **Conserving the diversity of important species for current and future use is critical**
- **Important questions concerning use of "local" plant material compared with broadly adapted cultivars. What are the appropriate seed transfer zones? Research needed…**
- ***Ex situ* and *in situ* conservation are complementary, but how many *in situ* sites and where? Research needed…**
- **For a given species, collections should represent the diversity across the landscape for current and future use**

Why the Gene-ecology Approach?

- Gene-ecology provides a way to conserve the minimum needed accessions for future utilization, rather than a much larger set with potential duplication
- Provides plant adaptation zones to help land managers with revegetation decisions
- Provides an approach to develop science based *in situ* conservation sites that are complementary to *ex situ* collections

Major collections of native species at the Pullman gene bank total more than 3,000 accessions (not including taper tip onion and the Save our Seeds material)

Genus/species	Number Accessions	Genus/species	Number Accessions
Achillea millefolium	25	Lesquerella fenderli	109
Achnatherum hymenoides	266	Leymus sp	291
Alopecurus borealis	22	Lotus unifoliolatus	17
Amorpha fruticosa†	23	Lupinus sp.	216
Astragalus adsurgens	46	Pascopyrum smithii	73
Bouteloua dactyloides	21	Phalaris arundinacea†	116
Bromus sp	68	Phaseolus sp.	332
Deschampsia cespitosa	155	**Poa sp**	192
Elymus sp.	471	**Pseudoroegneria spicata**	157
Festuca sp.	458	Sanguisorba officinalis	19
Hedysarum alpinum	18	Trifolium wormskioldii	24
Koeleria macrantha	91	Trisetum spicatum	25

†Weedy?

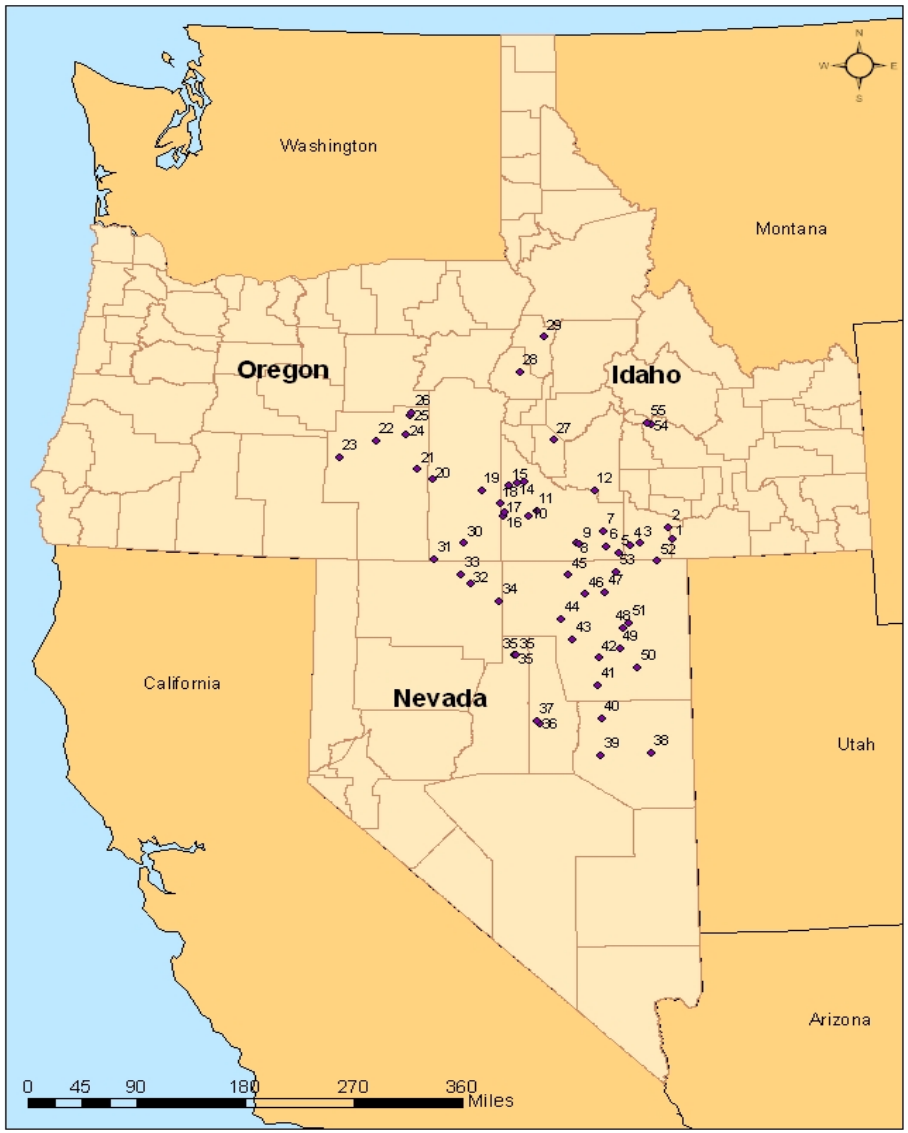
Taper-tip Onion (*Allium acuminatum* Hook.)

- Common and important Great Basin species associated with healthy rangeland and good habitat for sage grouse
- Collection completed in 2005
- Common gardens establishment 2006
- Data summary 2006
- Future work

