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FOOD PHREAKING

ISSUE 01

A CULINARY COMPENDIUM OF CURIOUS BOTANICAL FRUIT CULTIVARS

THE CENTER FOR GENOMIC GASTRONOMY

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INTRODUCTION

FOOD PHREAKING ISSUE 01: A CULINARY COMPENDIUM OF CURIOUS BOTANICAL FRUIT CULTIVARS

This publication is a collection of stories that might be useful to Food Phreakers. Who are Food Phreakers? They are individuals and groups interested in experimenting with human food systems at multiple scales. Food Phreakers believe that food culture should be free, open and accessible. Some Food Phreakers have professional skills as farmers, seed savers, chefs, biohackers and food scientists. Others tinker in their backyards, basements, kitchens or home labs. The Food Phreaking journal aims to connect foodies who care about sustainability with the scientists and hackers who care about open culture. Food Phreaking is where food, technology, and open culture meet.

In this first issue, we examine a range of botanical fruit cultivars that have been manipulated by human food cultures. Wild plants, ancestors to our domesticated varieties, make up a very small percentage of what humans eat. Most of the animals and

plants that we eat are domesticated and cultivated. For example, some of the fruit cultivars featured in this publication have been selectively bred to be larger or sweeter than their crop wild relative. Other cultivars have been genetically modified for pest resistance or herbicide tolerance. Each entry in this issue describes a specific cultivar or variety of botanical fruit that exhibits certain agricultural or culinary traits preferable to humans. Collectively, these examples demonstrate how organisms and environments are manipulated to suit human needs and desires.

It can also be said that organisms and environments manipulate us humans. For example, in the tropics breadfruit has become a staple food because it provides cheap calories, despite the fact that many eaters initially dislike the taste and struggle to cook with it. Similarly, large agricultural regions and entire countries transition to monocultures in order to create uniformity and efficiency, at the expense of resilience and biodiversity. Other times plants are chosen for the color of their flowers or taste of their fruits. Our very human desires for beauty, profit and predictability can lead us to propagate one species or cultivar over another.

Breeders, farmers, eaters, chefs, governments and companies are all agents of selection, whose preferences and habits contribute to the cultivars that are observable across the planet's agricultural lands. These cultivars are given multiple names, from the scientific to the colloquial. In this book we have primarily used English common names or corporate trademarks to identify a fruit cultivar, but many of these fruit cultivars are known by additional names around the world.

For this first issue we decided to focus on botanical fruits, because they account for a large portion of the food that is grown in the world. Botanical fruits include most of the world's major grain crops as well as colorful fruits like apples and mangoes that have extensive cultural and symbolic meaning. But who gets to decide what changes are made in a single species of botanical fruit such as apple, corn, mango or rice?

Food Phreaking Issue 01 is intended to help amateur readers, who are not involved in agronomy, agribusiness or the food industry, familiarize themselves with some of the technical aspects of agricultural biodiversity.

At the Center for Genomic Gastronomy, we anticipate a future where the ability to manipulate the phenotypical traits of fruits is rapid, easy and widely available. We believe that during the 21st century, many chefs,

home cooks and eaters will become knowledgeable about and motivated to experiment with a wider range of fruit cultivars than they experience today. In 2035, testing a new cultivar might be as easy as loading an app on your smart phone is today. But plants still need time to grow. Fad cultivars will come in and out of fashion on a seasonal basis, similar to clothing, and the environment these plants are nurtured in will have a huge impact on their agricultural and gastronomic suitability. So far, developments in agricultural biotechnology have resulted in the reduction of biodiversity. If emerging biotechnologies become more accessible, will we see the opposite trend?

Food Phreaking is the journal of experiments, exploits and explorations of the human food system. We hope you use this survey of botanical fruits as a starting point to understand past and present fruit cultivars, and to imagine a range of potential food futures.

FRUITS

ARCTIC®APPLES

Okanagan Specialty Fruits Inc. is currently seeking approval in the US and Canada to sell genetically engineered apples that will not brown as a result of bruising, cutting, biting, juicing or baking. Licensed gene silencing technology is used to prevent browning by inhibiting the expression of polyphenol oxidase (PPO), a technique initially developed by Australian researchers developing non-browning in potatoes. Four existing cultivars of apples, Golden Delicious, Granny Smith, Fuji, and Gala, have been modified to have eternally-white flesh and are expected to be sold as trademarked Arctic® apples.

