

Thanks to the organizing committee of the ECPGR Beta WG for developing the Meeting: “Improving a cooperation network between actors involved in conservation and utilization of *Beta* genetic resources.” Venice - A great place to observe *Beta* *maritima*!



From Genetic Resource to Enhanced Germplasm: Utilization of Crop Wild Relatives

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Sugarbeet Research at Fort Collins

Multi-disciplinary Team Research

**An Integral Part of an U.S. National Sugar Beet
Research Effort**



At Fort Collins germplasm is collected, evaluated, and pre-bred into useable sugar beet germplasm for release to public and private plant breeders

Near Agadir, Morocco



Porto Levante, Italy



San Louis Obispo State Park, California

The USDA National Plant Germplasm System has a *Beta* collection with over 500 *Beta vulgaris* ssp. *maritima* populations (Plant Introductions – PI's)



The USDA-ARS has a nation wide evaluation program for our PI collection. The Fort Collins program evaluates for resistance to *Rhizoctonia solani* and works with universities and private companies to evaluate germplasm throughout the pre-breeding process.

National PI Evaluation Program

Location	Descriptor
East Lansing, MI	Cercospora
Fort Collins, CO	Rhizoctonia
Fargo, ND	Root Maggot
Scottsbluff, NE	Root Aphids
Parma, ID	Nematode
Kimberly, ID	Curly top virus, Rhizomania

Evaluation for resistance to rhizoctonia crown and root rot in Fort Collins, Colorado



The process of developing “enhanced germplasm” is called pre-breeding, as opposed to commercial breeding which results in hybrid varieties.

ARS Germplasm is developed for commercial plant breeders, therefore the public pre-breeder needs to understand the goals of the commercial breeder, who is the direct customer, as well as the grower, who is the ultimate customer.



Genetic male sterility (*aa*) is often used to make crosses in populations as is green(*rr*)/red(*RR*) hypocotyl color. When we make our population crosses between sugar beet and *Beta maritima* we also make individual plant crosses for genetic analyses.



Throughout the pre-breeding process plants are screened in the field or in the greenhouse to maintain the resistance trait of interest and to see if the population has resistance to other diseases.



To develop the genetically defined populations for mapping, F_2 families from single plant crosses are grown in the greenhouse to produce F_3 seed. Each seed from an F_2 family is grown to a mature plant, vernalized and selfed-pollinated in the greenhouse to produce seed of the F_3 populations. DNA is collected from each F_2 plant that is the parent of an F_3 family



As we obtain information on the response of these F_3 families, they are put into our breeding program and tested in the field. We have used these populations with the Stevanato lab for SNP discovery and verification of SNP markers.



PI 546413 x 9933

Having a marker for resistance allows us to much more easily move the resistance gene into other germplasm, but there always is field testing before release.

Field testing for resistance to *Fusarium* sp. in Sterling, Colorado



We grow mother roots during the field season in infested fields for selection or in a nursery to increase seed for release. They are shaved, vernalized and planted in the greenhouse or the field after vernalization.



The germplasm listed below has been released over the last years from the Fort Collins station in collaboration with other ARS plant breeders.

- Multiple disease resistance with Salinas
 - FC201, FC301, FC220, FC221, FC1018, FC1019, FC1020, FC1022, FC1740, FC1741, FC242
- Cercospora and other resistances with Salinas and East Lansing
 - FC1028, FC1036, FC1037, FC1038, FC305
- Multiple disease resistance with Fargo
 - F1024
- Rhizoctonia resistance
 - FC720, FC722, FC722CMS, FC723, FC723CMS, FC724, FC710(4X)



Thank You for Your Attention



Any Questions?