Plant Quarantine Programs Managed by APHIS-PPQ

Last Modified:

The quarantine programs for the various crops processed by the Plant Germplasm Quarantine Program (PGQP) are listed below with a short description of how each functions.

For general questions or information about the PGQP, contact Joseph Foster (Permit Holder) at joseph.a.foster@usda.gov.

Bamboo Clones and Seed

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Clonal bamboo is usually imported as clumps that include stems with a few to several nodes or sometimes as plantlets in tissue culture. The quarantine for clonal bamboo if healthy is one year during which the plants are inspected during growth and tested twice for viruses, phytoplasmas, and undescribed pathogens. Tests include leaf dip assay via electron microscopy, ELISA serology, PCR, and high-throughput sequencing (HTS). Infected clones are discarded. Introductions that test negative for pathogens are released from quarantine and distributed as whole plants

to importers.

Alternatively, bamboo may be imported into the U.S. as seed. Bamboo seed is treated to control bacteria and fungi, germinated in seed trays, and eventually potted. These seedlings are also observed for disease symptoms and insect pests and tested for viruses, phytoplasmas, and undescribed pathogens by ELISA serology, PCR, and HTS. Symptom-free plants that test negative for the various pathogens are released from quarantine for distribution as whole plants.

Cassava Clones (*Manihot*)

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Cassava plants for propagation are usually imported as tissue cultures but may arrive as bare-rooted plants. During growth, the plants are tested for pathogens by mechanical transmission to sensitive indicator plants, grafting to a sensitive cassava cultivar, ELISA serology, PCR, and HTS. Infected cassava is subjected to meristem tip culture and heat therapy, and then the resulting plants are retested to ensure the elimination of the pathogen(s). This therapy treatment usually adds one year to the quarantine period. Cassava accessions are shipped to each recipient as 3–4 *in vitro* plantlets per clone.

Grass Clones and Seeds

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Grass clones may arrive as whole plants, rhizomes, sprigs, stools, canes/stems, or plantlets in tissue culture from all countries. The growing plants are inspected for fungal or bacterial pathogens and tested twice a year for many exotic viruses and phytoplasmas. Pathogen tests include mechanical transmission to sensitive herbaceous indicator plants, leaf dip assay via electron microscopy, ELISA serology, PCR, and HTS. Infected germplasm may either be destroyed with the approval of the importer or entered into the therapy program for pathogen elimination by heat treatment and tissue culture. Grass clones released from quarantine are usually shipped to the importer as whole plants.

Seeds of certain grasses are prohibited in commercial quantities from certain countries but can be imported through quarantine. The seeds are sown in spring, the growing plants are inspected for pests, and the seed of these plants are harvested and shipped to the recipient. If pests are found, the seed lot is destroyed.

Pome Fruit Clones [Apples (*Malus*), Pears (*Pyrus*), Quinces (*Cydonia*, *Chaenomeles*)]

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Pome fruit clones are usually imported as dormant budwood but could arrive as bare-rooted plants. Selected buds are propagated on the appropriate domestic virus-free seedling rootstocks. Growing plants are inspected for pests and tested for different viruses, viroids, and phytoplasmas by PCR and HTS. Provisional or early releases within 1 year of importation are possible if the tested importation is negative for all mentioned tests. Importers must obtain a permit from APHIS Plant Protection and Quarantine (PPQ) to grow provisionally released pome fruits. A final release is granted after the second round of PCRs and HTS is conducted during the second growing year and results are negative. Thus, the quarantine period for healthy pome introductions is a minimum of 2 years. If the introduction is infected, it is subjected to therapy to eliminate the detected pathogen(s). Therapy is done by growing the importation in tissue culture followed by exposure to several months of heat treatment cycles. Then, 0.2 millimeter meristem tips are excised and cultured in sterile tissue culture media. A small tree is grown from the meristem and subjected to all testing to confirm the elimination of the pathogen(s). Thus, detection of pathogens in pomes adds at least 18 months to the quarantine period. Importers will receive notification via email about the status of their importation after the first round of testing has been concluded, approximately 8 months after importation and establishment of small trees. Pome fruits are released and distributed as dormant budwood from the tested clone.

Potato Clones and True Potato Seed (*Solanum*)

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Potato clones are usually imported as plantlets in tissue culture but may arrive as cleaned tubers. During growth from September to May, the potato clones are tested for many viruses, phytoplasmas, bacteria, and potato spindle tuber viroid by mechanical transmissions to sensitive indicator plants, ELISA serology, leaf dip assay by electron microscopy, molecular hybridization, PCR, and HTS. Suspicious symptoms in the imported plant may be investigated by grafting healthy potato plants with the introduction. Potatoes that are free of pathogens may be released in spring, 9 months after arrival. Infected potatoes are exposed to chemotherapy and thermotherapy in tissue culture, meristem tips are grown, and then the resulting plants are retested to determine the success of the therapy. The therapy process may add a year or more to the quarantine period. Vegetatively propagated potatoes from the tested clones are distributed to each recipient as 3–4 *in vitro* plantlets per clone.

Samples from each true potato seed (TPS) lot are germinated and grown in a quarantine greenhouse from September to May. Each sample is inspected during growth and tested for viruses by mechanical transmission tests to sensitive indicator plants and potato spindle tuber viroid by molecular hybridization. Selected PCR tests and HTS will also be used to detect viruses and other potential pathogens. Seed lots with samples testing negative for pathogens are distributed to recipients in the spring without the seeds removed for testing purposes. Infected seed lots are destroyed.