According to president Neal Carter, Okanagan chose the name "Arctic" because: "Like the snow-driven landscape for which they are named, the flesh of Arctic® apples remains pristine and unspoiled," and says that, "An apple brown betty might now be better described as an 'apple no-brown betty.'"

#ColorBlindCuisine
#CulinaryDermatology
#SnowWhiteAndTheSevenTransgenes

BELLAFINA™ BELL PEPPER

These “snack-size” peppers are one-third of the size and “one-third the cost” of other commercial bell pepper varieties. Sold in plastic wrapped packs, BellaFina™ peppers are designed to replace traditional bell peppers, which are too large for many home cooks to use completely in one recipe. The company believes that selling smaller fruits might eliminate the waste of unused pepper portions, which inevitably go brown in the fridge and are thrown out.

Emerging techniques in genome sequencing, including allele analysis of juvnile plants and seeds, improve the ability of plant breeders to achieve desired traits without using transgenic techniques, allowing Monsanto (via its wholly-owned subsidiary Seminis) to get its vegetables onto the plates of even GMO-averse consumers.

SELECTIVELY BRED FOR SMALLER SIZE

#Capsicumpanionship
#LonelinessIsASmallFruit
#UserCenteredBreeding

BRS-PARA AÇAÍ

Native to swamp and floodplain areas of Central and South America, the açaí palm tree produces small, round and tart black-purple berries that can be processed into a juice, which proponents claim to be high in anti-oxidants and other nutrients. The BRS-Para cultivar of the açaí palm tree was developed by the Brazilian government to maximize the productivity of the fruit.

After the açaí berry's health benefits were touted by guest "doctors" on the Oprah Winfrey show in 2004, it became a popular health supplement for weight loss, reversal of diabetes, increased penis size, raised energy levels, anti-aging, and other benefits. Many of these claims, however, are unsupported by scientific evidence.

The growing US demand for açaí-related products has caused a sharp increase in its wholesale price. This health-hype marketing cycle makes açaí (and other ingredients like quinoa) unaffordable for those who have eaten them as staple foods for centuries.

#ExoticNostrum
#FruityFad
#KaleTodayAcaiTomorrow

SELECTIVELY BRED FOR IMPROVED FRUIT AND PALMS

BT BRINJAL

Bt brinjal is a suite of transgenic brinjals (aka aubergines or eggplants) created by inserting a crystal protein gene (Cry1Ac) from the soil bacterium *Bacillus thuringiensis* into the genome of various brinjal cultivars. Unlike many other commercial transgenic crops, Bt brinjal has been developed as a suite of fruits, reflecting the huge diversity in brinjal size, shape, color and culinary use.

Mahyco, a Monsanto subsidiary, has attempted to introduce Bt brinjal for sale in India, but in 2010, public protests focusing on human and environmental health, loss of biodiversity, corporate control and intellectual property, convinced India's Environment Minister to put a moratorium on the immediate release of Bt brinjal. While there continue to be legal disputes about local cultivars and foreign technology in India (the world's second largest brinjal producer), its neighbor, Bangladesh, has recently introduced four varieties of Bt brinjal for commercial cultivation.

#BiodiversityOfTheKitchen
#GuardYourGermplasm
#MahycoAway

CISGENIC GALA APPLE

After years of attempting to introduce scab resistance into the world's second most ubiquitous apple variety (Gala), Dutch breeders employed a technique they dubbed "cisgenesis," which uses the same methods as "transgenesis" (GMO technology) but targets genes that already exist in wild plant relatives (and thus could be conceivably—though not conveniently—selected using conventional breeding techniques).

European and North American regulators are currently deciding on the official classification of cisgenically-produced food products in relation to conventional and transgenic crops. Adding a layer of confusion to the proceedings, the term "cisgenesis" was coined and promoted by the think tank named Cisgenesis. Is cisgenesis an essential breeding technique, or just a way of skirting around the public's fear and the legal barriers to growing transgenic cultivars?

