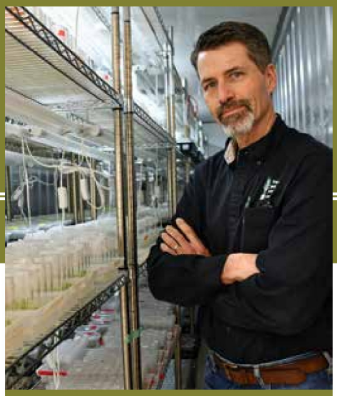
NO POLLINIZERS NEEDED

Self-Fertile Nonpareil Almond Varieties Could Be Game-Changers for the Industry

By **VICKY BOYD** | *Contributing Writer*



Burchell Nursery Owner Tom Burchell has beefed up their tissue culture lab to handle the expected demand for its self-fertile Nonpareil+ almond variety (photo by V. Boyd.)

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> —TOM BURCHELL, BURCHELL NURSERIES

Sierra Gold Nursery is propagating FruitionOne self-fertile Nonpareil trees at its Yuba City facility (photo courtesy Sierra Gold Nursery.)

TWO NURSERIES PLAN TO BEGIN MARKETING

What some in the industry consider the Holy Grail of almond trees, self-fertile Nonpareils that don't require pollinizers, within the next few years.

In making the separate announcements, Burchell Nursery and Sierra Gold Nursery said the new varieties are the results of individual collaborations with genetic research firms that involve gene editing.

Oakdale-based Burchell Nursery Inc. hopes to have a limited number of its patented Nonpareil+ trees available to plant in test orchards by 2026, with more trees coming in 2027, said owner Tom Burchell.

"Even though it's the same genetically as a Nonpareil, I still want to see it in the field, see it grafted on a rootstock in an orchard," he said.

The nursery already held an informational town hall grower meeting in Parlier on February 19 and planned two more in the coming weeks. They are March 6 at the Stanislaus County Agricultural Center in Modesto and March 20 at the Foundation Plant Services building in Davis.

Yuba City-based Sierra Gold Nursery plans to have a limited number of its patented FruitionOne trees available for growers to plant test blocks in fall 2026, with additional volume in 2027, said CEO Reid Robinson.

What Is Gene Editing?

Both new self-fertile Nonpareils were developed using CRISPR gene editing, although each was derived with slightly different methods.

As Burchell was quick to point out, the new Nonpareils are not GMOs, or genetically modified organisms. With GMOs, DNA is typically modified by transferring genetic material from one organism to another.

Gene editing, on the other hand, involves no foreign genetic material. Instead, geneticists simply clip out, turn on or turn off a selected gene or genes in a DNA strand.

Self-compatibility, also known as self-fruitful or self-fertile, occasionally occurs naturally in almonds, with the Italian cultivar Tuono known for centuries. Sporting a thick, hairy shell, Tuono lacks many desirable agronomic traits.

More recently, breeders have tapped Tuono as a parent to develop self-fertile varieties using traditional methods of crossing and then repeatedly back-crossing, which can take decades. Burchell did so with its Shasta and Pyrenees self-fertile almond varieties and Sierra Gold with its Earlybird self-fertile variety.

But gene editing allowed the nurseries to develop the new self-fertile Nonpareils in only a few years. Had they gone the older route and crossed Tuono with Nonpareil, Burchell said the resulting offspring would still contain some Tuono genetic material even after repeated backcrossing.

Gene editing allowed breeders to develop new varieties that are genetic copies of the originals except for the edited gene or genes.

While regulations continue to change, both the FDA and USDA don't have nearly the restrictions on plants derived from gene editing as they do for GMOs. In fact, some agency consultations are voluntary for gene-edited plants.

Both Burchell Nursery and Sierra Gold Nursery plan to obtain all necessary regulatory approvals.

The Road to Self-Compatibility

For the past six years, Burchell has worked with individuals affiliated with the Innovative Genomics Institute at UC Berkeley and Verinomics in New Haven, Conn. to develop a gene editing process for Nonpareils.

Yale University Geneticist Stephen Dellaporta and his Verinomics team mapped the Nonpareil almond genome and identified the location of the gene responsible for pollen incompatibility. Then they used CRISPR-Cas9 technology and other proprietary methods to edit or snip out the gene. The result is a Nonpareil that has all the same traits as the unedited version except it can now accept pollen from other Nonpareil without aborting pollen tube growth and impeding fertilization.

