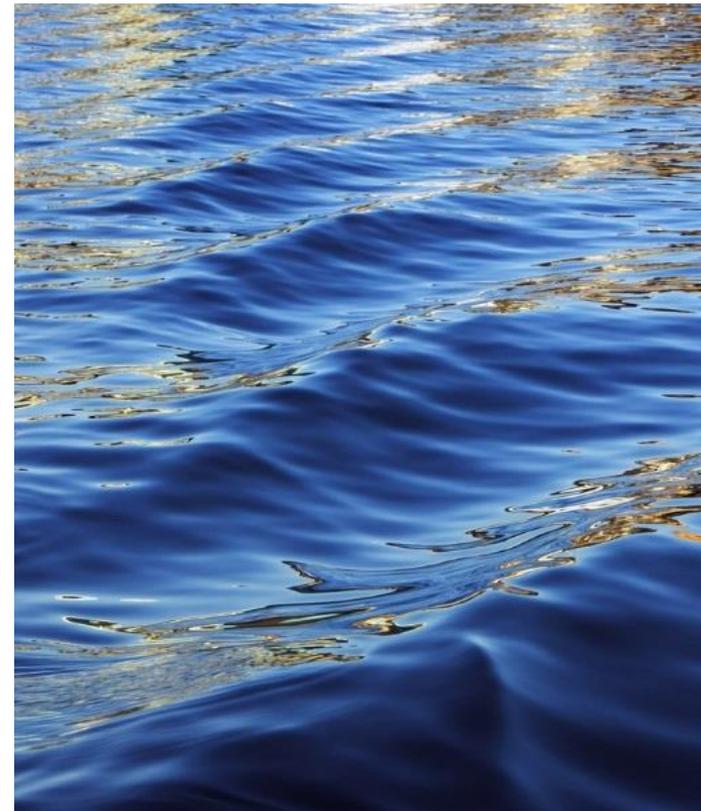




BEYOND SUSTAINABILITY

A BETTER WAY



INTRODUCTION

CAN WE HUMANS CHANGE
(FOR THE BETTER),
THE COURSE OF NATURE, THROUGH THE
USE OF MODERN SCIENCE AND
TECHNOLOGY?

I BELIEVE THE ANSWER TO THAT QUESTION IS **YES**, and in the following slides I will show you why I have come to that conclusion.

