Soil Culture Solutions, LLC (d/b/a Soilcea)
3802 Spectrum Blvd., Suite 157, Tampa, FL 33612
Yianni@soilcea.com

FAQ: CarriCea T1 (patent pending) and BeneCea D1 (patent pending)

Q: What is the CarriCea T1?
A: CarriCea T1 is a new citrus rootstock developed using CRISPR to make a traditional Carrizo more resistant to HLB. Key highlights include:

- Carrizo rootstock with improved resistance to HLB
- T for triple or three precise CRISPR edits
- Restores the tree's natural defenses
- Demonstrates significantly reduced disease levels and vigorous growth in the field
- The resulting fruit is classified as non-bioengineered by the USDA
- Backed by University of Florida research, USDA funding, and NSF funding

Q: What is the BeneCea D1?
A: BeneCea D1 is a new citrus rootstock developed using CRISPR to make a traditional US-812 more resistant to HLB. Key highlights include:

- US-812 rootstock with improved resistance to HLB
- D for double or two precise CRISPR edits
- Not yet field tested
- The resulting fruit is classified as non-bioengineered by the USDA

Q: What is CRISPR?
A: CRISPR stands for Clustered Regularly Interspaced Short Palindromic Repeats, which does little to explain its use as a tool for breeding. Over billions of years, bacteria have developed sophisticated molecular tools—far superior to any man-made inventions—to protect against invading pathogens. Researchers have adapted the CRISPR tool to improve plants. The cutting tool in the CRISPR system, the Cas9 (CRISPR-associated protein 9), performs an extremely precise cut that makes CRISPR editing one of the most versatile tools for breeding new resistant citrus cultivars. Rather than introducing foreign traits, CRISPR can restore the plant's existing biological defenses to create healthier citrus.

Q: How big of a problem is HLB?
A: CarriCea T1 was developed to help growers manage HLB. HLB Economic Impact:

- Huanglongbing (HLB), or Citrus greening, directly translates from Chinese to "Yellow Dragon Disease."
    - HLB has killed 50 million trees, led to the loss of 47,000 jobs, resulted in an estimated $76.5 billion in lost economic impact, and slashed Florida citrus production by a staggering .95%—from 291.8 million boxes to 14.6 million boxes
- 80% of orange juice is imported (Florida used to account for 23% of the global citrus trade)

Q: Is the fruit GMO or non-GMO?
A: The fruit is considered non-transgenic because it contains no foreign DNA, which classifies it as non-GMO (Genetically Modified Organism). The USDA doesn't make that distinction, but instead uses the term non-bioengineered. The USDA classified the fruit from normal scions grafted on the CarriCea T1 as non-bioengineered. In a letter of support submitted on behalf of the USDA for Soilcea's HLB resistant Carrizo rootstock it was stated that "USDA notes that a key citrus industry marketing benefit of this gene-edited loss of function approach is that it will result in no use or production of recombinant DNA in trees. This means that fruit grown from trees on these rootstocks (and processed products using these fruit) will not require USDA 'bioengineering' labeling."

Q: What is the regulatory status of CarriCea T1?
A: The **"**U.S. The Environmental Protection Agency (EPA) approved CarriCea T1." "EPA conducted a robust dietary safety assessment under its existing regulatory framework for plant-incorporated protectants to ensure that the registration decision is protective. This includes residues from both the pesticide being registered as well as any breakdown products. The fruit produced from CarriCea T1 rootstock will be indistinguishable from those using other rootstock varieties."

Q: What is the regulatory status of BeneCea D1?
A: BeneCea D1, Soilcea's CRISPR-edited US-812 rootstock, is not registered but currently in the regulatory review process with the relevant regulatory agencies. Soilcea continues to work closely with regulators to support the review and authorization process.

Q: What is the consumer perception of CRISPR-edited citrus?
A: During two EPA public comment periods and one USDA public comment period, there were ZERO negative comments objecting to the approval of the CarriCea T1 rootstock, and there were a total of 64 positive comments.

Q: Who do I contact to reserve HLB resistant rootstocks?
A: Trees can be reserved by emailing yianni@soilcea.com or through Soilcea's website; soilcea.com, as well as with authorized nurseries such as Agromillora Florida, Brite Leaf Citrus Nursery, W.E. Green and Sons, Southern Citrus Nurseries, CitriSun, Propagations Unlimited, Phillip Rucks Nursery.

