STATE OF UTAH
Annual Report for Calendar Year 2014
to the W-6 Technical Committee
Compiled by Kevin B. Jensen

Germplasm Activities of Edward Bradley (Eagle Mountain, UT – *Fragaria x ananassa*)

My daughter and I ordered this germplasm from the USDA for a school project. My grandfather had planted Catskill strawberries in Ohio decades ago and my daughter wanted to see if we could grow them in the soil in Eagle Mountain, Utah. We planted the starts on the east facing side of our home. Unfortunately the heat of August was too much for the plants and they died. We learned that we should have planted them in planters until their root systems were strong and then transplant them outside. We'd like to try again and I have placed a request in but have not heard back. I am not sure if this is what you need. If you do please let me know and I'd be happy to supply further detailed information.

Germplasm Activities of B. Shaun Bushman (USDA-ARS, Logan, UT - *Poa sp.*)

The accessions that I requested were all of *Poa* species with putative low polyploid levels. I germinated at least five plants from each accession and tested each for ploidy level using flow cytometry and root-tip chromosome squashes. Most accessions fit the predicted low ploidy levels, but some accessions had mixed ploidy that spanned a wide range of values. Those accessions with the majority of plants as diploid or tetraploid were sampled for further DNA genotyping studies. Additionally, two plants from each diploid or tetraploid accession are currently maintained in our greenhouse for future in situ hybridization.

Germplasm Activities of Richard Clark (Univ., of Utah, Salt Lake City, UT – *Glycine max*)

Our laboratory obtained both soybean and maize germplasm in 2014 to support our studies of plant-herbivore interactions. A specific focus is on the herbivore *Tetranychus urticae*, the two-spotted spider mite, a generalist spider mite herbivore. Spider mites, including *T. urticae*, are well known and difficult to control plant pests in greenhouses. Moreover, especially under conditions of high heat and drought, they can also be economically significant pests for field crops. In the US, this includes both maize and soybean, for which we received germplasm from NPGS. Because spider mites are notoriously difficult to control with pesticides, significant interest exists in understanding natural resistance to mites (intraspecific plant variation in resistance). For both maize and soybean, resistant lines have been reported in the literature, and our germplasm requests for both species included susceptible and resistant lines as reported from earlier studies. Our initial work focuses on testing these lines with mites to establish, in our experimental set up, which lines are susceptible or resistant. A longer-term aim is to perform transcriptomic (RNA-seq) and other studies to understand the genetic and genomic bases of plant resistance to spider mites. Below, our work to date is summarized for soybean and maize separately.

I. Soybean

We obtained (as part of two orders) 12 soybean lines that, based on previous work, have been reported to harbor marked variation in resistance to *T. urticae* (4). In 2014 in a greenhouse we first bulked seeds for all lines (this has been completed). All material germinated well and gave good seed yields. In 2014 (albeit finishing in 2015) we screen the lines – either at the plant level and/or using detached trifoliate leaves on wet cotton – for mite survivorship and fecundity. This was done by placing female *T. urticae* mites (a defined number at a defined stage after the last molt) onto leaves and recording measures of fecundity (such as eggs laid) at defined time points.

Although we obtained soybean lines previously reported to show dramatic differences in resistance to *T. urticae*, in the current study we observed no statistically significant differences in resistance across the soybean lines obtained from NPGS (a postdoctoral fellow in the lab, Huyen Bui, performed this work).

Our inability to detect differences in resistance to a single *T. urticae* strain was somewhat surprising given the previous report for the germplasm. However, biotic interactions can be highly dependent on small differences in the environment. Moreover, a number of studies have reported variation among mite strains in performance on a single host plant. Currently, we have collected and inbred six independent strains of *T. urticae* from different plant hosts (all collected from within about 100 km from Salt Lake City, and mostly from non-crop hosts). Our current plans are to screen these inbred lines against, minimally, the most sensitive and resistant soybean lines as reported earlier [e.g., strains Chippewa 64 and S100]. A desirable outcome would be a mite strain by soybean line effect on resistance that would provide an entry point for understanding the genetic and genomic basis of resistance in soybean to mite herbivores. We hope to complete this work in the next year, although the timing will be dependent in part on several factors (grant funding and opportunity/possibility to recruit a student to push the study).