A MORE BIODIVERSE WORLD



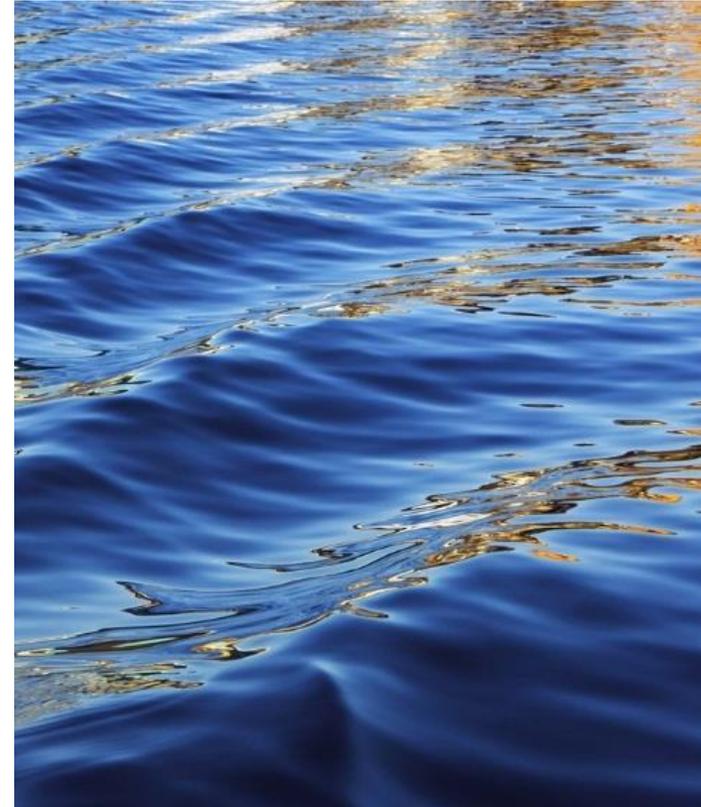
DEFINITIONS

- **SUSTAINABILITY** – using a **RESOURCE** so that the resource is not depleted or permanently damaged. In other words, “Do No Harm”.
- **RESOURCES** – Fertile Soil, Potable Water, Clean Breathable Air and Life Sustaining Climate.



FERTILE SOIL

Recapturing Desert Soil



DESERTIFICATION

- **THIRTY (30) MILLION ACRES** per year of Fertile Land is lost to droughts, increasing water scarcity and poor farming practices.
- Earth is made up of **79% water mass** and **21% land mass**.
- **33%** of earth's land mass is made up of what is classified as desert (approximately **15 – 16 billion acres**).
- Deserts encompass **5.5 billion acres** on earth excluding the north and south poles.
- At the current desertification rate, we will add one (**1**) billion acres of desert every thirty-three (**33**) years.

THIS IS NOT SUSTAINABLE



HOW CAN WE CHANGE THE ABOVE DYNAMIC

- Rotate crops more often in marginal areas to recharge the soils.
- Reduce farming in marginal areas.
- Reduce population growth in marginal areas.
- Don't over graze grasslands.
- Grow trees as wind shields to protect against erosion.
- Introduce clay into marginal/desert soils (using standard practices takes 7 to 15 years on a good sized piece of property).
- Encourage private capital and governments to invest in science/technology to recapture marginal lands and deserts.

DESERT CONTROL

This private company founded in 2017 in Norway has invented and patented a way to convert desert sands into productive land. In 2010 they demonstrated that through their use of **NANO-TECHNOLOGY** they could grow crops that used 50% less water and produced 500% more crop load than previously produced on the same land. One application of their nano-clay, suspended in water and spread over the surface acreage would penetrate to a depth of 40 to 60 centimeters. This one application turns sand that runs through your fingers into clay that you can shape into apple sized balls and last 5 + years even on land that is tilled annually.

From 2010 to 2017 the scientific community would not sign off on their invention, even though they continually demonstrated that it worked. Simply because Desert Control could not explain why it worked. As such they could not get sufficient capital to grow their business. However, in 2017 they had their NIRVANA moment. They discovered their NANO-CLAY promoted and sustained the growth of a FUNGUS that for more than 450 million years formed a symbiotic relationship with plants. This fungus is believed to be the single reason plants were able to evolve from the oceans to dry land. This fungus is **Mycorrhizal fungi**. After that realization scientists signed off and they raised \$87,000,000 in a public offering. They have their first US trials in Yuma, Arizona and all reports are, everything is working as promised.



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DESERT CONTROL – APPLICATION – 2022 AWARD