Not only is the Nonpareil+ self-compatible, Burchell said it also is universally cross-compatible, meaning it can accept pollen from all other almond varieties and pollinate any other almond variety without issues.

For about the past four years, Sierra Gold has worked with Ohalo Genetics of Santa Cruz to develop its Fruition-

Burchell Nursery is propagating its self-fertile Nonpareil+ using tissue culture (photo by V. Boyd.)

Sierra Gold Nursery grafted FruitionOne scion onto commercial rootstock (photo courtesy Sierra Gold Nursery.)

Self-fertile Nonpareil varieties can improve orchard returns by reducing pollination costs and simplifying orchard operations.

One line. Ohalo also has mapped the Nonpareil genome, or an organism's complete set of genes.

The FruitionOne is self-compatible. While Robinson said growers will likely come up with different strategies, "There's going to be some advantage of planting it at 100%."

But editing the gene is just part of tree development. Then the plant cells that housed the edited DNA must be regenerated using tissue culture. Both Burchell Nursery and Sierra Gold Nursery have their own in-house tissue culture laboratories.

Under controlled conditions, technicians place plant cells in test tubes with specially designed growth medium that provides nutrients as well as plant hormones. Depending on the desired result, select hormones promote different functions such as rooting and/or leaf development.

Incubated in climate-controlled rooms under grow lights, the small green clumps of cells eventually push roots into the medium and recognizable leaves from atop.

Also known as micro-propagation, tissue culture has been used for years to clonally reproduce clean, disease-free plants. Woody plants are much harder to propagate using the process, and Robinson and Burchell agreed that Nonpareil is even more difficult.

Financial Benefits

Much like the draw for other self-fertile almond varieties on the market, the new Nonpareils are designed to reduce labor expenses, harvest time and expense, management issues and beehive rentals.

The new varieties have an added attraction: They're Nonpareils, coveted by the industry for their high quality, large kernels, thin shell and mild flavor. In fact, about 40% of the state's production by weight is from Nonpareil.

Currently, rows of Nonpareil are alternated with rows of one or two other varieties to provide genetically different pollen sources. Growers rent bees during late winter to move the pollen among the trees and pollinate the crop.

The average beehive stocking rate runs about two hives, or about $400, per acre for conventional varieties, making bees one of almond growers' largest input expenses.

Despite some claims that growers could eliminate renting beehives altogether for self-fertile varieties and still set a crop, recent UC Davis and USDA research found financial benefits from using managed bees.

In a study with the Independence self-fertile variety surrounded by traditional varieties, they found trees did set a crop without beehives due to pollinators flying in from nearby trees. By putting 0.5 beehives per acre, the researchers increased yields enough to cover hive rental cost and produce an additional $122 return per acre compared to self-fertile orchards without beehives. The calculations were based on $200 per hive per acre.

At one hive per acre, the researchers found an additional $644 economic value over self-fertile orchards without hives.

Robinson said they recommend using managed bees with their Earlybird self-fertile variety, although at a reduced rate. They will also do so with FruitionOne but will leave the stocking rate up to the grower.

While Burchell Nursery also recommends augmenting Shasta and Pyrennes self-fertile almond orchards with a reduced number of beehives, the recommendation for Nonpareil+ "is to be determined," Burchell said.

The new Nonpareils also will allow growers to manage an entire block the same. Gone will be the days of making two or more navel orangeworm hull split treatments, one for the Nonpareils followed by a later one or two for pollinizers.

In addition, growers should be able to make single shaker and harvester passes with self-fertile Nonpareils, significantly reducing harvest costs. But having a large portion of acres mature at the same time will undoubtedly challenge hullers.

With the increased popularity of self-fertile varieties already, many hullers have had to manage more or larger stockpiles. And that could become even more an issue should growers adopt self-fertile Nonpareils on a large scale.

But Burchell said the same genome mapping and editing that led to the Nonpareil+ also may help them develop a later-blooming Nonpareil, which would spread out harvest. An existing line of naturally mutated late-flowering varieties could provide a starting point.

Robinson pointed to the diverse growing conditions and production systems throughout the state and within smaller growing regions that already affect harvest timing. That said, he cited the walnut industry where 70%+ of the crop is one variety, which stresses harvest crews and handlers during harvest.

Should self-fertile Nonpareils prove as popular as expected, it could also shift the almond industry's varietal composition away from pollinizers. But both Burchell and Robinson said they believe there will always been some demand for other varieties, such as for in-shell or smaller kernels for confectioners.

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