#FamilyAffair
#OldCiderNewBottle
#NoScabScandal

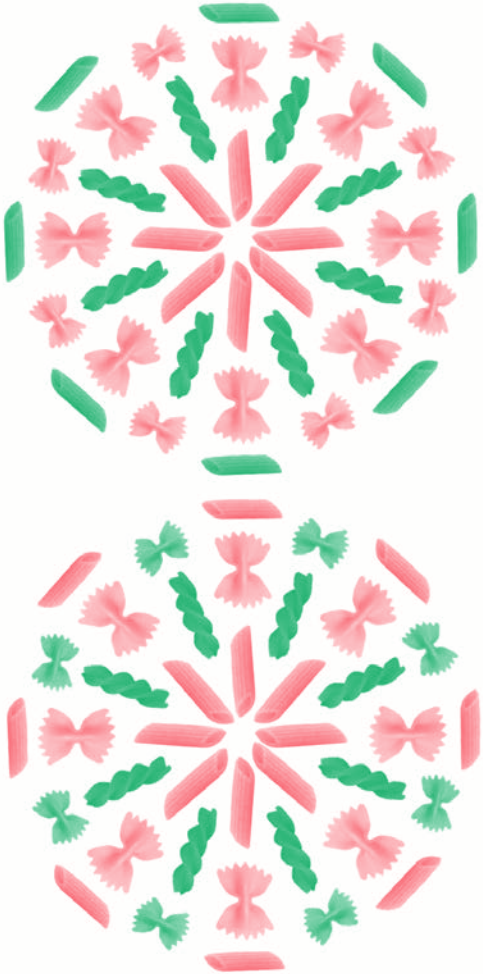
CORN (VARIOUS GM)

In 2013, six Chinese citizens were indicted in Iowa on charges of plotting to steal GM seeds from Monsanto, DuPont and AgReliant Genetics. Mo Hailong, a Director at Beijing Dabeinong Technology Group, was arrested after being spotted on his knees, digging in an Iowa cornfield.

Seeds can be stolen in a number of ways: transplanting seedlings before they germinate, obtaining ears of corn, selfing a hybrid, laboratory analysis, and employee leaks. Companies attempt to prevent theft of corn germplasm by delivering seed close to planting time in unmarked bags and not telling contract growers what they are growing.

The indictment claims that three of the defendants attempted to ship 250 lbs of corn seed, packaged in ziplock bags, from Illinois to Hong Kong. On another occasion, a defendant attempted to smuggle corn seed on a flight by concealing it in 100 SUBWAY® napkins within two boxes of Orville Redenbacher brand microwave popcorn.

#LeakedLibertyLink
#SomebodyCallTheCobs
#WhiteCollarRedHanded



DURUM WHEAT

Durum wheat is one of the most well-known and important historical examples of genomic gastronomy. Although it was selectively bred from the domesticated Emmer wheat thous-ands of years ago, it is the only tetraploid wheat species of commercial importance today. Durum is a protein-rich and low-gluten wheat variety, making it particularly well suited for culinary uses such as pasta, and less useful for most kinds of bread production.

Although durum wheat has to be kneaded for a long time to make pasta, a suite of machines have reduced the amount of human labor required, making dried pasta easy to store and transport. As global demand for pasta increases, durum wheat is becoming a hot investment for agricultural and life sciences companies. Recently, a leading Italian durum wheat seed company was acquired by Syngenta, the Swiss-owned global agribusiness.

#AnythingsPastable
#BreedItThenEatIt
#NoodleSheWrote

SELECTIVELY BRED FOR HIGH PROTEIN CONTENT

FISH TOMATO

The Fish Tomato was a transgenic tomato created by the insertion of an antifreeze gene (afa3) isolated from the Winter Flounder, with the aim of increasing the tomato's tolerance to frost. Although never commercially released, DNA Plant Technology grew the tomato in the lab, and applied for a field test permit to grow it in Contra Costa County, California. The so-called "Fish Tomato" became an icon of the 1990s debate over genetically modified food. The combination of genes from different species managed to upset the political right, left, Christians, greens and even the British Royal Family.