MYCORRHIZAL FUNGI

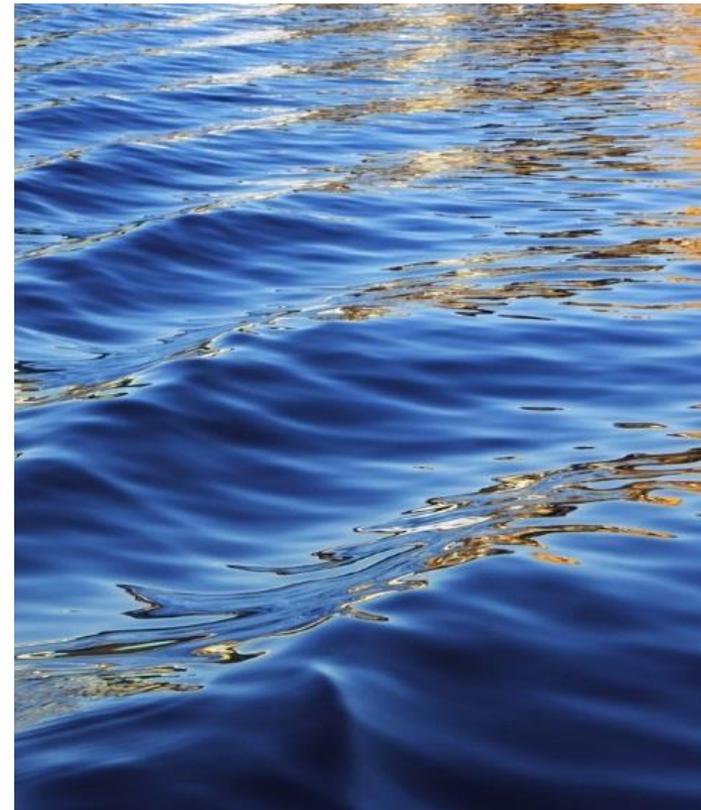


- Mycorrhizal – “Myco” meaning fungi – Rhizae meaning root.
- Mycorrhizal (MCR) at one time covered 80 % of land mass.
- MCR forms a symbiotic relationship with 80% of all plant life through the plant’s roots. There are between 170 and 200 varieties of MCR.
- To survive, MCR get carbohydrates and other compounds excreted from living plant roots. In exchange, MCR assists plants in ways such as increasing nutrient and water uptake, especially the mineral nutrient phosphorus.
- Plants with MCR grow bigger and faster and require less watering and fewer applications of nutrients.
- MCR protects plants from soil born pathogens and establishes a network that forms almost a carpet of inter-connected hyphae. This interconnection allows the connected plants to become aware of attacks from pathogens on other plants in the network.
- MCR are responsible for holding up to 36% of fossil fuel emissions below ground – more than China emits each year. The process of carbon sequestration by MCR involves the transfer of carbon from the plants to the fungus, which then stores it in the soil.