A. acuminatum collection teams

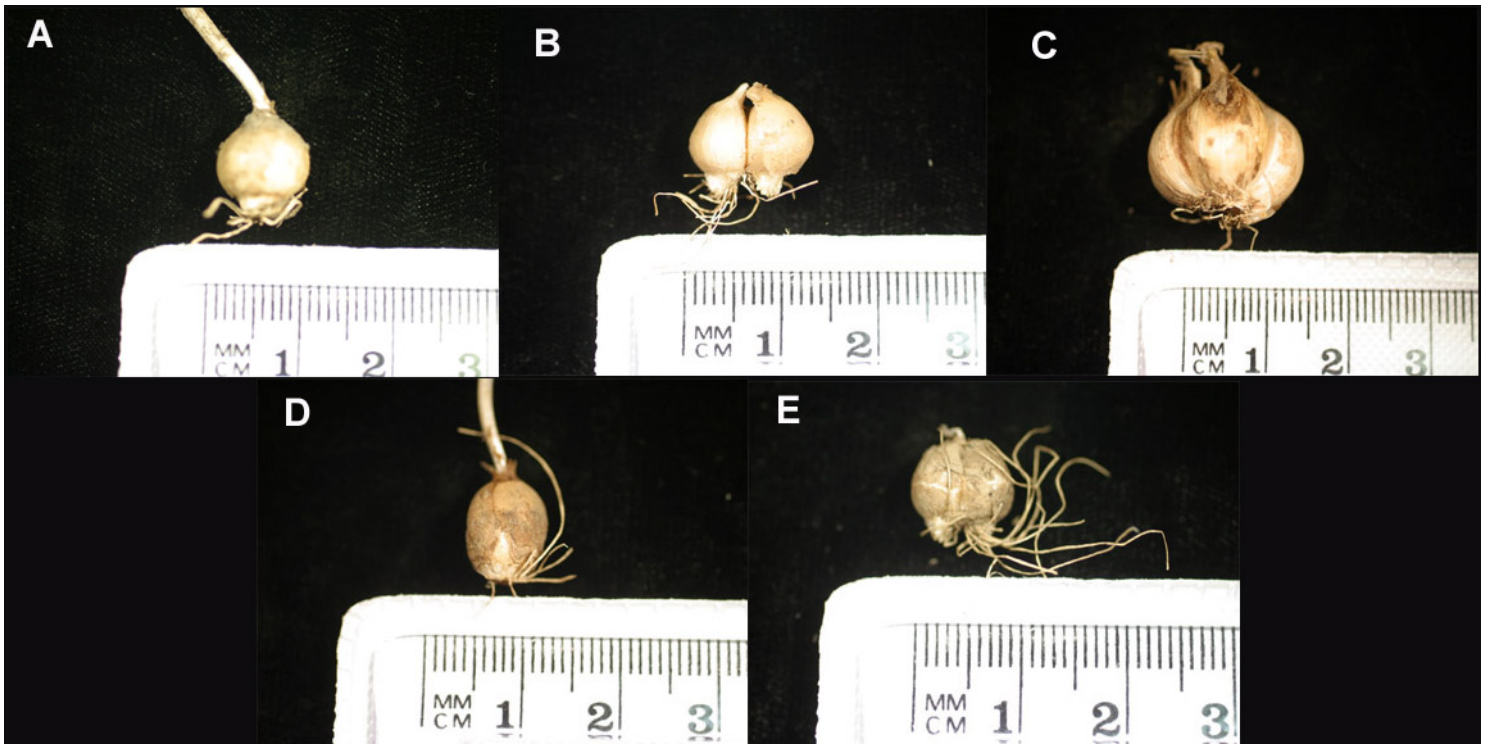
Walt Kaiser collecting *Allium acuminatum* near the Snake River

Allium acuminatum (Taper-tip onion) collection, spring 2005

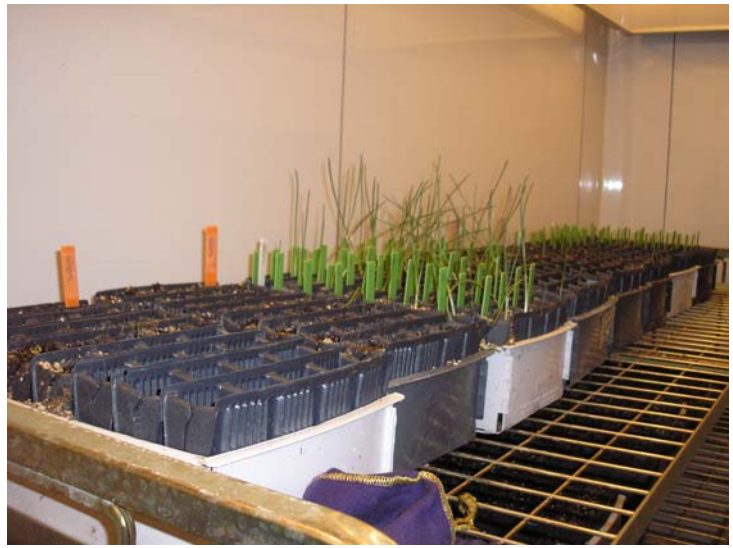


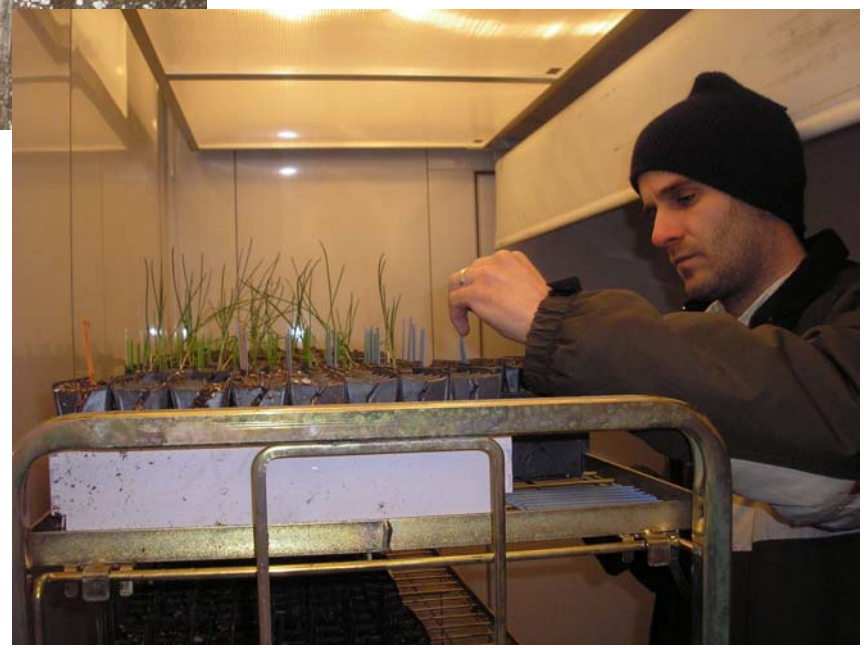
Twenty Level 4 Ecoregions	Collectionn sites
Semiarid Hills and Low Mountains	1
Southern Forested Mtns/Dry Partly Wooded Mtns	1
Mountain Home Uplands	1
Southern Forested Mountains	1
Pluvial Lake Basins	1
High Desert Wetlands	1
Continental Zone Foothills	1
Unwooded Alkaline Foothills	1
Semiarid Foothills	1
High Glacial Drift-Filled Valleys	1
Central Nevada Mid-Slope Woodland and Brushland	1
Central Nevada High Valleys	1
Carbonate Woodland Zone	2
Carbonate Sagebrush Valleys	2
Mid-Elevation Ruby Mountains	3
Semiarid Uplands	4
High Lava Plains	5
Upper Humboldt Plains	6
Owyhee Uplands and Canyons	8
Dissected High Lava Plateau	13