II. Maize

Our rationale for obtaining maize germplasm was, conceptually, essentially identical to our rationale for obtaining soybean lines. As for soybean, a number of earlier studies have reported marked variation in resistance (mainly antibiosis) to *T. urticae* or the Banks grass mite (*Oligonychus pratensis*) among maize inbred lines. The specific strains we obtained included B73 (reported to be sensitive) and Oh43 (reported to be resistant). We also obtained B96, which is reported to be highly resistant, along with several other widely used lines (like W22) and the parents of the Nested Association Mapping (NAM) population (which includes Oh43). Our interest in the NAM population is that, if resistance among NAM parents is observed, the resistance can in principle be mapped in the derived NAM families (these families share B73, reported to be sensitive, as the common parent).

While our initial focus was on soybean, in winter we sent seeds for all the maize lines obtained from NPGS to a winter nursery (27 Farms in Homestead, Florida) for bulking of seeds (some of these lines require short days to flower, but do so readily in FL in the winter). Bulking worked well for all lines except for B96 (which is known to be hard to grow, and is usually used as a male parent in breeding programs to confer resistance to insects). Currently, the seed stocks are bulked, and thus we can begin to screen these lines for resistance to spider mites (we plan to test both *T. urticae* and *O. pratensis*). We hope to initiate this work in late summer or fall of 2015; as for soybean, the timing will be dependent in part on several factors (grant funding and opportunity/possibility to recruit a student).

Germplasm Activities of Dave Gedge (Saratoga Springs, UT - *Helianthus cusickii* and *H. pumilus*)

During the summer of 2013 20 accessions of *H. cusickii* and eight accessions of *H. pumilus* were requested and received from the National Plant Germplasm System. Seed of these asscessions were planted, late October, 2013 in my back yard garden at 417 W Plum Place, Saratoga Springs, Utah. Purpose in planting in the fall was to allow for the cool, moist soil conditions to break possible seed dormancy.

(Year 2014) - Most accessions produced some plants during the summer of 2014. The exact count is listed in the transplant table.

Crossing of either *H. cusickii* or *H. pumilus* on to a proprietary *H. annuus* inbred line B207 was attempted. My intention had been to collect pollen from both species and store in a refrigerator prior to placing on hand emasculated flowers of B207. The amount of pollen produced by each individual flower of *H. cusickii* and *H. pumilus* proved to be too little for the equipment I had available. I therefore opted to pick a flower at the peak of flowering and directly apply the little pollen that was available to the hand emasculated flower of B207. Small cloth bags were placed over individual flower heads of *H. cusickii* and *H. pumilus* to prevent pollinating insects from collecting the pollen before I could get to it. Because of the limited number of flower heads of either species that were in bloom to match the flowering time of B207 both species were used as pollen source on the same head of B207. Some seed was produced on the hand emasculated flower heads of B207. Is it a desired inter species cross or inadvertent selfing or outcrossing to other *H. annuus*?

Transplanted and planted October 27 and 28, 2014

Helianthus cusikii	no plts	survived winter
Ames 31341	8	3
Ames 31342	11	10
Ames 31343	9	9
PI531039	8	5
PI531040	8	5
PI649957	9	5
PI649958	13	13
PI649959	1	1
PI649960	2	2
PI649961	7	5
PI649962	1	1
PI649963	1	1
PI649964	4	3
PI649966	7	5
PI664657	4	3
PI664658	1	0
PI664659	14	6
PI664660	9	4
PI664661	1	0
Helianthus pumilus		
PI650041	3	3
PI650049	2	2
PI650055	2	2
PI650060	5	5
PI650072	4	4
PI650078	5	3

Open pollinated seed was collected from all plants of *H. cusickii* and *H. pumilus*. Seed of each species was kept separate but seed of the different accessions for each species was bulked together. During the later part of October 2014 the tap roots of *H. cusickii* and *H. pumilus* were dug up and transplanted to a different section of my back yard garden. Details are listed in the excel document titled 2014 to 2015. Bulk seed of *H. cusickii* collected from the plants growing in 2014 was planted the end of October 2014.