POTABLE WATER

CREATING WATER FROM THE AIR AND THE SEA



A DESERT AQUIDUCT

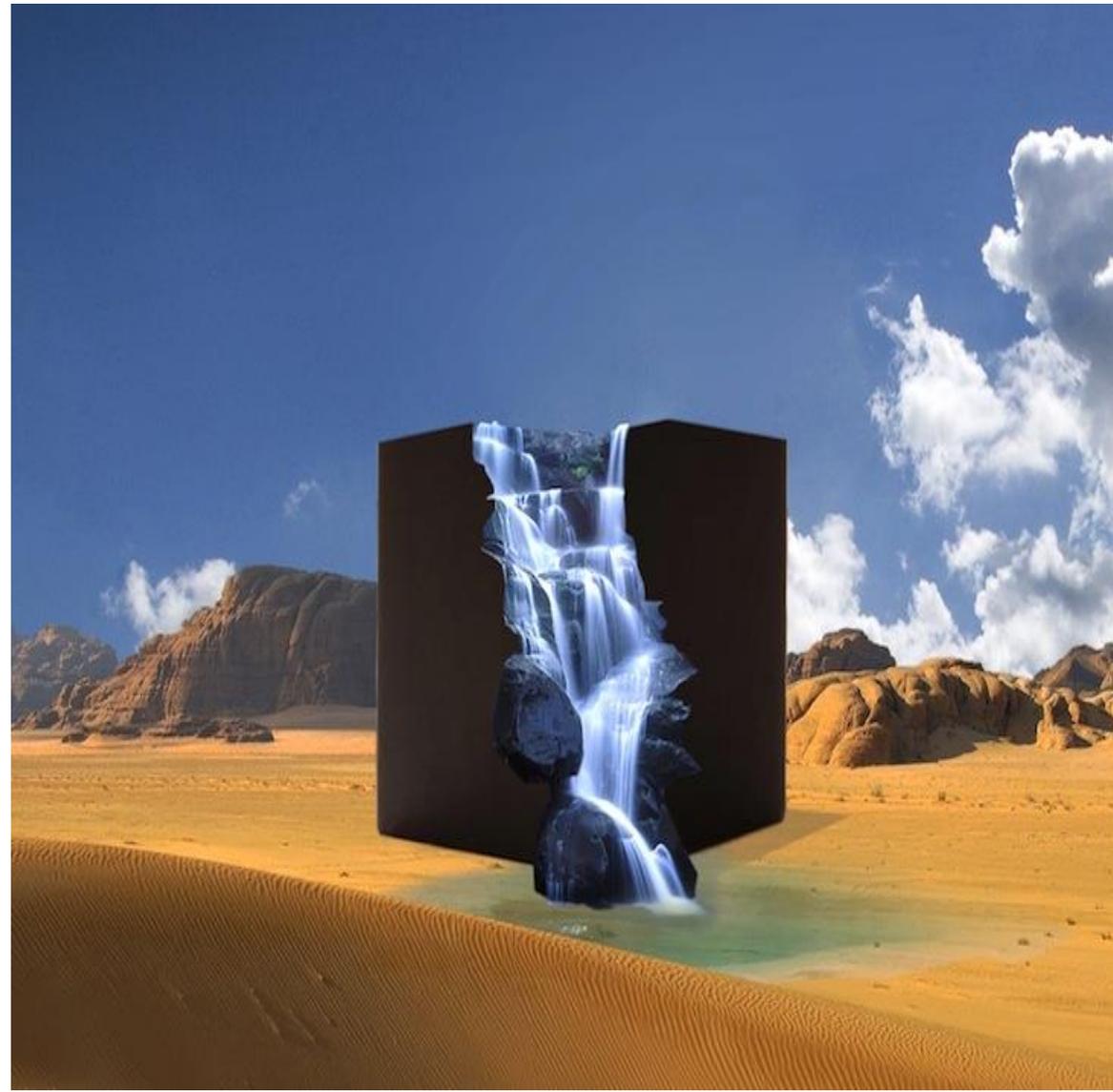


CREATING WATER FROM THE AIR AND THE SEA

If we are successful in transforming deserts to lush grasslands, fertile farmlands, groves, orchards and forests. Where do we get the water?

- Deserts are too hot to have rain but there is moisture in the air and technical solutions are being developed.
- There is a company called “SunGlacier Technologies” that has created an affordable condensation solution to create water from the air using the sun and battery storage to operate it.
- This patent pending technology is called “DROPLER” and their current 20 foot portable solar driven unit can produce 1200 liters of water per day.
- In coastal deserts there is fog that can be captured and turned into water. One such installation on the Canary Islands is capable of producing over one million liters of water per year.
- There are several promising new technologies emerging in the desalination of seawater. These include **Forward Osmosis, Carbon Nanotube Membranes, Graphite Oxide Membrane, and Biomimetics Reverse Osmosis.** The world is currently producing 100 billion liters of water per day from desalination. It is estimated we can reduce the cost of fresh water production from seawater by up to 60% by the year 2030.