Bulb morphology. Single, globed (A), Cloved (B), Three-cloved(C), High-globed (D), flat-globed (E).




Establishing *A. acuminatum*
common gardens





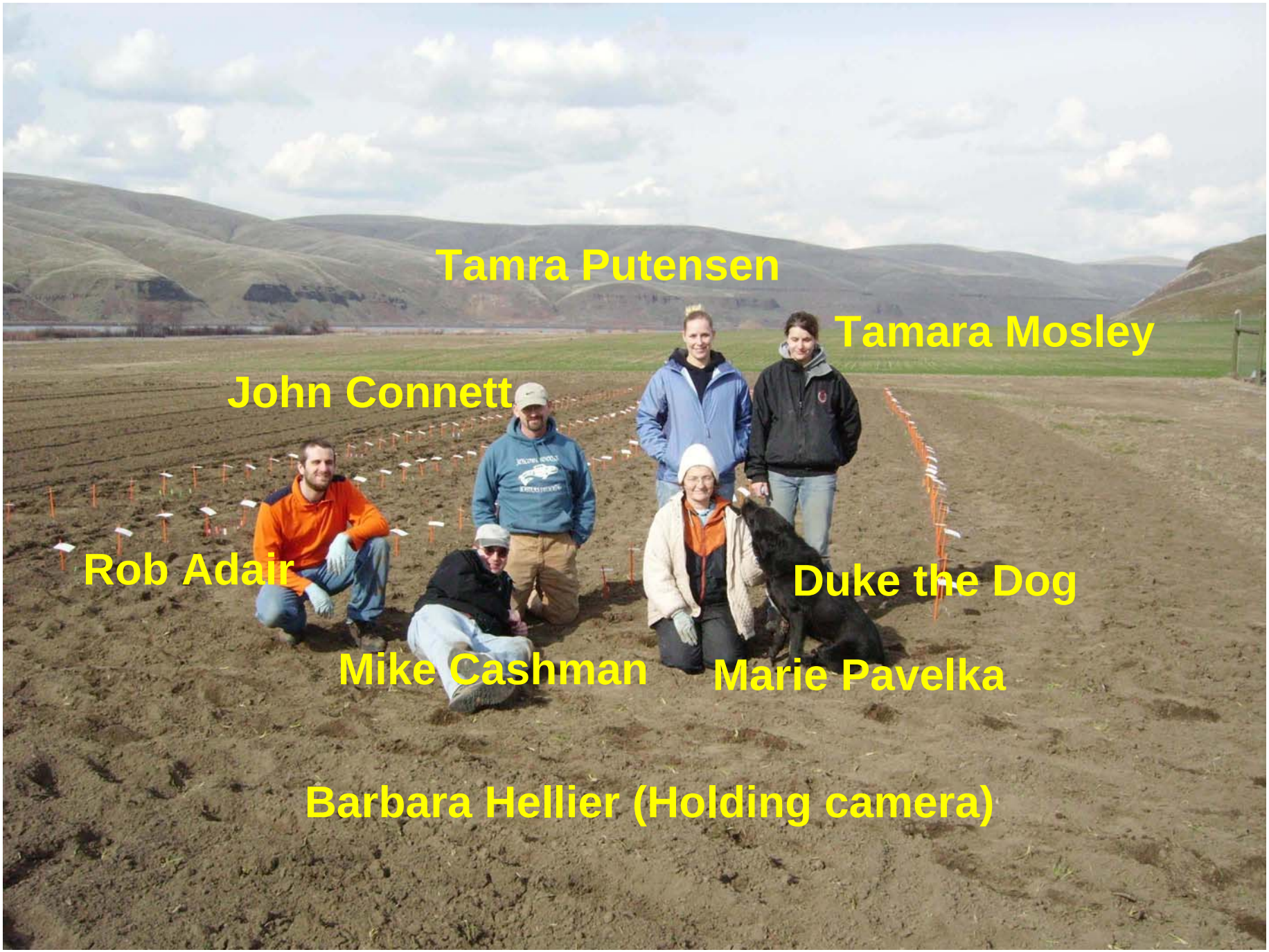
A. acuminatum bulbs planted in rootrainers (above).

Plants in vernalization chamber at 4°C (upper right)