However, the Fish Tomato was soon forgotten by the public, along with DNA Plant Technology's other disasters like its butterless popcorn and its federal indictment for illegally exporting genetically engineered, high-nicotine tobacco seeds to Brazil. No one seems to know if Fish Tomato germplasm or any data collected about it are still in existence.

#FishyARoma
#GMOsMakeStrangeBedfellows
#NoDataNoScience

GHOST CHILLI

The ghost chilli, grown in South Asia, was considered the world's spiciest chilli pepper until 2012, when it was superseded by the Scorpion and Carolina Reaper peppers. Although, the spiciness of an individual fruit is dependent on environmental conditions, temperature, and precipitation, some ghost chillis have been measured at one million Scoville heat units.

Not just for eating, this pepper is smeared on fences or incorporated into smoke bombs in Northeastern India as a method for keeping out wild elephant populations. Scientists at India's Defence Research and Development Organisation plan to use the peppers as an ingredient in non-lethal hand grenades and pepper spray. Despite its spiciness, the pepper is still regularly used in both everyday and competitive eating scenarios.

#DARPAdoesDinner
#FireInTheHole
#HotHeadThinSkinHauntedBowels

CROSSBRED FOR INCREASED CAPSAICIN CONCENTRATION

GROS MICHEL BANANA

From the late 19th century until after World War II, Gros Michel was the only banana cultivar grown for export to the US. At the height of production, a few corporations maintained extensive plantations of this seedless, human-propagated clone. With assistance from the US government, they exerted a destabilizing (often brutal) influence over Honduras, Guatemala, and other countries. These countries came to be known as "banana republics," a term coined in 1904 by the American writer O. Henry.

In the 1950s, a fungus called Panama disease wiped out most of the world's Gros Michel banana crop, forcing producers to switch to a new cultivar, the Cavendish, which now accounts for 95% of banana exports, in an industry worth billions of dollars. New strains of Panama disease are threatening the Cavendish, prompting more research in genetic modification for disease resistance, which may ultimately give Gros Michel a new lease on life.

#GrosNegligence
#MonoculturalSuicide
#YesWeStillHaveBananas

HADEN MANGO

In Coconut Grove, Florida, growing among a grove of trees they planted in 1902, the Haden family noticed a mango tree with exceptionally colorful and tasty fruit. State officials and breeders began propagating it almost immediately, and large-scale commercial breeding soon followed in Florida, Hawaii, Honduras, and Australia.

In the 1950s, a new tree grown from Haden seed produced a distinctly purple-hued mango with good fungus resistance and a long shelf life. Its grower, Thomas Atkins, submitted the fruit to the Florida Mango Forum, but it was repeatedly rejected for its fibrousness and relatively unremarkable taste. Undeterred, Atkins succeeded in marketing his variety to commercial growers who appreciated the fruit's resilience in transportation and handling. Today, the Tommy Atkins mango is the most extensively planted commercial mango in the Americas. The Haden variety is still common in nurseries for home growing.

#FruitsFloridaFolksFind
#PersistentMediocrity
#TasteVsTravel

HEINZ 1706 TOMATO

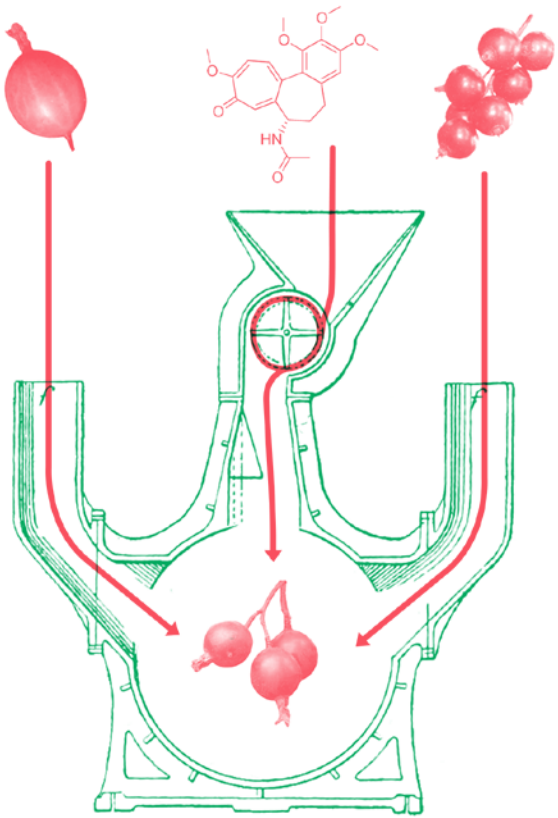
In 2012, the International Tomato Genome Sequencing Project announced they had sequenced *Solanum pimpinellifolium*, the tomato's closest wild relative, and the Heinz H1706, the tomato used in Heinz Ketchup

