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Avocado Plant Breeding Takes a Leap Forward

In January 2015 the avocado plant breeding program at UC Riverside (UCR) was reenergized when Dr. Patricia Manosalva joined the team. She joins the Plant Pathology and Microbiology Biology Department as an assistant professor, following a lengthy search to replace Dr. Greg Douhan. Dr. Manosalva has a very strong background in plant pathology and molecular biology and has taken the lead for the avocado rootstock breeding program.

As we've discussed in a number of previous articles in *From the Grove*, for the past three years the California Avocado Commission has been working to restructure the avocado breeding program to better address the urgent needs of the industry — salinity and Phytophthora. With Dr. Manosalva's arrival those changes are finally coming to fruition.

A New Emphasis on Rootstock Breeding

Even before her official start in January, she began communicating and planning with Commission staff and other members of the UCR avocado breeding team. Because of this,

Dr. Manosalva was able to prepare and submit to CAC a detailed, comprehensive proposal for jump starting the rootstock breeding program that the board approved for funding at its April meeting.

Perhaps the biggest change to the rootstock breeding program is the condensing of all efforts into one project. Previously, the Commission funded up to three different projects at any given time to work on the various aspects of new rootstock development. In some cases, this led to the duplication of efforts, materials falling through the cracks and questionable use of growers' funds. The new program will be directed by Dr. Manosalva with Drs. Mary Lu Arpaia and Peggy Mauk co-



Dr. Patricia Manosalva addresses grower questions at a recent CAC field day

operating on field testing and salinity tolerance screening, respectively. This setup will ensure good communication among the researchers and between the project team and CAC.

This new project includes a plan for fast tracking existing rootstock selections through the screening process to get the most promising ones

into growers' hands as soon as possible. There are almost 100 rootstock selections from the previous rootstock programs that have never been fully evaluated for salinity or Phytophthora tolerance. As part of the new rootstock breeding program, the evaluation of these selections will be expedited and the most promising candidates moved into field trials to collect the necessary data to decide whether they should be released. (See "Advances in Salinity Tolerance and Phytophthora Detection" in the Spring 2015 issue of *From the Grove* for an example of some of these promising rootstock selections.)

Another key component of the restructured program is revising the way rootstocks are screened for Phytophthora tolerance. Prior to his departure from the program, Greg Douhan began to develop a much better understanding of the dynamics of Phytophthora in California

avocado groves. Specifically, he found there are numerous different isolates of *Phytophthora cinnamomi*, some from northern growing regions and some from southern growing regions. These isolates differ in virulence and rootstocks that show tolerance to one isolate may still be susceptible to other isolates. Thus, revising how potential new rootstocks are challenged with Phytophthora and the mixture of isolates used in those challenge studies is a critical first step to ensuring that new rootstocks are as robust as possible when released to the industry.

Similarly, rootstock screenings to date have been for Phytophthora or salinity tolerance. However, in the field these two stresses often occur together, and there is very little data about their interaction in avocados. Thus, another early step in the new project will be to study the effects of Phytophthora and salinity interac-

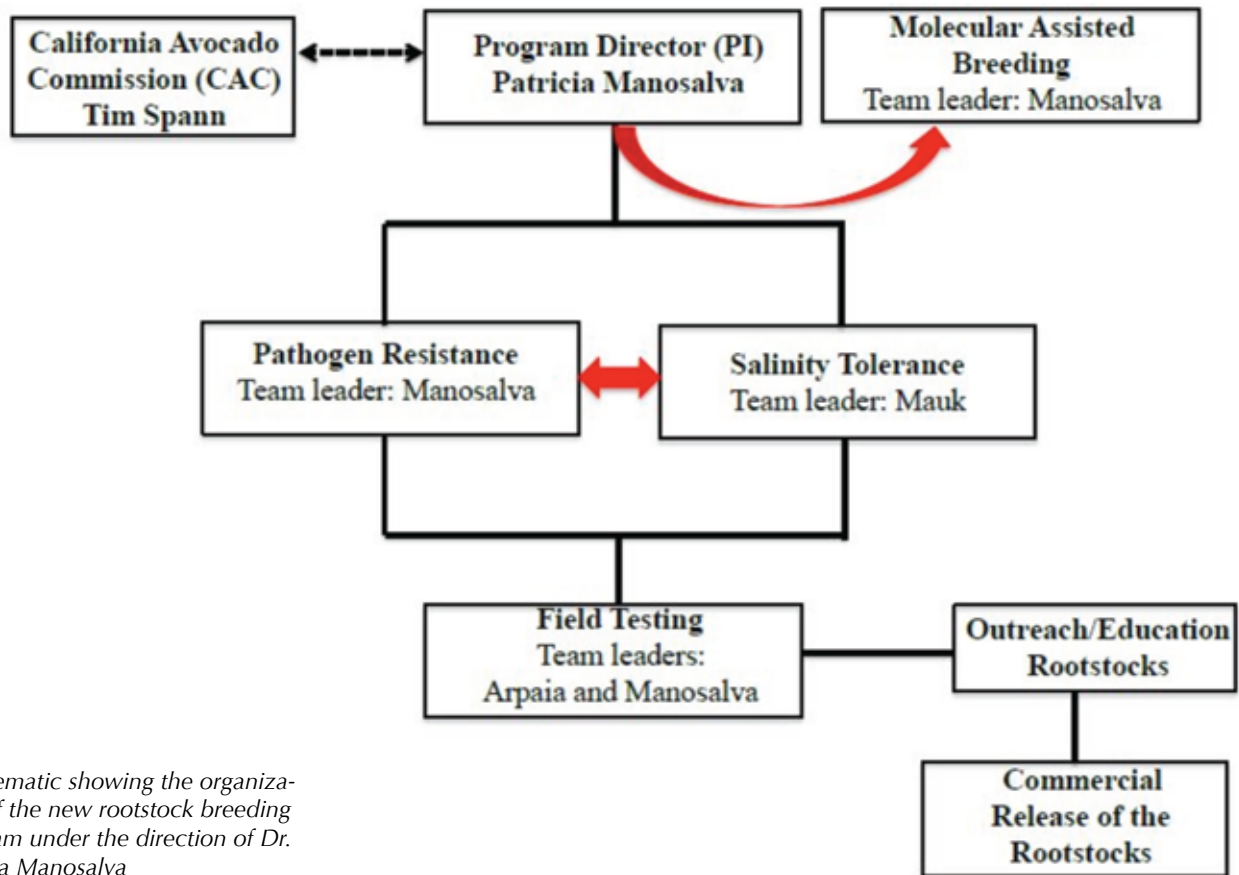
tions in avocados and to identify the best way to screen rootstock materials to ensure they have the best tolerance to both stresses.