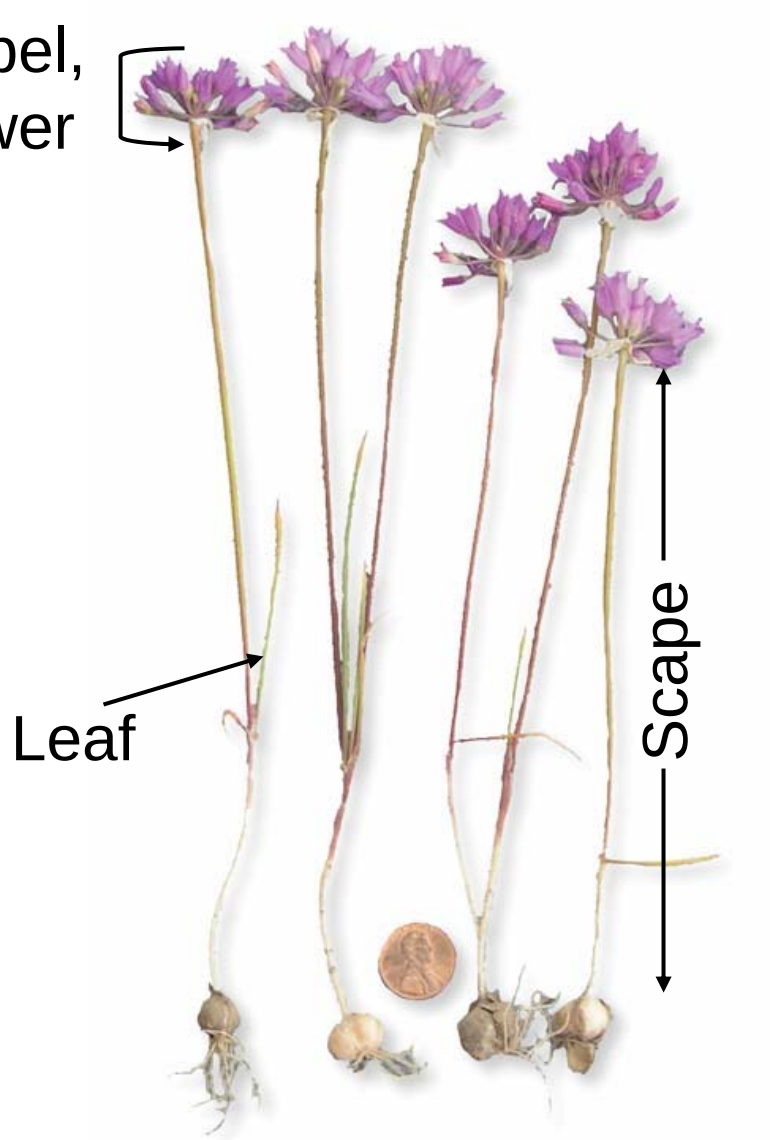
Rob Adair collecting tissue samples for DNA extraction (right).

Planting *Allium acuminatum* common garden at Central Ferry WA location, 2006


BBCS
Accession no: 53
Jarlshope Burn NV
Allium acuminatum


Tamra Putensen
Tamara Mosley
John Connett
Rob Adair
Duke the Dog
Mike Cashman
Marie Pavelka
Barbara Hellier (Holding camera)

