

Support to Foundation Plant Services 2020/2021

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Project Summary/Abstract

Briefly describe the long-term objectives for achieving the stated goals of the project.

The State of California and University of California have collaborated for many years on the development of healthy grapevine and fruit tree materials for the benefit of state agricultural interests. Separate programs for the registration and certification of grapes and fruit trees were implemented in the 1950's through close cooperation between the California Department of Food and Agriculture (CDFA) and Foundation Plant Services (FPS), University of California, Davis. Key functions mandated by the state program include testing, treatment (if necessary) and maintenance of grapevine and fruit tree materials. The selections are required to test negative for certain specified diseases, primarily viruses, to qualify for initial inclusion in the state program, and then must continue to pass periodic inspections and testing to remain in the program. FPS performs the required testing of the plant material, including index testing, laboratory tests such as ELISA and PCR analysis and DNA testing for proper identification. Should plant material test positive for prohibited diseases, FPS performs microshoot tip tissue culture therapy on selections to eliminate any disease. An FPS expert determines the correct identification of each grape and fruit tree selection using state of the art DNA technology. FPS laboratory and field staff provide ongoing maintenance and testing of grape and fruit tree selections to monitor continued compliance with program standards. The work to be performed in the project described below will enable FPS to develop and implement the high-level testing and treatment protocols and effective maintenance strategies for the plant material under its care. The mutual goal of FPS and CDFA is to continue to ensure healthy plant material for the grape and fruit tree industries in California.

Scope of Work

Describe the goals and specific objectives of the proposed project and summarize the expected outcomes. If applicable, describe the overall strategy, methodology, and analyses to be used. Include how the data will be collected analyzed, and interpreted as well as any resource sharing plans as appropriate. Discuss potential problems, alternative strategies, and benchmarks for success anticipated to achieve the goals and objectives.

Objective I. Maintain California Registration & Certification Foundation Orchard at CDFA standard. (Budget items 1, 2, 3, 7, & 8 see budget summary table.)

The FPS foundation orchard is maintained as an elite source of propagation materials of various Prunus fruit and nut trees as part of the California Fruit & Nut Tree Certification Program under the aegis of CDF A. The FPS fruit and nut tree collection now contains nearly 350 selections and over 1,500 scion wood and seed trees. The almond, apricot, cherry, nectarine, peach, and plum are planted in replicates of four and are pruned as budwood sources. There are approximately 30 rootstock selections. The plant material is primarily distributed to California nurseries for the creation of the next generation of disease-tested and professionally-identified budwood sources. Twice annually, FPS and CDFA conduct joint visual inspections of the Foundation Orchard to ensure that the trees are healthy and free of virus symptoms.

Funding for the FPS Fruit & Nut Tree Program for 2019-2020 includes annual testing of the trees and orchard maintenance and development. All new fruit and nut tree selections entering the program must be tested for the diseases specified in the state regulations in order to qualify for the program. Such testing includes ELISA, real time quantitative PCR, and high throughput sequencing (HTS) methods. If those selections are found to be virus infected, tissue culture microshoot tip therapy (see above) will be performed. Selections acquired from the Clean Plant Center of the Northwest at Prosser Washington are pre-screened prior to planting and must undergo annual maintenance testing along with other selections in the FPS orchard blocks. This project includes funding for ELISA testing of 2/3 of the FPS orchard for *Prunus* necrotic ringspot virus (PNRSV) and Prune dwarf virus (POV). Ongoing maintenance of the orchards includes pest control, irrigation, soil relations, pruning and other practices inherent in maintaining a healthy and virus-negative collection. Aging trees are routinely re-propagated and planted in new orchard areas (Budget item 1, 2 & 3).

An FPS scientist will continue to develop micro satellite profiles for FPS fruit & nut tree accessions and improve the fruit & nut tree ID database. This analysis should provide reliable objective information about the FPS tree collection, which will be useful in the professional identification of our selections, and in providing a database for comparison with material distributed from FPS. Developing this database for our materials will allow nurseries to check their materials against that database for verification. It will also be possible to make international comparison with other documented collections, facilitating professional identification of selections in the R&C program (Budget item 7).

Fruit and nut tree selections that test positive for any disease prohibited by the regulations of the Fruit & Nut Tree Certification Program do not qualify for inclusion in the program. In order to qualify those selections, FPS performs disease elimination therapy on the material. The most effective technique used for disease elimination on fruit and nut trees is a combination of thermotherapy and microshoot tip tissue culture therapy, which involves excision of a very small (less than 0.5 mm) piece of the shoot tip of the tree, growing it in media into a new tree and testing the tree for the diseases in the program. Funding for this project will fully support the work of one FPS technician working on fruit and nut trees in the tissue culture laboratory (Budget item 8).