SUNGLAZIER – DUBAI 2022



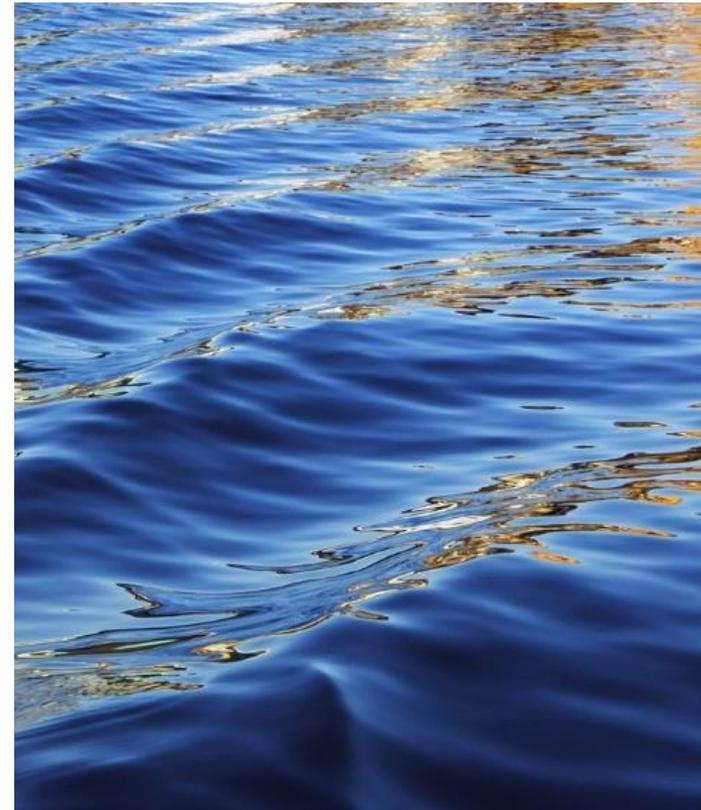
FOG NETS – CANARY ISLANDS





CLEAN BREATHABLE AIR

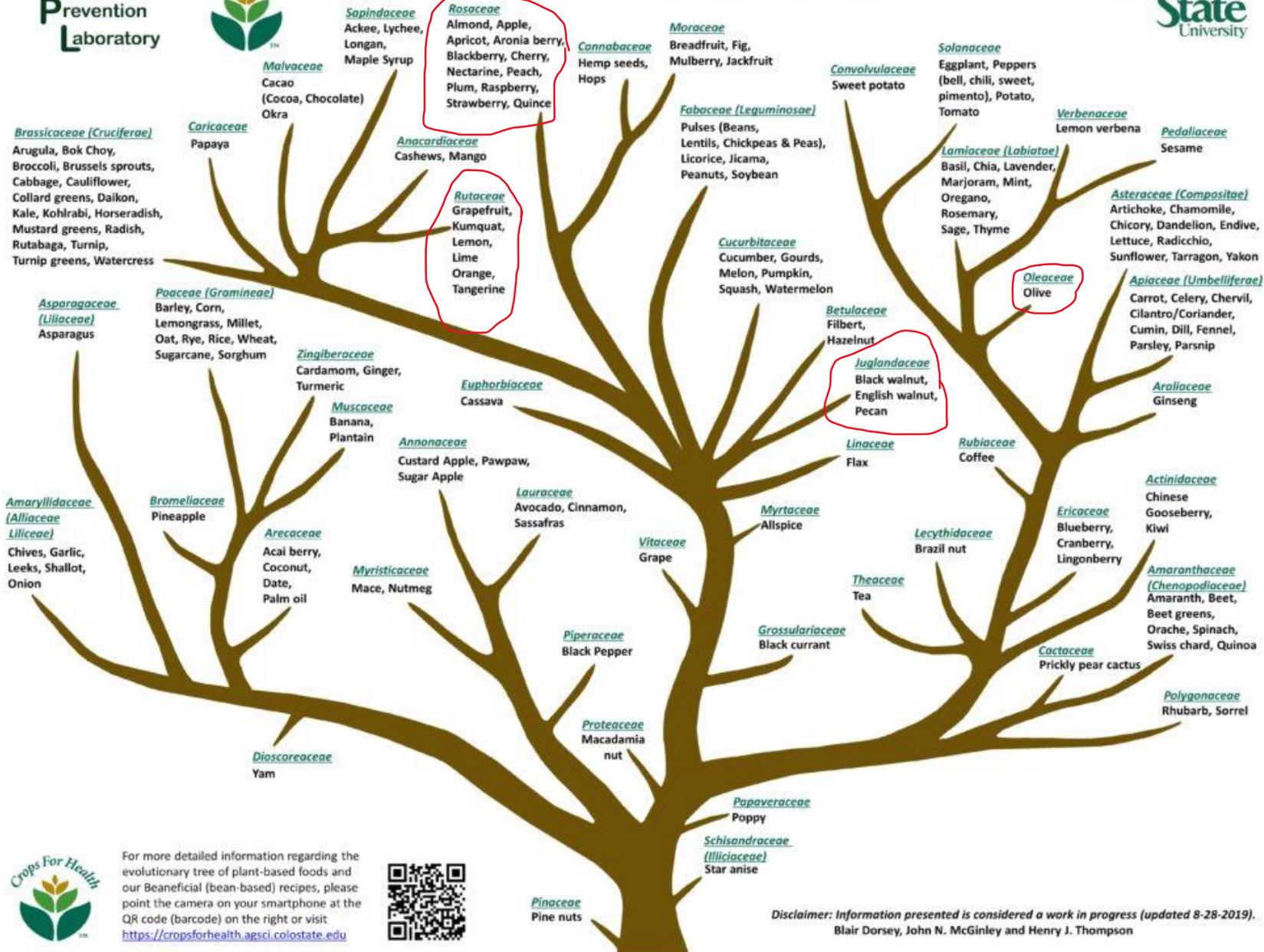
THROUGH PHOTOSYNTHESIS PLANTS ABSORB
CARBON AND PRODUCE OXYGEN. TREES COVER 30%
OF LAND, PRODUCE 15% OF OUR OXYGEN AND STORE
45% OF CARBON