A. acuminatum field evaluation at Pullman and Central Ferry sites

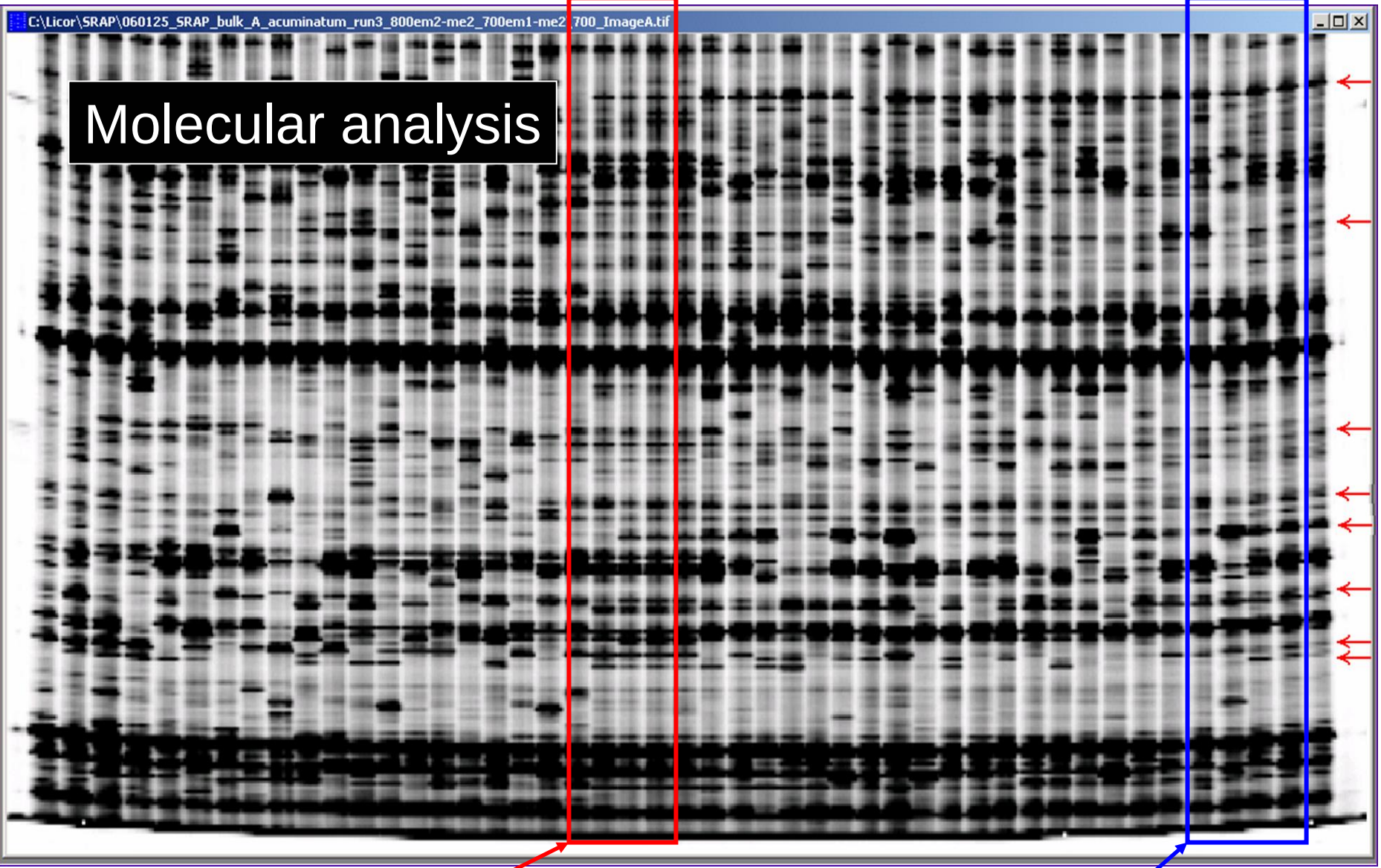



Pullman 2006

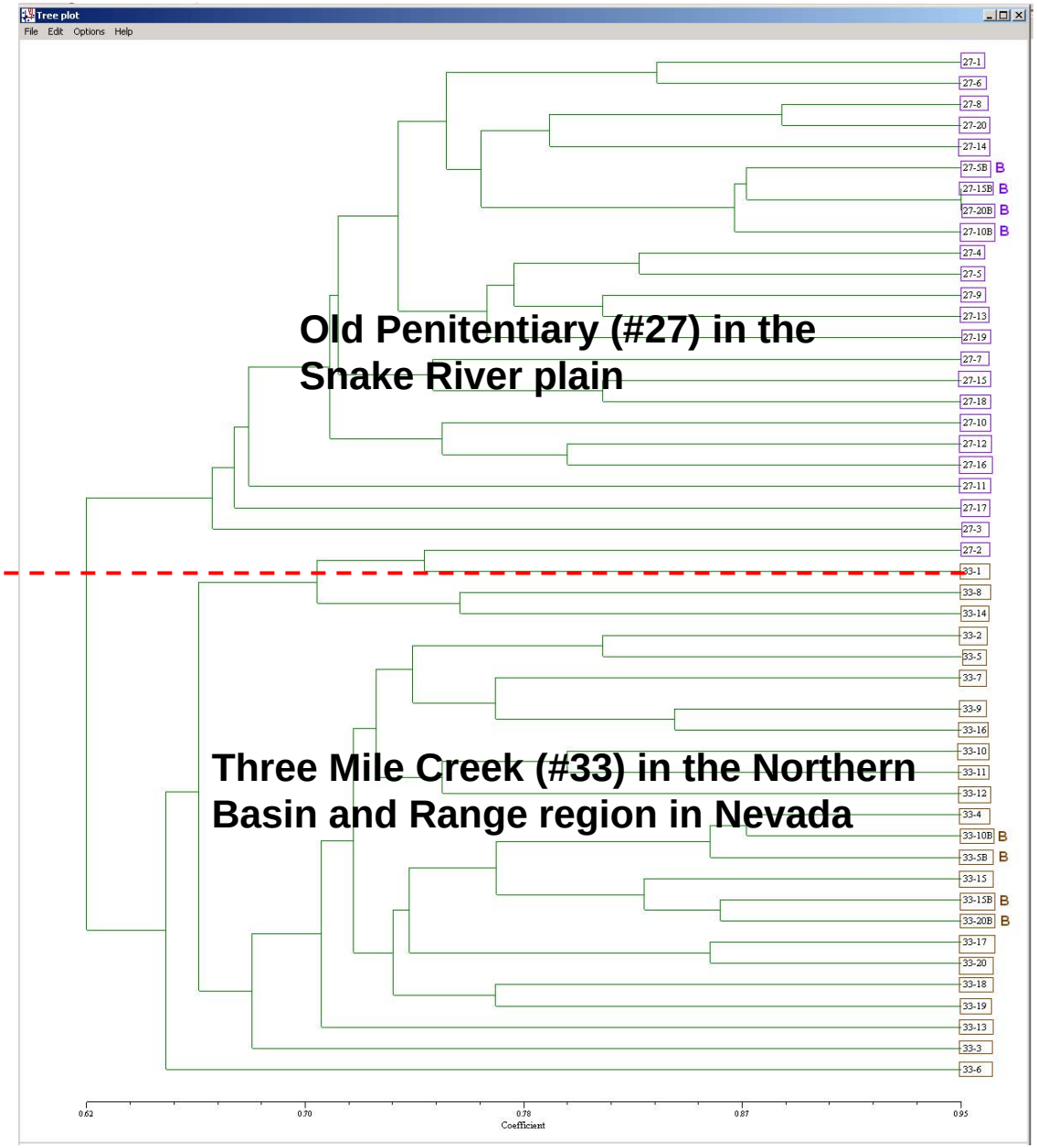
Allium acuminatum ANOVA summary from common gardens at Pullman and Central Ferry WA sites and 55 collection locations (2006)

Factor	n	mean	CV	Prob. Site	Prob. Loc	Prob. Site X Loc
Leaves/plant	467	2.17	19.5	ns‡	<0.001	ns
Plants w/leaves	469	2.74	30.4	<0.001	<0.001	ns
Bolting date†	248	113	4.0	<0.001	<0.001	0.003
Scape length (mm)	230	99.8	28.8	ns	<0.001	ns
Scape dia. (mm)	231	1.71	28.4	ns	ns	ns
Flowering date†	229	146	2.23	<0.001	<0.001	ns
Flower color (1-8)	230	6.95	11.4	ns	<0.001	0.008
Flowers/umbel	227	15.6	38.6	0.012	0.020	ns
Umbel dia.(mm)	227	37.1	25.6	0.023	ns	ns
Seeds/plant	170	15.7	70.9	0.001	ns	ns
Maturity date†	183	174.8	6.72	<0.001	0.024	<0.001