Objective 2. Maintain California Registration & Certification Program Foundation Grapevine Vineyards at CDF A standard. (Budget item 2, 4, 5, 6 & 9)

The California Grapevine Registration & Certification Program is administered by CDFA. The program targets the elimination of specific grapevine diseases such as red blotch, leafroll, fan leaf, corky bark, stem pitting and fleck that are spread from vine to vine by grafting and/or vegetative propagation. Some of the targeted diseases are also spread by soil nematodes (fanleaf), mealybugs (leafroll), and three-cornered leaf-hopper (found to transmit red blotch in greenhouse conditions). Under the auspices of the CDF A Program, correctly named grape materials that pass specific disease tests are identified and/or created. Once identified, foundation materials are maintained by FPS and then multiplied by participating nurseries into commercial quantities according to procedures prescribed by the Program.

The foundation source vines for the California R & C Program are maintained by FPS in its foundation vineyard blocks at UC Davis. FPS maintains 90+ acres of foundation level grapevines; the collection includes more than 800 grape scion and rootstock cultivars and nearly 3,500 different clones (selections). FPS developed the foundation collection at the Russell Ranch Foundation Vineyard to the highest phytosanitary standard in the world. The standard was specified in a document entitled '2010 Protocol for Qualification of Vines for Russell Ranch'. To satisfy the 2010 Protocol, all vines must be generated using microshoot tip tissue culture therapy and test negative for more than 37 grapevine viruses prior to planting in Russell Ranch. The Classic Foundation Vineyard still exists and remains an important source of material as it contains much mother vine material from traditional, heritage and classic clones. In addition, since the Classic Foundation Vineyard has been less affected by the occurrence of red blotch disease as Russell Ranch Foundation Vineyard, it is valued as an important backup collection.

These Foundation Vineyards contain vines that have been tested, or were propagated from sources that have been tested, using all the methods prescribed in CDFA regulations for foundation stock. During the first two years after a qualified vine is planted in the foundation block at FPS, the vines are tested annually for red blotch, leafroll-associated and nematode-transmitted viruses using real time quantitative PCR tests. In addition, as soon as the vines are large enough to produce fruit, they are visually inspected by a professional grape variety expert who checks the accuracy of the variety identification.

The state regulations require that 1/5 of the foundation grapevines in the California Grapevine R & C Program be tested each year to ensure that they have not become infected with any of the diseases prohibited by the program. The vines are maintained in isolation on the UC Davis campus but are subject to ongoing testing to ensure they stay healthy. FPS will test approximately 1/5 of the Foundation Vineyard blocks by qPCR methods for the following 19 pathogens: Grapevine fanleafvirus; Grapevine tomato ringspot virus; Grapevine leafroll-associated virus 1, 2, 2RG, 3, 4, and 7; Grapevine leafroll-associated virus 4 strains 5, 6, 9, Pr and Car; Grapevine red blotch virus; Grapevine Virus A and B; Grapevine Pinot gris virus; Phytoplasmas and *Xylella fastidiosa* (Pierce's Disease) (Budget item 2, 4 & 5). FPS plant pathologists walk the vineyard and inspect regularly. And twice annually, FPS and CDFA conduct joint visual inspections of the Foundation Vineyard to ensure that the vines are healthy and free of virus symptoms. Due to the increased incidence of red blotch disease, FPS is now testing the entire Foundation Vineyard collection for GLRaV-3 and GRBV annually (this testing is covered by funds not requested in this proposal).

The regulations for the California Grapevine R & C Program require that the grapevines in the program be true to variety. FPS employs a scientist experienced in genetic analysis to conduct DNA microsatellite testing on the grapevines in the program to ensure correct variety identification of each selection. This scientist will continue to develop micro satellite profiles for FPS grape accessions and improve the grape ID database, while generating data on new accessions to the collection. This analysis should provide reliable objective information about the FPS grape collection, which will be useful in the professional identification of our selections, and in providing a database for comparison with material distributed from FPS. Developing this database for our materials will allow nurseries to check their materials against that database for verification. It will also be possible to make international comparison with other documented collections, facilitating professional identification of selections in the R&C program (Budget item 6).

Grapevine selections that test positive for any disease prohibited by the regulations of the California R & C Program do not qualify for inclusion in the program. In order to qualify those selections, FPS performs disease elimination therapy on the material. The most effective technique used for disease elimination on grapevine is microshoot tip tissue culture therapy, which involves excision of a very small (less than 0.5 mm) piece of the shoot tip of the grape, growing it in media into a new vine and testing the new grapevine for the diseases in the program. FPS employs several scientists experienced in tissue culture techniques and performs hundreds of excisions each year. Funding for this project will support the work of two FPS technicians (one in full and one in part) on grapes in the tissue culture laboratory (Budget item 9).

Objective 3. Provide scientific support for Objective 1 & 2.

Funding is provided for the salary of an Academic Administrator who is responsible for monitoring the health status of foundation plantings at FPS by performing proper laboratory tests and visual inspections. This scientist will oversee the disease inspection and testing of quarantine and new introductions, monitor and record symptom expression on all field and greenhouse indexed plants, oversee FPS laboratory testing for virus using ELISA, PCR, HTS or other applicable technology, and review all test results and prepare reports for inclusion in the FPS database. This work will be in support of both Objective 1 and Objective 2, above. (Budget item 2).