In the 1960s, Charlie John developed the H1706, an open-pollinated variety, by combining the commercial Fireball, Roma, VR Moscow, Burgess Crackproof and ES25 varieties at a Heinz research facility.

How will sequencing the ketchup tomato genome affect future flavors? Scientist Jim Giovannoni says, "Plant breeders have had more success breeding tomatoes with features of interest to producers, like long shelf life, than with the traits that matter to consumers, like taste and quality...The tomato genome sequence may help redress the balance, since plant breeders can now rely on DNA as well as physical traits to govern their breeding programs."

#57VarietiesAndASaladAintOne
#AGoodIdeaInHeinzSight
#NotAFruitOrVegetableButASauce

INBRED FOR MACHINE HARVESTING, CRACK RESISTANCE AND VISCOSITY



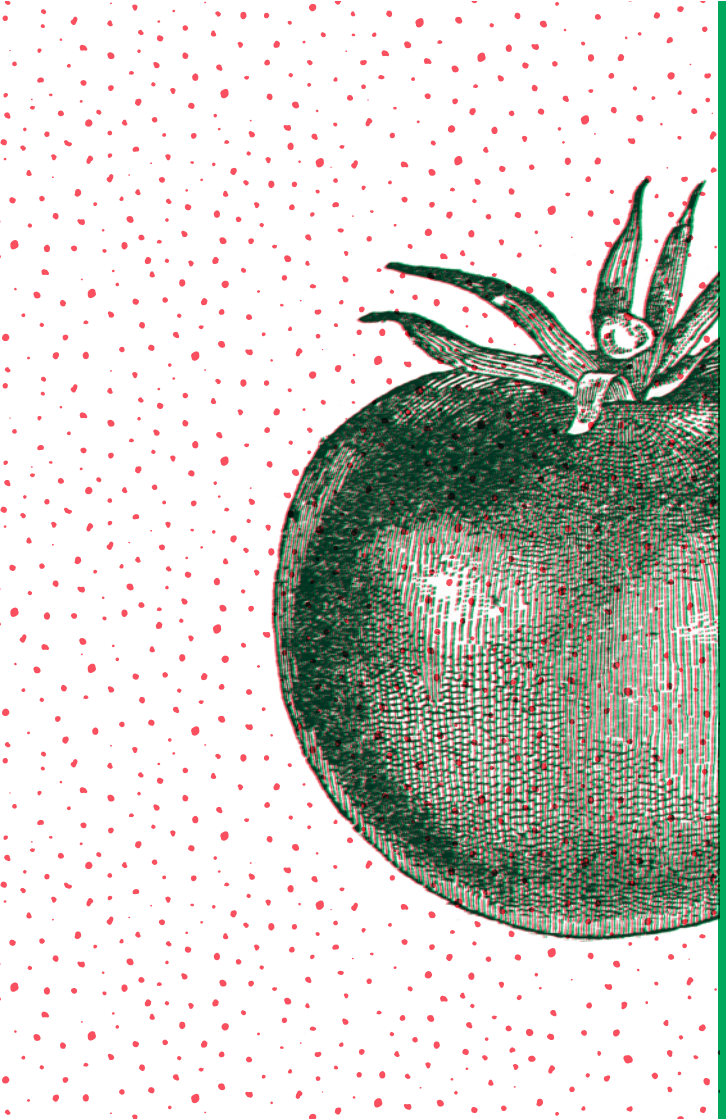
JOSTABERRY

European breeders wanted to cross gooseberries and currants for years. Although they are both members of the genus Ribes, their evolutionary distance meant that their chromosomes could not fuse or form viable gametes. The hybrids yielded variety, but their seeds were always sterile.