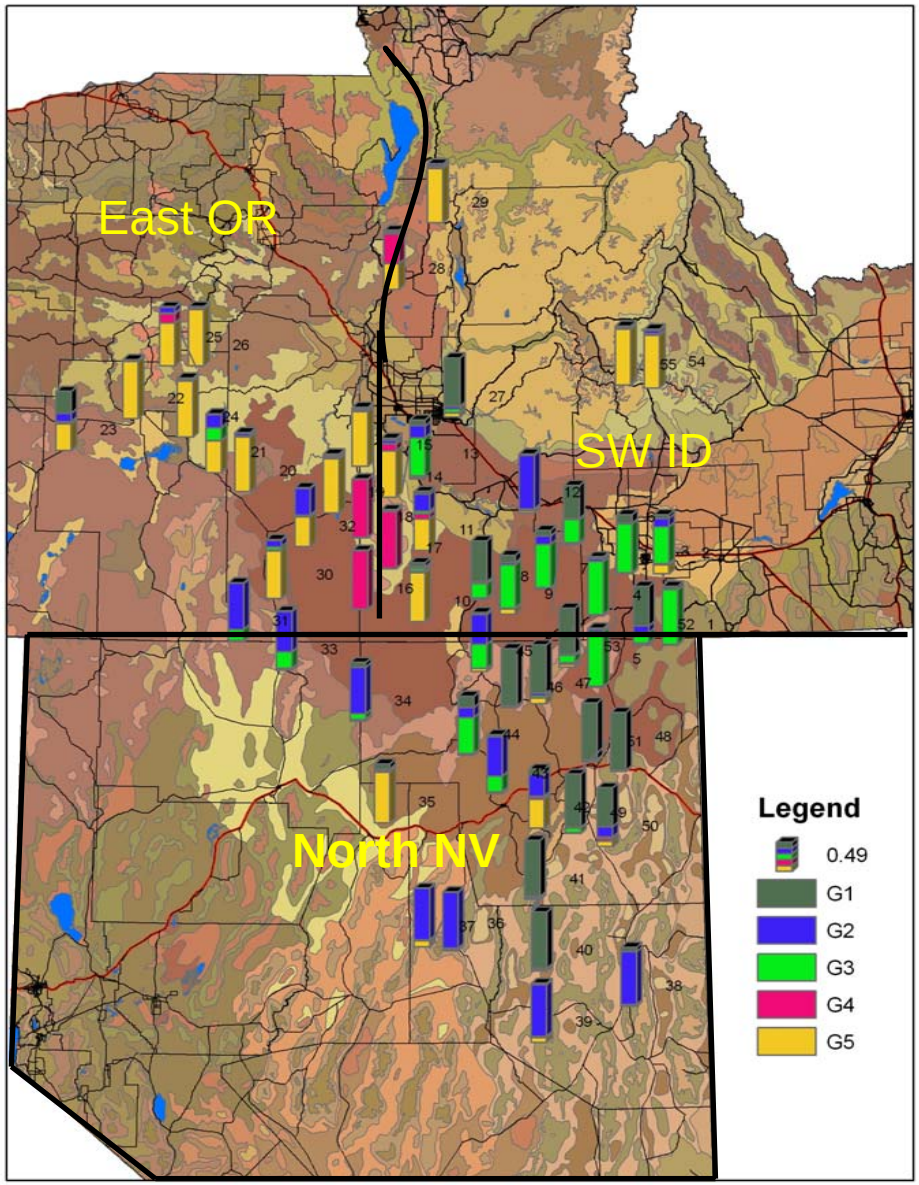
†Day of year; ‡ns, not significant



SRAP gel of *A. acuminatum* DNA). Bulked samples from Old Penitentiary site (#27) are highlighted in in **red**, and bulks from Rd. to 3 Mile Creek (#33) are in **blue**. Individual plant DNA extractions are to the left of each respective bulk sample.



Dendrogram of individual and bulked samples from two populations of *A. acuminatum* constructed by unweighted pair group method with arithmetic averaging based on simple matching coefficients of SRAP molecular markers.



SRAP molecular marker variation on taper-tip onion in the Great Basin sorted into groups (G) by the STRUCTURE program.

Does this relate to field data, and if so, how?

Future plans

Tapertip onion

- **Finish phenotypic data collection (2007) and analysis**

Mt Brome

- **Finish data analysis, write-up, and publish**

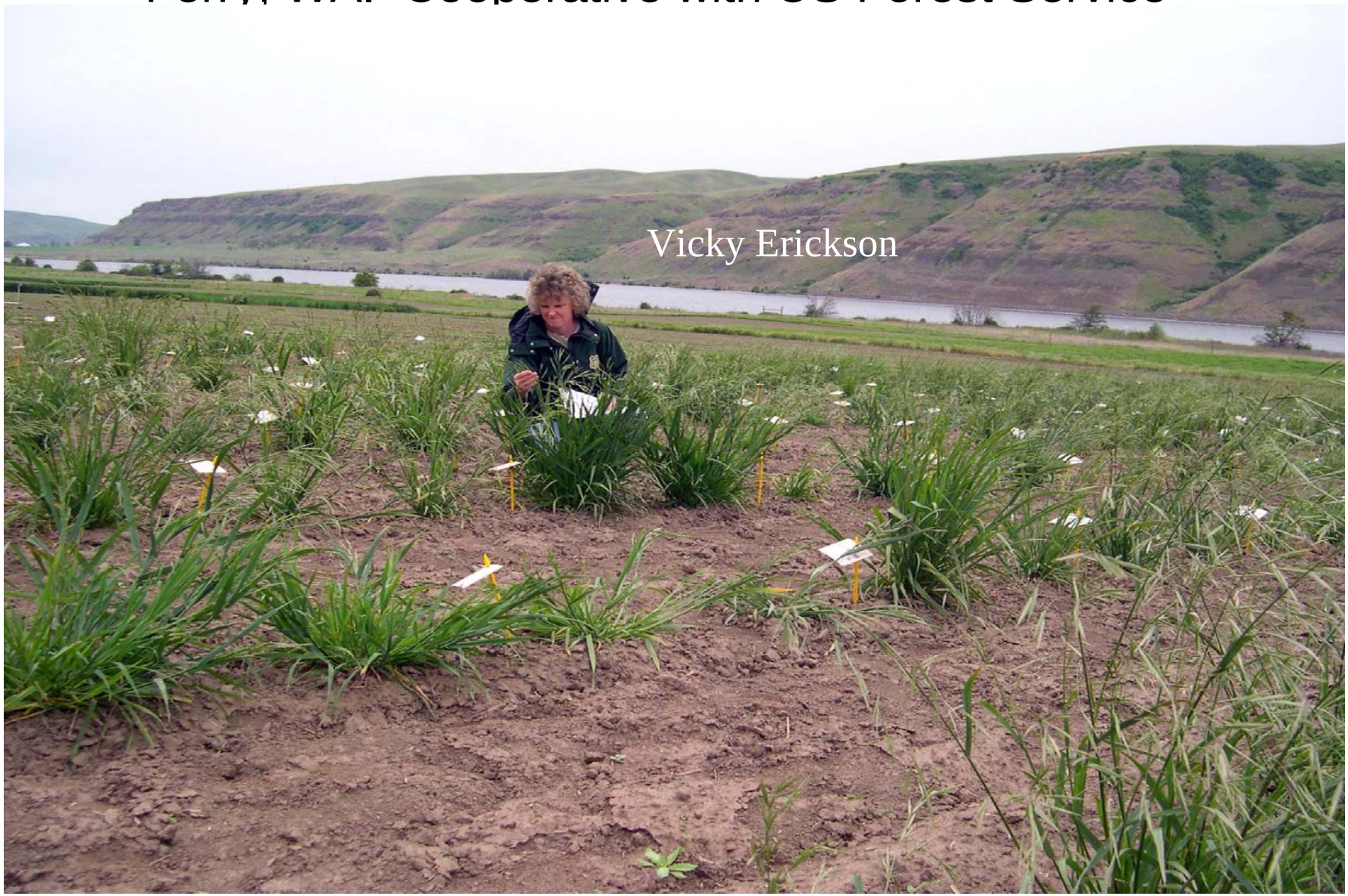
New Common gardens (2006 and 2007)