The last component of the new program is to introduce modern molecular tools to the process of avocado breeding — specifically "marker assisted selection." A highly simplified explanation of marker assisted selection is as follows: when plants respond to various biotic and abiotic stresses (e.g., salinity, disease or insect attack) various genes are turned on or off. This is known as regulation. If a gene is turned on in response to a stimulus it is said to be "up regulated;" if a gene is turned off it is said to be "down regulated." Using modern molecular tools these gene regulation patterns can be observed. By observing gene regulation in response to different stimuli, scientists can start to understand which gene or group of genes are involved in various responses. These responses are then used as indicators or "markers" for specific traits. Marker assisted selection allows for the quick screening of large numbers of potential rootstock candidate seedlings very soon after germination.

In addition to allowing for more efficient screening of potential new rootstocks, the parent trees can be screened. The parent blocks from which seeds are collected can then be refined to contain the parents that possess the traits desired in a new rootstock, improving the chances that the seeds harvested will result in seedlings that have those combined traits. In essence, marker assisted selection allows for the use of modern molecular tools to expedite the traditional breeding process without entering the realm of a genetically modified rootstock.

A greater understanding of how the tree responds to various stresses not only allows for the development of better rootstocks, but also allows for a greater understanding of





A schematic showing the organization of the new rootstock breeding program under the direction of Dr. Patricia Manosalva

the interaction of those stresses with the tree. This knowledge can lead to improvements in grove management practices to better combat the various stresses being studied.

Scion Breeding

While there is a renewed effort on the rootstock side of the avocado breeding program, there is a de-emphasis on the scion breeding program. This decision was not made lightly or without controversy. However, following input from the Production Research Committee, the CAC Board and the industry at large, this path was determined to be the best way to address urgent industry needs while staying within budgetary constraints.

Although the Commission will no longer fund *active* scion breeding, the board recognizes the importance

of the genetic resources the program has built up over the past 20 years or so. Thus, CAC will provide continued funding for the scion program to keep this material alive and ensure it is not lost.

In addition, the Commission is interested in finding more permanent and secure ways of preserving the genetic resources from the scion and rootstock program, aside from just field plantings. To this end, Drs. Manosalva and Arpaia, along with CAC staff, met with Duarte Nursery personnel in early April to view and discuss the potential for their tissue culture technology to be used to preserve material where it is not exposed to the risks of the field (e.g., freezes, pests and diseases). The Commission is also following work being done by the Huntington Gardens and an Australian laboratory to develop tissue culture and cryopreservation tech-

nology for avocado. The group was recently successful in making major advances with this technology for *Magnolia* species, which are in the same order as avocado.

Dr. Arpaia and her team at UC Riverside also are working to secure funding through the USDA Farm Bill to keep the scion breeding program moving forward. The Commission strongly supports their efforts.

The new energy and knowledge brought to the rootstock breeding program by Patricia Manosalva is a welcome input to a program that has been stalled for the past several years. Although plant breeding is always a time consuming, high risk investment, we are optimistic that the program is on the right track and is poised to make tremendous advancements over the next few years that will genuinely benefit California avocado growers. 🥑