In 1946, the Berlin-based breeder, Rudolf Bauer, started treating sterile hybrids with a solution of colchicine, an alkaloid derived from autumn crocus. Colchicine inhibits spindle formation during mitosis, causing chromosome doubling without dividing the cell. Chromosomes can then bind with their exact duplicates, and eventually spur the development of a viable plant.

The hybrid-of-a-hybrid jostaberry spread across Europe and North America, but it never achieved widespread appeal. The berries have an interesting quality however, they start out tasting like gooseberries, and as they ripen, they begin to taste like black currants.

#CutAndPasteTraits
#FailedCeleberry
#FromSterileBerryToVeryViable



KUMATO® TOMATO

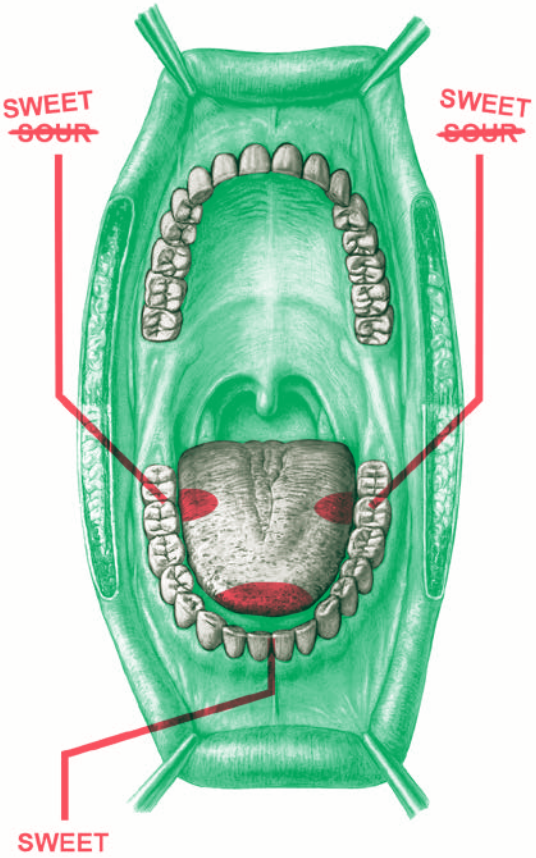
The genuine Kumato® cultivar was developed by Louis Ortega Fernández, a Spanish grower working for Syngenta Seeds Europe. As a young farmer, Fernández set himself a personal challenge: to grow a tomato with an authentic and intense flavor that was a different color.

The result: highly profitable hybrid seeds of the Kumato®, which are patented and cannot be purchased by the public.

The cultivar is also regulated through a strictly controlled "growing club" system. Syngenta maintains ownership throughout the entire value chain—from breeding to marketing—selling seeds to selected growers who agree to follow specified cultivation protocols and pay licensing and royalty fees. Kumato® tomatoes are grown in greenhouses in Spain, France, Belgium, the Netherlands, Switzerland, Greece, Turkey, Canada and Australia. "Welcome to a world of sensations all the year round."

#GeneticFranchising
#OwnTheRainbow
#YouSayKumatoISayCorporateLawyer

SELECTIVELY BRED FOR SWEETNESS AND DARK COLOR



MIRACLE BERRY

The miracle berry comes from a shrub native to tropical West Africa where, in 1725, European explorer Chevalier des Marchais noticed that local people chewed the shrub's berries before meals. The berry contains miraculin, a protein that binds to receptors on the tongue, causing sour foods to taste sweet.

Attempts to commercialize the fruit's sweetening effects in the 1970s ultimately failed when it was classified as a food additive, subjecting it to rigorous testing. Widespread speculation holds that the sugar industry sabotaged the project, fearing a competing "sweetener."

Since then, the berry has achieved a kind of countercultural status, gaining popularity through recreational use during "flavor-tripping parties," where participants take freeze-dried, powdered miracle berry pills and then consume sour and bitter foods, such as lemons, pickles, and beer, in order to experience the "miraculous" changes in taste.