- **Bluebunch wheatgrass**
- **Indian ricegrass (current collections)**

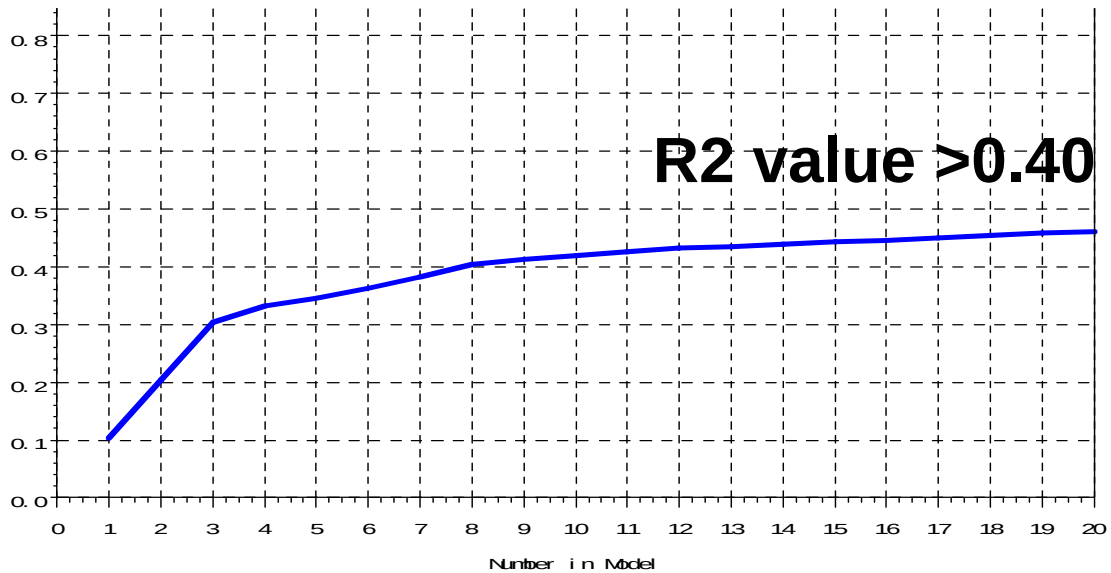
Ongoing Collections for future common gardens

- **Indian ricegrass (new collections)**
- **Sandberg's bluegrass**

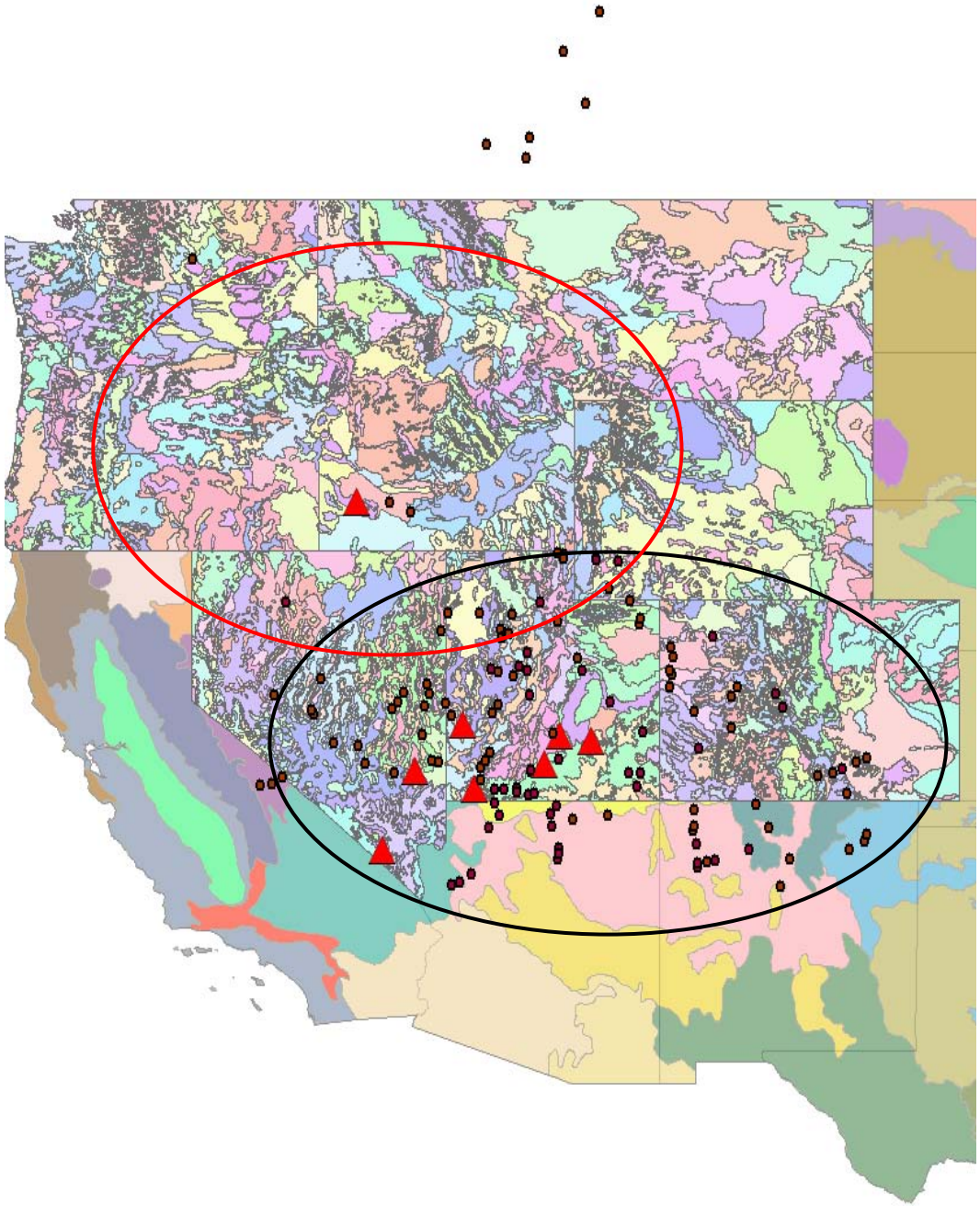
Collection site diversity in size and habit in Mountain Brome evaluation plots at the Plant Germplasm Unit, Central Ferry, WA. Cooperative with US Forest Service