Rice Seeds (*Oryza*)

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Quarantine regulations are designed to prevent the importation of several exotic seed-borne fungal and bacterial rice pathogens and control the introduction of certain rice species (*Oryza longistaminata, O. punctata,* and *O. rufipogon*), which are on the Federal Noxious Weed list. Upon entry in spring, the rice seeds are inspected and treated with hot water (56 °C, 15 minutes) by an APHIS-PPQ inspector at the Beltsville Plant Inspection Station. Dried and repackaged seed, which serves as the parental seed, is released to the crop manager. For each accession, at least 30 healthy seeds are dehulled and surface sterilized in a 1.575-percent sodium hypochlorite solution for 2 hours. After rinsing in sterile deionized water, seeds are

grown in a tissue culture medium (PDA + 0.5x MS) for 2–3 weeks. Seeds contaminated with fungal or bacterial growth are discarded. Plants from microbe-free cultures are transplanted into pots in the greenhouse. These plants are inspected visually during growth and at least once as seed heads ripen for fungal or bacterial pathogens. The growing plants are tested for pathogens by HTS. The quarantine period for imported rice is usually about 12 months. Seeds free of pests are released in the fall or early winter and shipped to the importer.

Small Fruit Clones (*Actinidia*, *Ficus*, *Ribes*)

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Currants and gooseberries are usually imported as cuttings but may also arrive as bare-rooted plants. Kiwis and figs arrive as dormant budwood or tissue cultures. Gooseberry cuttings may be grafted onto domestic jostaberry plants to establish them and promote vigorous growth before rooting cuttings. Dormant kiwi and fig budsticks are rooted under mist. Kiwis can be grafted on domestic rootstocks. Growing plants are tested for pathogens by mechanical transmission to sensitive herbaceous plants, PCR, and HTS. Dormant Ribes buds are budded onto sensitive currant indicator plants to test for graft-transmissible pathogens. Introductions that test negative can be released within 2–3 years. Infected introductions are exposed to therapy procedures involving heat treatment of growing plants or tissue cultured plants, and then the resulting plants are retested to confirm that the pathogen has been eliminated. Currants, gooseberries, figs, and kiwis are distributed as bare-rooted plants.

Stone Fruit Clones and Seeds (*Prunus*)

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Stone fruits, which include fruiting and ornamental almonds, apricots, cherries, nectarines, peaches, plums, and prunes, are usually imported as dormant budwood but may arrive as cuttings for rooting or bare-rooted plants. Selected buds are propagated on the appropriate domestically purchased seedling rootstocks. Growing plants are inspected during growth and tested for viruses, viroids, bacteria, and

phytoplasmas by transmission tests to sensitive indicators, ELISA serology, PCR, and HTS. Provisional or early release of clones that test negative in the initial testing is possible 1–2 years after arrival. Importers must obtain a permit from APHIS-PPQ to grow provisionally released stone fruits. The final release of the tested clone occurs after all tests for pathogens are negative, usually within 2–3 years of importation. Infected clones are exposed to heat treatments in tissue culture or growth chambers, tips are grown, and then the resulting plants are retested to determine if therapy was successful. Stone fruit clones are usually distributed as dormant budwood or bare-rooted trees.

Stone fruit seeds are germinated in the fall and winter and then grown in the greenhouse in spring. Growing seedlings are tested individually for plum pox virus by ELISA and RT-PCR, and for potyviruses and ilarviruses by RT-PCR. Buds from dormant budwood from each seedling are budded on GF 305 peach seedlings to check for various pathogens. Seedlings that test negative are released and sent to the importer as bare-rooted plants.

Sugarcane and Related Grass Clones (*Saccharum*)

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Sugarcane is usually exchanged as cane setts and occasionally as plantlets in tissue culture. Setts should reach PGQP by March (southern hemisphere origins) or August (northern hemisphere origins). Growing plants are observed for symptoms during each of two growing cycles and tested for bacteria, viruses, and phytoplasmas by mechanical transmission to sensitive herbaceous plants, serology, culturing attempts, PCR, and HTS. Additional tests are conducted after cutting back and then at shipping. The released setts will be taken from mature plants of the tested clones that were grown from long, hot water-treated cane pieces. The released setts are subjected to a long hot water treatment before shipping. The quarantine period for healthy sugarcane clones imported for propagation is usually about 18 months. Infected clones are entered into the tissue culture program for pathogen elimination, and then the resulting plants are retested to determine if therapy was successful. Therapy prolongs the quarantine period for infected sugarcane.

Sweet Potato Clones (*Ipomoea*)

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Sweet potato clones are usually imported as plantlets in tissue culture but may occasionally arrive as cleaned roots or cuttings. Plants are grown from April through October in quarantine greenhouses. Growing plants are inspected for pests and are tested for viruses and phytoplasmas by grafting stem pieces to *Ipomoea setosa*, by PCR, and by HTS. Clones that test negative may be released up to 9 months after testing has begun. Infected sweet potatoes are subjected to meristem tip culture and heat therapy, and the resulting plants are retested to verify that the therapy procedure eliminated the detected pathogen(s). This therapy treatment usually adds 1 year to the quarantine period. Sweet potatoes are released and then shipped to recipients as 3–4 *in vitro* plantlets per clone.

Woody Ornamentals

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During the last 5 years, various prohibited woody ornamentals, including juniper, pine, spruce, elms, maples, mulberries, barberries, boxwoods, redbuds, oaks, hibiscus, and some bonsai have been imported by PGQP. Woody ornamentals are usually imported as bare-rooted plants but may arrive as cuttings that require grafting or rooting. The inspection and testing requirements vary with each genus. Barberries only require inspection during growth for evidence of black stem rust of wheat. Other genera, such as elms and maples, involve inspections during growth and pathogen tests for viruses, viroids, and phytoplasmas. Plants testing negative for pathogens are released and shipped to the importer as whole plants.

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