#CookTheEaterNotTheFood
#PutSomeNonSugarOnMyTongue
#SugarLobbyGoneSour

MIRACLE RICE

IR8 (also known as “Miracle Rice”) is a cultivar developed by the International Rice Research Institute which identified the rice semidwarf gene (sd1). The high yields of IR8 required the use of fertilizers and pesticides, but produced substantially higher yields than the traditional cultivars, helping to avert food crises predicted in Asia from the 1960s - 1990s. India went from the verge of a mass famine to becoming one of the world’s largest rice producers, exporting millions of tons of rice each year.

The global adoption of IR8 and its hybridized progeny (IR36, IR64, IR72) was part of the Green Revolution, which led to massive increases in grain yields, use of pesticides, synthetic fertilizers, and irrigation infrastructure, but had the negative effects of reduced crop diversity and loss of fish & frog habitat. In the face of new and different global challenges, the tenants of the Green Revolution are being reexamined.

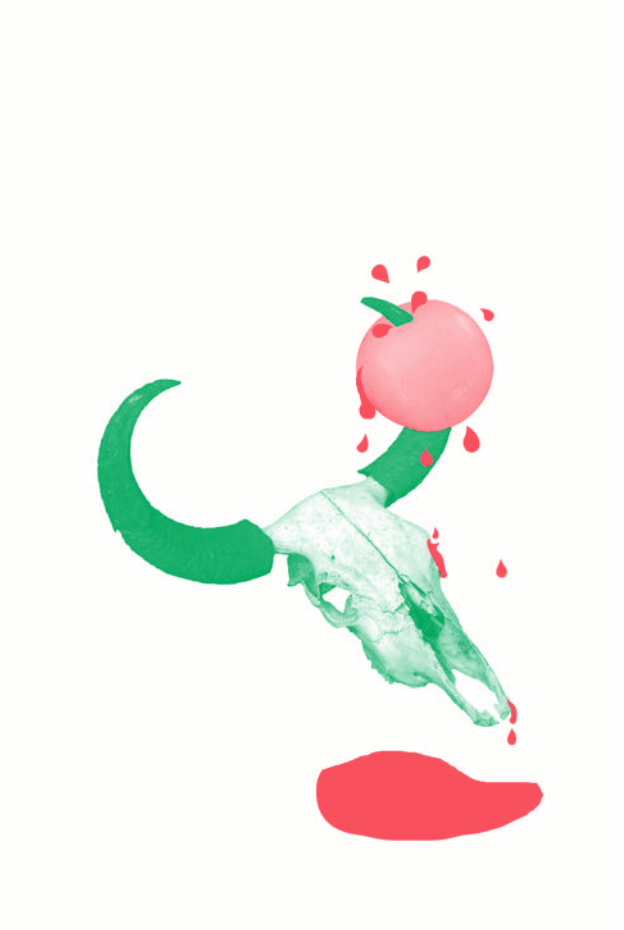
#BigYieldsComeInSmallPackages
#CulinaryEugenics
#LetThemEatRiceCakes

RAINBOW PAPAYA

By 1992, papaya ringspot virus had severely impacted Hawaii's papaya production. In partnership with the state government and industry, researchers developed a disease-resistant variety by introducing a gene from the virus into the Sunset cultivar, thus creating a transgenic variety dubbed "SunUp." It was crossed with Hawaii's popular Kapoho Solo variety and they called it "Rainbow."

Papaya seeds are easily distributed and Hawaii's papaya industry is relatively concentrated within a small geographical area. The adoption rate of the virus-resistant Rainbow papaya strain was rapid and widespread, but the cultivar also seems to be highly vulnerable to a new disease called "black spot fungus." Today, most Hawaiian papayas sold in the US and Canada are Rainbow or a similar transgenic variety, and farmers who grow Kapoho Solo for sale in countries that do not accept transgenic papaya complain that the Rainbow compromises their exports.

#GoingKapohoSolo
#PapayaMiteSurvive
#RainbowContamination



RIO RED GRAPEFRUIT

The Rio Red grapefruit is one of the thousands of plant crop varieties developed using mutation breeding techniques and registered in the International Atomic Energy Agency's (IAEA) mutant variety database. In this case, radiation breeding was carried out by treating budding Ruby Red grapefruit sticks with thermal neutrons in order to generate novel mutations. The resulting Rio Red variety was cultivated from these mutants, which exhibited deeper red color and vigor across a range of growing conditions.