TREES

- TREES – more specifically fruit and nut trees are my area of interest because not only do they aid in producing **CLEAN BREATHABLE AIR**, but they also produce **HIGHLY NUTRITIOUS FOOD**.
- Fruit and Nut Trees can be bred to be more productive and more sustainable.
- More productive by its very nature is more sustainable because you need fewer trees to produce the same quantity of crops.
- Breeding trees that need less water, require no chemical herbicides & fungicides, produces fruit with longer shelf life/that don't brown and harvest easier are sustainable traits.
- **TRADITIONAL BREEDING TAKES TOO LONG, COSTS TOO MUCH AND IS EXTREMELY RISKY.**

Evolutionary Tree of Plant-Based Foods



For more detailed information regarding the evolutionary tree of plant-based foods and our Beneficial (bean-based) recipes, please point the camera on your smartphone at the QR code (barcode) on the right or visit <https://cropsforhealth.agsci.colostate.edu>

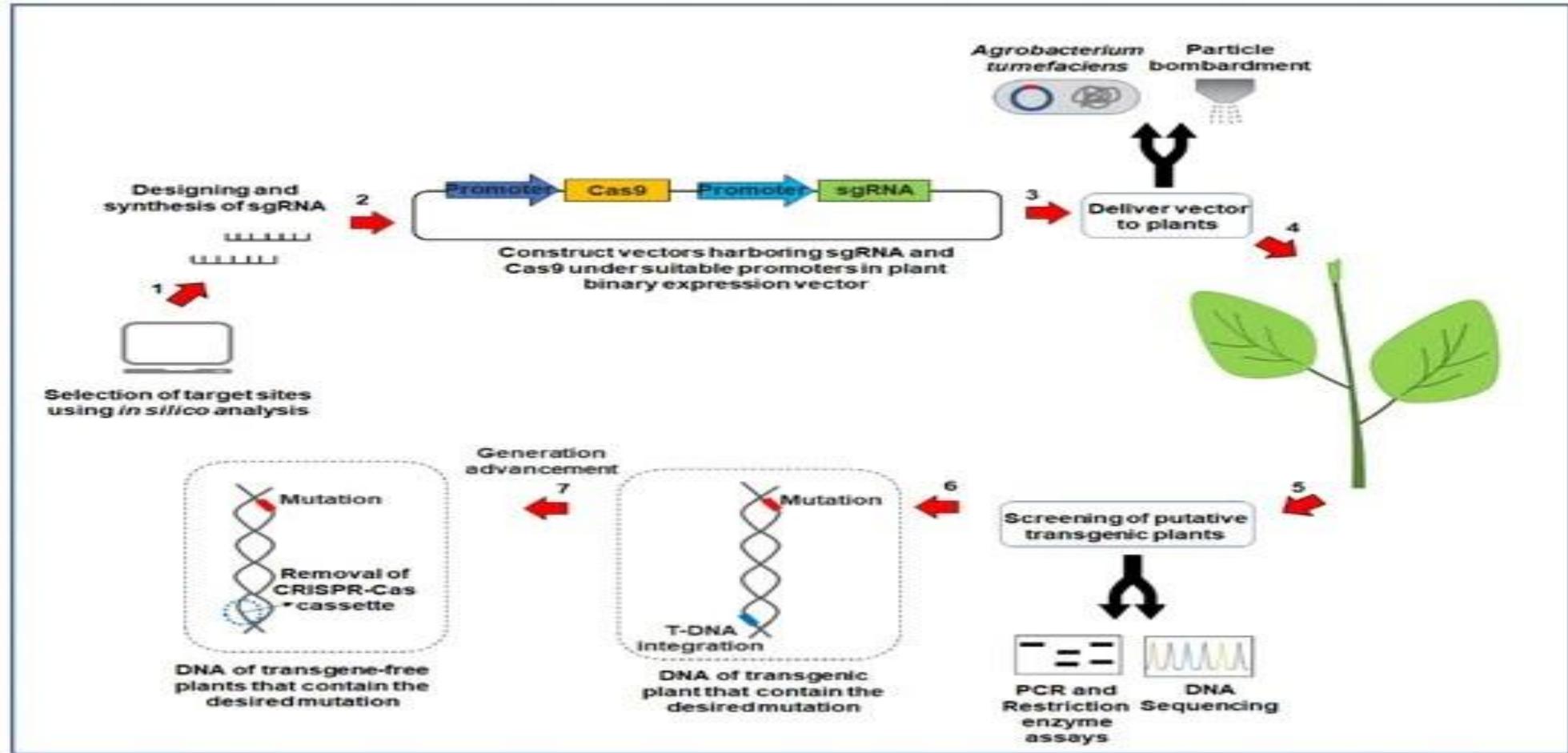


Disclaimer: Information presented is considered a work in progress (updated 8-28-2019). Blair Dorsey, John N. McGinley and Henry J. Thompson

BREEDING'S FUTURE – FROM THE FIELD TO THE LABORATORY

- The Future is Now: Gene Enhancement