Q: How does CarriCea T1 work?
A: Huanglongbing (HLB) is spread by the Asian Citrus Psyllid, which transmits the bacterial pathogen *Candidatus* Liberibacter asiaticus (*C*Las). *C*Las secretes effector proteins that disrupt the citrus tree's natural cell death defense pathway by upregulating negative regulators (ACD2 and Lls1) and suppressing gene activity but not expression of another cell death and defense-related protein (PLCP).

The CarriCea T1 citrus plant resists *C*Las by targeting the effector interacting proteins–ACD2 and Lls1–preventing the suppression of the defense response and restoring proper cell death signaling. Additionally, interrupting the effector interacting protein–PLCP–prevents the suppression of the paralogous PLCP gene expression and activity in the plant, enhancing resistance and mitigating disease. These combined changes enable the tree to defend itself and reduce HLB infection. The CarriCea T1 started from a Carrizo citrange rootstock variety that is a hybrid of *Citrus sinensis* 'Washington' sweet orange X *Poncirus trifoliata*.

Q: How does BeneCea D1 work?
A: The BeneCea D1 citrus plant resists CLas by editing two HLB susceptibility genes to restore the tree's natural defense. The BeneCea D1 started from a US-812 rootstock variety that is a hybrid of *C. reticulata* 'Sunki' X *P. trifoliata* 'Benecke'

Q: Do CarriCea T1 and BeneCea D1 eliminate HLB?
A: No. CarriCea T1 is showing strong resistance to HLB, but not complete immunity. There is still *C*Las bacteria surviving in the CarriCea T1 rootstock, but at much lower levels than control trees (traditional trees). The BeneCea D1 has not been tested yet.

Q: What is the economic impact of HLB to growers?
A: Over the past two decades, orange yields per acre in Florida have declined by 84%, mirroring the spread of HLB. In the 2024-2025 season, only 167,400 bearing acres of oranges remain in Florida, with a projected production of 12.2 million boxes, an average of 72 boxes per acre (USDA-NASS, 2025). This represents a dramatic contraction from the 2003-2004 season, where 564,800 acres produced 242 million boxes, an average of 428 boxes per acre (FASS-USDA, 2007).

In addition to the per acre yield reduction, production costs have also increased due to HLB. The nominal cost increase to manage HLB is $995 per acre, and the real cost to manage HLB "in Florida is estimated to be $663 per acre, which represents a 67% increase compared to pre-HLB levels" (Singerman, 2019). Growers are spending $1,859.90 in production costs per acre (Singerman, 2022). Most of that increase is due to foliar sprays of pesticides and fertilizers, both of which have detrimental environmental effects (Singerman, 2022). That production cost compares to a revenue of $957.90 at $13.30 per box (USDA-NASS, 2025). On average, citrus growers are losing $902 per acre.

Q: Will CarriCea T1 replace pesticide applications?
A: CarriCea T1 may help reduce reliance on certain conventional pesticide applications, but it is not intended to eliminate pest management programs entirely. In Soilcea's initial field trial, our desire to spray less pesticides on the psyllids has led to damage from leaf miners, thrips, and citrus canker.

Q: What fruit quality should growers expect?

A: We have not confirmed. On a single-edited Carrizo rootstock topworked 19 months prior with a standard Valencia scion, we measured an average 8.2 °Brix at the end of January compared to the control average of 7. The fruit was picked before the January 2026 Winter Storm Gianna. Mature fruit was expected to see the Brix increase to approximately 10 to 11 for a tree that is less than 2 years old; According to Domingues et al. (2020), a Valencia fruit that had a 7.5 °Brix 3 months prior to being fully ripe had an 11.5 °Brix when fully ripe.

Q: Is CarriCea T1 compatible with commercial scion varieties?
A: Soilcea has grafted various combinations of popular commercial scions, including Valencia, Hamlin, Donaldson, W. Murcott, Roble, Ruby Red, Ray Ruby, Flame, and Rio Grapefruit, all of which successfully took.

Q: Are the CRISPR edits stable in the CarriCea T1?
A: Soilcea has completed whole-genome sequencing on the CarriCea T1 on multiple lines to ensure the stability of the edits. All Soilcea material is propagated via tissue culture resulting in plants that are clones of the original CarriCea T1 plant. We are working with our tissue-culture partners Agromillora and Agristarts to routinely reintroduce the CarriCea T1 material to ensure it remains true-to-type, but tissue culture can lead to somoclonal variations.