Plans for 2015 are to continue. Seed of potential inter species cross will be planted and evaluated to determine if the actual cross has occurred. Further attempts at inter species crosses will be made. Collecting in bulk of *H. cusickii* and *H. pumilus* seed will be done.

In the fall of 2014 three (3) accessions of *H. annuus* were requested and received from the National Plant Germplasm System. The plan is to plant these accessions in 2015 and cross them to proprietary B lines and R lines as appropriate. This is to incorporate confection type traits found in the accessions to traits found in my proprietary material.

Germplasm Activities of David Gibby (Salt Lake City, UT – *Malus* sp.)

My son and I have been gathering germplasm from various sources including the USDA on various fruits to test the feasibility of fruit production using polyculture versus the normal monoculture normally practiced in most production systems. We think it might be possible to reduce pest and disease pressure and therefore pesticide usage. We are also experimenting with heavy mulching to reduce irrigation needed. To date we have successfully grafted and are beginning to establish over 200 cultivars of various hardy fruit types, some not normally grown in Utah

We are at an early stage in the project and it will be some few years before we will have any real data to share, however some minor experimentation on a very limited basis has shown promise. Again, we are grateful for our inclusion in the USDA distribution and will be happy to share any results as they come available on our little research project.

Germplasm Activities of Kevin Heaton (Utah State Univ., Panguitch, UT – *Prunus cerasus*)

During the spring of 2014, two *Prunus cerasus* from the U.S. National Plant Germplasm System were grafted into an existing North Star cherry. Grafts were successful and survived the winter of 2014-2015. They will be monitored for cold tolerance and late blooming ability in the future.

Germplasm Activities of David Hole (Utah State Univ., Logan, UT – *Triticum* sp.)

All of the germplasm that we requested in 2014 was used for observation and crossing for disease resistance studies. We are evaluating some low temperature tolerant rice for use in Utah, and are generating recombinant inbred populations from dwarf bunt differential lines.

Germplasm Activities of Jessica Ivy (Brigham City, UT – *Corylus*, *Fragaria*, *Humulus*, *Lonicera*, *Pyrus*, *Ribies*, and *Rubus* species)

The seed I received was planted in late winter in cold ground dirt in a planter box that spans about 8 feet long and 3 feet wide, it is kept out doors, in a shaded area where plenty of indirect light is avail and my irrigation reaches to mist it with water every early morning. All seeds were planted in same conditions and exposed to various types of music playing my goal was to discover if music had any effect on the growth of the plants as well as to discover if these plants could thrive in the Utah climate with minimal attention. I have many plants in the area that are not exposed to music and they all require a lot of attention. The plants simply watered and left to enjoy soft playing tunes from a waterproof radio grew just fine all had growth of about 4 to 6 inches on their own, had no pest issues; however they could not survive the climate, a late spring snow killed off all of them. I really never got a chance to get much information that I intended to use in a blog and possibly a book, as they all died too quickly so I have abandoned this research idea and think I would be better suited to home gardening, with easy grow seed made for my area.

So I have learned that music is an effective pest repellant, and that plants exposed to music really do seem to grow a bit faster than plants that are not, however music has no effect on saving plants from frost, and these particular plants are not able to recover from a 3 day freeze at least not as they are just starting to grow.

My only suggestion or request for a change in your seed program is that I think it could go a long way to helping everyone understand plants better if the USDA had a home garden club, or programs to promote growing things at home, you could even charge a fee for membership and use the funds to support your research which I see now is best left to the experts.

Germplasm Activities of Rick Jellen (Brigham Young Univ., Prov0, UT - *Atriplex hortensis*)

We received seed for 24 accessions labeled as *Atriplex hortensis*. The following were misidentified and are perennials and hence, not A. hortensis; PI 357344, PI 357346, PI 357347, PI 379087, PI 379088, and PI 420154.

Germplasm Activities of Tom King (City Academy, Salt Lake City, UT - *Punica granatum*, *Ficus carica*)

The material that was acquired from NPGS at Davis, CA last year consisted of 19 accessions of *Punica granatum* and one accession of *Ficus carica*. Our efforts to root and establish the cuttings were about 75% successful. The single *Ficus* cutting is not showing any signs of life this spring, but isn't definitively dead yet either. Our uses of the material so far have been confined to establishing viable plants from the cutting. Our intended research will entail cold trials and productivity evaluations here in the Wasatch Front area. To date, we have no data and have published nothing regarding these efforts. I would be happy to keep you informed as this multi-year undertaking yields information.