 1. Select a variety of fruit tree that is highly prized in the market but, has one flaw that if changed would make it even more valuable; say an apple variety that browns too quickly after being sliced open.
 2. Find another variety of apple that does not brown as easily or at all.
 3. Map the DNA of both apples and locate the area in the DNA that controls browning through a comparison of the two varieties.
 4. Find an appropriate guide RNA to guide the CAS9 into a single cell of the first apple to the appropriate site and prune away the portion of that Marker causing browning. Repeat until desired quantity of enhanced specimens is achieved.
 5. Remove the guide RNA and regenerate trees from the cells Enhanced.
 6. Sequence the DNA of the new trees to make certain the DNA is exactly the same with the exception of the Enhancement and that no foreign DNA exists (Non-GMO).
- **TO DATE THIS HAS NOT HAPPENED** (The breeder was not able to remove the guide RNA), **HOWEVER GMO APPLES HAVE BEEN APPROVED BY THE USDA THAT DO NOT BROWN WHEN CUT. HOWEVER, THEY MUST BE LABELED "GMO"**.
- **WITHIN THE NEXT TWO YEARS THE ABOVE NON-GMO PROCESS WILL BE PROVEN AND NEWLY CREATED VARIETIES WILL HIT THE MARKET SHORTLY THEREAFTER.**

CRISPR CAS₉ – GENE ENHANCEMENT



TRANSGENE FREE APPLE





IMAGINE ALL THE ENHANCEMENTS ACHIEVABLE

WE CAN GO BEYOND SUSTAINABILITY