Q: Is CarriCea T1 the only variety Soilcea is developing?
A: No. CarriCea T1 is the first commercialized product in Soilcea's citrus innovation platform. The company has various HLB-resistant scion and rootstock varieties in the pipeline; notably the 'BeneCea D1', an HLB-resistant US-812 rootstock. Soilcea has developed additional CRISPR-edited scion and rootstock varieties that it is growing and continuing to test before releasing to citrus growers.

Q: Will future varieties target other citrus diseases besides HLB?
A: Soilcea continues to evaluate traits that may address key production challenges facing the industry. Future products may focus on disease management, environmental stress, tree productivity, and other grower priorities.

Q: How long has CarriCea T1 been evaluated?
A: CarriCea T1 has only been evaluated since June 2025. The single-edited Carrizo rootstocks have been in the field since June 2023. The CarriCea T1 will continue to be evaluated in field trials to assess performance, disease response, and horticultural characteristics.

Q: Will CarriCea T1 maintain its performance against HLB as trees mature?
A: Single and double edited plants with edits incorporated into Carricea T1 have been tested for 3 years. The data suggests performance against HLB will continue. But we do not know without additional years of data.

Q: When was CarriCea T1 approved for use?
A: The Environmental Protection Agency approved CarriCea T1 for pesticidal use in citrus group 10-10 in April of 2026 following two public comment periods in which CarriCea T1 received 54 positive comments from growers, other government agencies, and industry partners. Notably, the HLB-resistant variety did not receive any negative comments.

Q: Can nurseries or growers propagate CarriCea T1 or BeneCea D1 independently?
A: No, all propagation of CarriCea T1 must occur with Soilcea authorized nurseries.

Q: How will growers learn about new varieties as they become available?
A: Information will be shared through Soilcea communications, authorized nursery partners, industry meetings, grower events, and technical publications.

Q: Why did Soilcea choose CRISPR precision breeding instead of conventional breeding?
A: Conventional citrus breeding can take decades due to long generation times as well as little to no genetic variation in commercial varieties. CRISPR precision breeding allows researchers to target specific traits while maintaining the desirable characteristics of the original variety or rootstock growers already rely on.

Q: Does CarriCea T1 function similarly to conventional Carrizo varieties?
A: CarriCea T1 is functioning the same as traditional Carrizo in greenhouse settings without HLB pressure. In the field the CarriCea T1 is showing early significant results against HLB compared to control plants.

Q: What age should growers expect their CRISPR trees to yield commercially viable amounts of fruit?
A: We do not know. Early results indicate promising early growth and fruiting, but we do not have a fully-productive tree in the field. The January 2026 Winter Storm Gianna also significantly damaged our oldest trial site.

Q: Was the CarriCea T1 developed by the University of Florida?
A: No, The rootstock was developed by scientists at Soilcea using findings discovered by the University of Florida. Dr. Nian Wang's lab at UF identified potential targets in citrus to disrupt *C*Las effector proteins and restore the tree's natural defenses, and optimized CRISPR transformation methods for citrus. Soilcea exclusively licensed those technologies from UF. Soilcea then went to work. Over the next eight years, Soilcea explored hundreds of CRISPR targets, created thousands of CRISPR-edited trees, and tested those trees by reverse grafting them on HLB-infected trees. Promising trees were then tested through traditional grafting of HLB-infected budwood onto edited rootstocks, ACP inoculation of trees, and Florida field trials in ACP infested locations, with many

potential targets failing; yet this narrowed down our research to the best targets, eventually bringing together edits from the three most promising targets to develop a tree ready for growers: a CRISPR-edited Carrizo rootstock—CarriCea T1—that resists *C*Las by targeting the effector interacting proteins to restore the natural plant defense of citrus.

Q: What rights does Soilcea have to University of Florida citrus CRISPR research?
A: Soilcea has an exclusive license with the University of Florida for patents and know-how regarding canker and HLB target susceptibility genes and citrus CRISPR transformation methods.

Q: What rights does Soilcea have to use the CRISPR technology?
A: Soilcea has a license with the Broad Institute for rights to use the underlying CRISPR technology in citrus.

Q: Does Soilcea collaborate with University researchers?
Soilcea believes that research partnerships are a central component of the company's strategy. Current collaborations include the University of Florida, Texas A&M University, and the Carnegie Institution at Stanford. These collaborations are essential for advancing research, improving the technology, and facilitating the deployment of resistant citrus trees in commercial production systems.