Germplasm Activities of Jennifer MacAdam (Utah State Univ., Logan, UT - *Trifolium arvense*)

I received 100 seeds of an accession of *Trifolium arvense*. The seeds are minuscule, and that's saying something for a person who works with birdsfoot trefoil. I germinated seed on filter paper, and I believe there were lots of hard seed but I didn't take data (and I still have some seed). Germinated seed were developed into seedlings in our AGRS 3rd floor growth room, and seedlings developed to maturity in the greenhouse. I've collect shoot material for tannin analysis, but have not tested the material yet. The plants of this accession are continually reproductive from the time they reach maturity, they become quite woody, and have either died from low water status (we're pretty attentive in the greenhouse) or from being sampled.

Germplasm Activities of Joseph Robins (USDA-ARS, Logan, UT - *Lolium perenne*)

The perennial ryegrass accessions are currently undergoing seed increase. We have yet to collect data from them.

Germplasm Activities of Matthew Robbins (USDA-ARS, Logan, UT - *Bouteloua curtipendula*)

The semi-arid and arid rangelands and irrigated pastures of the western U.S. provide a broad array of ecosystem services, including wildlife, and wildlife habitat, a diversity of native plants, pollinators, livestock forage, and recreational activities. Many of these regions are classified as severely disturbed and non-productive, and vast areas of arid and semi-arid rangelands in the western U.S. are currently classified as severely disturbed. Based on predicted climate change models for these rangelands, trends toward hotter and drier conditions will continue, increasing the already high rate of rangeland degradation, particularly on arid and semi-arid lands. Thus, there is a need to continue development of plant materials adapted to increased temperature, drought, and soil salinity for rangeland restoration to be successful in the western U.S.

Fire in the Mojave Desert was not prevalent prior to the invasion of red brome, which occurred in the early to mid-1900's. The increased fuel loads of red brome grass have caused a corresponding increase in wildfire frequency, which has resulted in severe economic losses and appreciable reductions in ecosystem services and land degradation. Based on a review of vegetation and ecological studies in the Mojave Desert, big galleta and sideoats grama grass have potential for revegetation because of their tolerance to grazing and drought, rhizomatous character, and high DMY potential. Although the NRCS Plant Materials Centers have released 7 cultivars of sideoats grama (Figure 1, these were developed mainly for use in the Great Plains with no specific releases made for the Mojave Desert. Thus, there is a need to collect and identify germplasm that will establish, persist, and compete with red brome. Since 2012 (2012-2014), the USDA, ARS Forage and Range Research Laboratory has collected 42 accessions (Figure 2) of sideoats grama grass from diverse sites in UT, AZ, NV, and CO (Figure 3).

These accessions are now being evaluated at the Red Cliffs Desert Reserve and the Beaver Dam Wash near St. George Utah. These areas are representative of areas in the Upper Eastern Mojave Desert that have relatively high concentrations of red brome grass and have experienced recent wildfires (e.g., 2002 and 2006). These accessions are being evaluated for their genetic diversity based on molecular analyses and their stand establishment and persistence. Sideoats accessions (10 plants from each wildland collection) are being assessed using amplified fragment length polymorphism (AFLP) techniques to determine their genetic diversity and structure.

With regards to morphological evaluations, accessions have been arranged in a randomized complete block design (RCBD) on 0.5 m x 1.0 m spacing with 4 replications of 10 plants replication^{-1} in 2015 at both test locations (Figure 4). Data on plant vigor including plant height (cm), crown width (cm), seed number and weight (g plant^{-1}), DMY (g plot^{-1}), and mortality (brown versus green) will be taken in 2016 and 2017.

<u>Germplasm Activities of Leslie E. Sieburth</u> (Univ. of Utah, Salt Lake City, UT – *Pisum sativum*)

I obtained pea plants with historically important mutations. These plants were grown and displayed as educational materials (outreach).