DNA Markers for Phytophthora Crown Rot Resistance

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Summary

DNA marker technologies are beginning to enhance new variety development in the UF strawberry breeding program. DNA markers were developed for detecting resistance to Phytophthora crown rot (PhCR) and have been successfully implementing in seedling selection. As a result of this technology, more future varieties should combine PhCR resistance with continued fruit quality improvements.

What is DNA marker?

DNA marker is a term used to refer to a specific DNA variant that is associated with a trait: for example, yield, fruit size or a disease resistance. DNA marker testing determines which variants a particular strawberry seedling, breeding selection or variety is carrying. DNA markers for traits such as disease resistance have been used in crop improvement for several decades.

The UF strawberry breeding program has recently been using DNA marker technologies for new cultivar development through marker-assisted selection. The breeding program now quickly and cheaply screens DNA markers in tens of thousands of seedlings, “stacking the deck” for desirable traits prior to field evaluation.

Resistance to Phytophthora crown rot

Phytophthora crown rot (PhCR) caused by *Phytophthora cactorum* is a common and destructive disease of strawberry around the world. Currently, almost all UF strawberry cultivars grown in Florida are susceptible to PhCR. The genetic location that accounts for most of the difference between resistant and susceptible varieties is called *FaRPc2*.

FaRPc2 is located on chromosome 7D of cultivated strawberry (Fig. 1). Two variants, H2 and H3, of *FaRPc2* are highly associated with PhCR resistance.

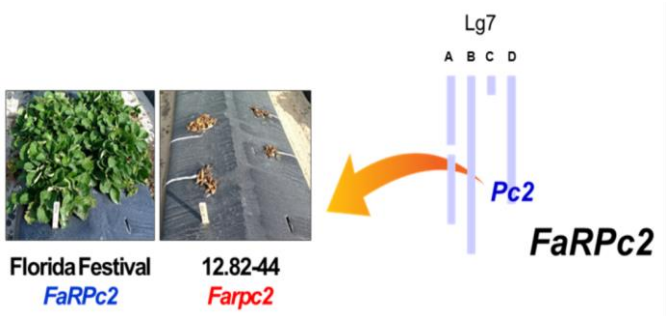

Figure 1. Phytophthora crown rot resistance conferred by *FaRPc2* in ‘Florida Festival’, and the location of *FaRPc2* in the cultivated strawberry genome.

DNA markers for PhCR resistance

High-throughput DNA markers were developed for the H2 and H3 variants of *FaRPc2* and have been successfully utilized for seedling selection. In the seedling selection process, a leaf disc is collected from each seedling and used to extract DNA. The DNA extraction method and subsequent marker screening methods are high-throughput, accurate, low-cost and user-friendly. It costs approximately 10 cents in materials and suppplies to screen one seedling with one marker. As shown in Fig. 2, high resolution melting markers precisely detect the presence of the resistant and susceptible variants of *FaRPc2*. Another type of probe-based DNA marker also successfully detected the present of *FaRPc2* in UF breeding materials.

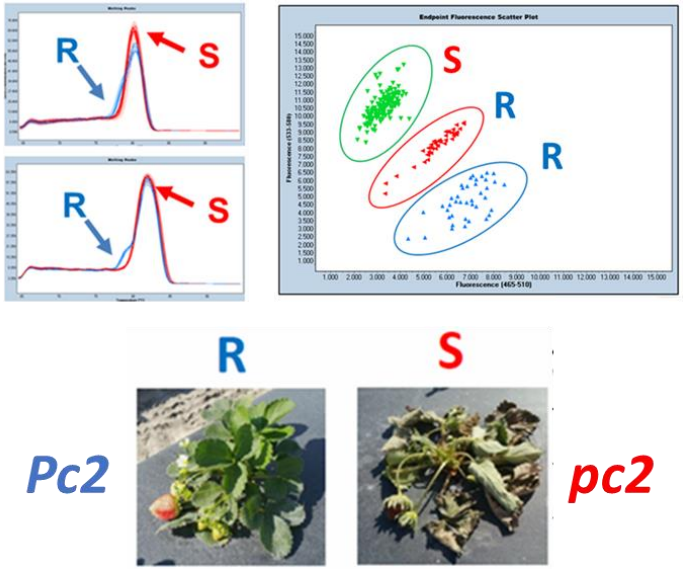

Figure 2. Different types of DNA markers for Phytophthora crown rot resistance, *FaRPc2*, were developed and tested. R: Resistance, S: Susceptibility. Left graph: high-resolution melting marker, Right graph: probe-based marker.

Hight-throughput marker-assisted selection

The most informative markers were implemented in marker-assisted selection for PhCR resistance breeding in strawberry. As shown in Fig. 3, high-resoluting melting markers specific to two resistant variants, H2 and H3, were successfully used to screen seedlings for PhCR resistance. The accuracy of marker selection is over 95%. In 2017 approximately 20,000 seedlings were screened with these markers. The seedlings that are retained and planted in the field for evaluation are more likely to carry resistance and are thus more likely to become sucessful cultivars.

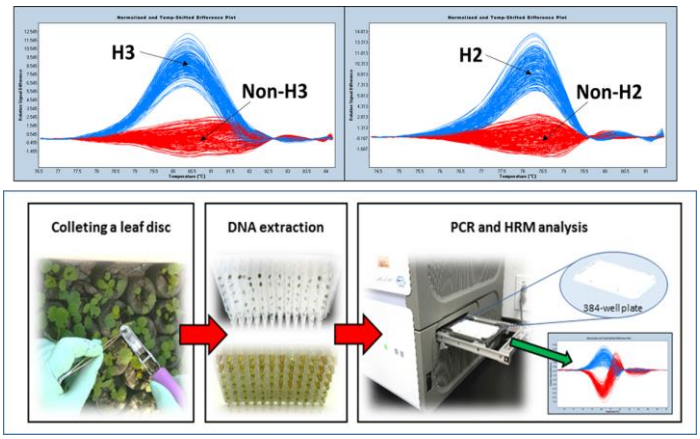

Figure 3. High-throughput marker-assisted seedling selection for Phytophthora crown rot resistance in the UF strawberry breeding program.

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