



United States
Department of
Agriculture

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- assess the nutritional needs of Americans;
- sustain a competitive agricultural economy;
- enhance the natural resource base and the environment; and
- provide economic opportunities for rural citizens, communities, and society as a whole.

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Agricultural Research Service

Plant Genetic Resources Unit

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Primary Mission

The mission of the Plant Genetic Resources Unit (PGRU) in the United States Department of Agriculture (USDA), Agricultural Research Service (ARS) is to acquire, maintain, characterize, and distribute plant genetic resources of selected fruit and vegetable crops and to develop new precocious and productive apple rootstocks resistant to pests, diseases, and environmental stresses. A component of the U.S. National Plant Germplasm System, PGRU conserves around 20,000 accessions representing nearly 200 species and encompassing both seed-propagated and clonal germplasm. These genetic resources are invaluable for crop improvement. Some of the larger crop collections include apple, grape, onion, tomato, and vegetable Brassica crops. PGRU distributes germplasm and carries out collaborative research activities related to management and evaluation of the collections, including nutritional characterization of fruits and vegetables. The Apple Rootstock Breeding Program applies molecular tools to enhance the efficiency of developing new rootstocks, which are then evaluated nationwide for commercial potential. Outreach activities to the public include support of organic farming and science education.



Major Crops Assigned to PGRU

| Botanical name | Common name | Approximate number of accessions |
|-----------------------|--|----------------------------------|
| <i>Allium</i> | onion | 1,130 |
| <i>Apium</i> | celery | 240 |
| <i>Asparagus</i> | asparagus | 160 |
| <i>Brassica</i> | cole crops: broccoli, cabbage, cauliflower, kale, etc. | 2,180 |
| <i>Cucurbita</i> | winter squash | 830 |
| <i>Fagopyrum</i> | buckwheat | 220 |
| <i>Malus</i> | apple | 6,600 |
| <i>Physalis</i> | tomatillo | 170 |
| <i>Prunus cerasus</i> | tart cherry | 100 |
| <i>Raphanus</i> | radish | 690 |
| <i>Solanum</i> | tomato | 6,560 |
| <i>Vitis</i> | grape | 1,460 |

Acquisition and Documentation

At PGRU, germplasm accessions are acquired from specialized research and breeding collections, genebanks, botanical gardens, seed companies, private growers and organizations, foreign exchange programs, and plant-collecting expeditions. A good example of recent major acquisitions at PGRU is the apple collection, which has more than doubled with collections of wild species from seven expeditions to Asia since 1989. Accession origin, species, life form, storage location, and characterization and evaluation information—all these data are recorded and verified. PGRU also is developing digital images of all its crops. Information about all of PGRU's germplasm is found in the Germplasm Resources Information Network (GRIN), a database managed by the ARS National Germplasm Resources Laboratory in Beltsville, Maryland (www.ars-grin.gov/npgs/searchgrin.html).

Impact of Collections

- Phylloxera-resistant grape rootstocks and hybrids derived from North American wild germplasm were instrumental in rescuing the European wine industry.
- The PGRU was the only institution that maintained the 100+ founding ancestors of popular apple cultivars. Genes for resistance to apple scab, fire blight, wooly apple aphids, and powdery mildew maintained in the germplasm collection have been deployed in disease-resistant apple rootstock and cultivars.
- Genes from wild tomatoes have been exploited to increase ease of harvesting and disease resistance and for stress and drought tolerance.
- More than 20 genes from the Geneva tomato collection for resistance to bacterial speck, spotted wilt virus, tobacco mosaic virus, leaf mold, fusarium wilt, verticillium wilt, light blight, and nematodes have been bred into modern cultivars.
- The Geneva® Apple Rootstock Breeding Program has released several dwarfing (G.41, G.11, G.935, G.214, G.16, and G.202) and semi-dwarfing (G.890, G.30, G.222, G.969, and G.210) apple rootstocks. These rootstocks are all commercially available and are of major interest because of resistance to fire blight (*E. amylovora*) and wooly apple aphids and tolerance to Apple Replant Disease.
- Orchard performance of Geneva® rootstocks has been superior to commercial standards series and confers disease resistance to allow the planting of fire blight-susceptible scion cultivars (Pink Lady, Fuji, Gala, and Mutsu) in good apple-growing areas with high disease pressure. These root stocks have resulted in higher production efficiency and viability of farms all over the United States.

Maintenance and Characterization

PGRU maintains a large collection of plant genetic resources in the form of seeds, plants, and pollen. Seeds are dried and then stored in sealed packets at -20 °C to maximize longevity and viability. Accessions of clonally propagated crops are preserved as living plants. All seed accessions and dormant apple and tart cherry buds are cryopreserved in liquid nitrogen and placed in backup storage facilities at the ARS National Center for Genetic Resources Preservation in Fort Collins, CO.

PGRU maintains germplasm of vegetables and buckwheat as seeds, while apple, grape, tart cherries, and asparagus are maintained as field plantings. Regeneration of seed crops, usually by controlled pollination using honeybees, is required to maintain germplasm and provide for distribution. Apple, grape, and tart cherry accessions are maintained in field plantings with two plants per accession, and these plants are repropagated as necessary when plants begin to show decline.

All crops maintained at Geneva are characterized with standard sets of descriptors. Many accessions are also tested for disease resistance and tolerance to environmental extremes and for nutritional quality traits. Much of this evaluation is done by collaborators under cooperative



agreements. Availability of this information allows cooperators to make more informed decisions about which germplasm accessions to order.

Other projects on germplasm characterization include genotyping and phenotyping selected traits and associating genotypic and phenotypic variation in apple grape and tart cherry. PGRU scientists are also working with Cornell University and ARS plant pathologists and entomologists to identify resistance to fire blight, scab, post-harvest diseases, and insects. Research in the seed crops includes strategically genotyping and phenotyping (characterizing and evaluating) priority and specialty vegetable crops for molecular markers and highly heritable horticultural, morphological, and nutritional and quality traits.

Breeding and Enhancement

Breeding and enhancement are critical elements of PGRU's activities and are implemented in a program to improve apple rootstocks.

The Geneva® apple rootstock breeding and evaluation program, in collaboration with Cornell University scientists, has two goals: (1) develop new dwarfing rootstocks that have improved tolerance to pests, diseases, and climatic extremes; and (2) develop genomic and bioinformatics tools to aid/facilitate/enable



marker-assisted breeding of apple rootstocks. The program has released several cost-saving, productive, precocious, disease-resistant rootstocks being implemented by fruit growers worldwide. These rootstocks are also being used by homeowners for fruit production and landscaping.



Distribution

PGRU distributes seed of tomato and tomatillo, members of the squash family, buckwheat, onion, celery, radish, asparagus, and members of the cabbage family (cole crops). It also distributes dormant and green cuttings of apple, grape, and tart cherry, as well as pollen of these crops. All germplasm is distributed at no charge to qualified individuals and groups worldwide. Germplasm sent internationally must pass through USDA's Animal and Plant Health Inspection Service.

To request germplasm—

- Visit www.ars-grin.gov/npgs/orders.html,
- Phone (315) 787-2244, or
- Write to—Crop Curator for (name of crop)
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