Red grapefruit buds were initially discovered growing on pink varieties in the Lower Rio Grande Valley of South Texas. The discovery eventually led to the elimination of white and pink varieties in the state. The Ruby Red has achieved a symbolic and commercial association with Texas ever since its patenting in 1929. The Rio Red grapefruit was approved in 1984, explicitly connecting the geography of Texas with the agronomic research conducted there.

#AtomicGastronomy
#Cobalt60Sauce
#LoneStarStateOfTheArt

ROUNDUP READY® WHEAT

In 2013, a farmer in Oregon sprayed their farm with glyphosate (aka Roundup) and was surprised to find that some plants survived the application of this strong herbicide. Eventually the plants were identified not as superweeds, but as a Roundup Ready® wheat variety, which Monsanto had been field-testing in Oregon from 1998-2005. Monsanto had dropped the research project before the wheat was ever approved for commercial planting. The reappearance of this Roundup Ready® wheat in Oregon became a tense issue, as buyers in Japan and South Korea suspended some imports of American wheat, and the EU requested increased scrutiny and testing.

It is unclear how the wheat ended up in the farmer's field, although Monsanto's Chief Technology Officer Robb Fraley hypothesized that it may have been a false flag attack by anti-GMO activists. In 2014, Monsanto reached a $2.4 million settlement with Pacific Northwest wheat farmers, but has never admitted liability.

#BetweenSoftWhiteWheat&AHardPlace
#FalseFlagFibs
#OopsieNoDaisies

SEA-BUCKTHORN

Sea-buckthorn is the name given to seven similar species of deciduous shrub native to a wide area of Europe and Asia. Because of its rapid growth of basal shoots (or "suckers") and extensive roots, it is often used in landscaping to create windbreaks and promote soil conservation. It is also used decoratively in Northern climates, where its colorful orange berries stay on the bushes long into winter.

Although Chinese, Tibetan, and Indian traditional medicines have used sea-buckthorn for centuries, interest in the berries of some subspecies of sea-buckthorn is increasing elsewhere because they can contain up to 15 times the Vitamin C of an orange, as well as various oils and fats used in nutritional supplements and cosmetics.

#AspiringCeleberry
#BitterNeons
#BreakWind_WindBreak

SEEDLESS BREADFRUIT

The common name of this flowering tree comes from the texture of its cooked fruit, which has an undercooked, potato-like flavor, similar to freshly baked bread. Many breadfruit hybrids and cultivars are seedless and incapable of dispersing seeds over long distances, but it is one of the highest-yielding food plants on the planet. This is why colonial administrators and plantation owners in the 18th century called for the introduction of breadfruit to the Caribbean, hoping to develop cheap, high-energy food for their enslaved workforce.

The Royal Society offered a cash bounty and a gold medal for the the food's successful introduction, but slaves refused to eat it. Although the taste and texture can be bland and unappealing for many, it has since become a staple food in some places and continues to be touted as an ideal source of inexpensive nutrition across the tropics.

#FailedFoodDystopias
#FruitOfThePoisonousTree
#SterileStaple

TRANSPLANTED TO THE CARIBBEAN FOR ITS HIGH YIELD

SEVILLE ORANGE

The Seville orange is a cross between a pomelo and a mandarin. It is a bitter tasting fruit with thick, dimpled skin. In 1797, as the story goes, the grocer James Keiller bought a large quantity of Seville oranges very cheaply from a Spanish ship taking refuge from a winter storm in the harbor of Dundee, Scotland. Unable to sell the bitter oranges, Keiller's wife, Janet, used them to produce pots of preserve, which became the first commercially sold marmalade. By the late 19th century Keiller Marmalade could be found in Australia, China, India, New Zealand and South Africa.

Once a year, Seville oranges that would otherwise be thrown away by the Spanish are still collected from trees in Seville and shipped to Britain for marmalade. Today this citrus migration still benefits Seville, but consumption of marmalade in the UK is dropping fast. Is this the end of the Iberian-British prank known as Dundee Marmalade?

#CitrusSchadenfreude
#JuteJamAndJournalism
#YouSayPreservesISayPerverse

GROWN IN SPAIN, PROCESSED IN SCOTLAND FOR HIGH PECTIN CONTENT

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