Regression showing relationship between leaf pubescence and environmental factors in Mt. Brome (Thanks to Nancy Mandel)

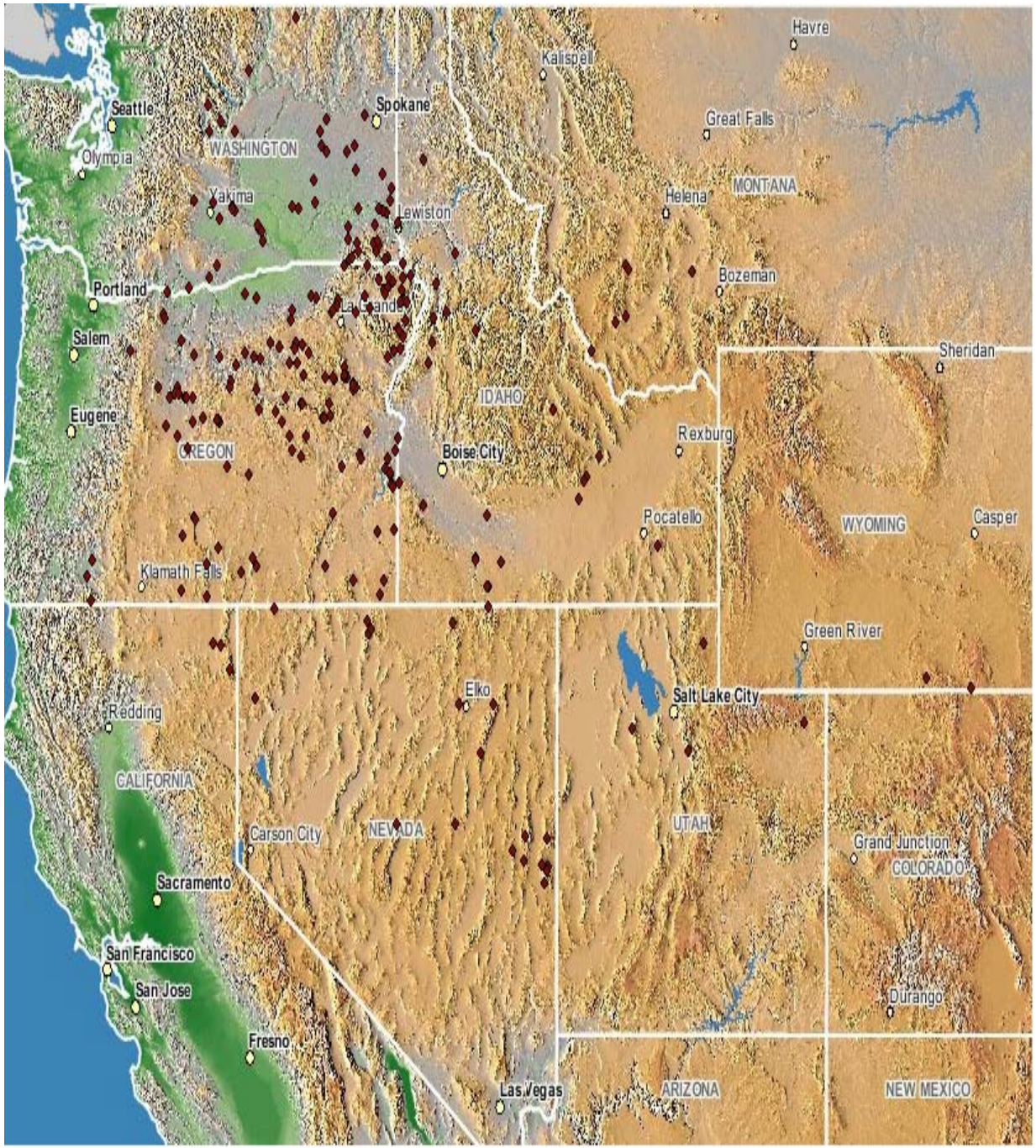


Dependent variable = Leaf pub05 Mt. Brome
Environmental var = lat long elev fllfrst sprfrst mnt1-mnt12 mxt1-mxt12 pre1-pre12



Indian Ricegrass (*Achnatherum hymenoides)* collections at the Pullman Gene-bank (thanks Tom Jones). These are the basis of common garden and molecular research concerning variation across the landscape. The red triangles represent location with preliminary molecular work.

Indian ricegrass for field transplanting, spring 2007



Collection of Bluebunch wheatgrass, 2005,led by Brad St. Clair with the US Forest Service. Common garden studies were started in the fall, 2006, at Pullman, Central Ferry, and Lucky Peak. Cooperative project with ARS, USFS, and BLM.

Transplanting Bluebunch wheatgrass at Lucky Peak, fall 2006


WHISTLER BLACKCOMB

Summary

- Differences in the collection location for many measured traits suggest genetic variation among *Allium acuminatum* across the landscape.
- Molecular marker data also show variation across the landscape, and it relation to phenotypic factors will be assessed.
- Similar work is ongoing with Mt. Brome, Bluebunch wheatgrass, Indian rice grass and Sandberg's bluegrass.
- The work is expected to provide tools for management and conservation of key native species.

Thanks! Questions?