

Pomology with Dr. Susan K Brown

Ologies Podcast

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Oh hello, it's that landscape artwork you made at a paint and sip event six years ago, Alie Ward. And hey, it's fall, it's creepy, it's spooky, it's apples. Listen, okay, we've got scarier subjects coming up this month. But I thought after our two-parter on witch culture we needed to lace up our worn-out leather boots, wear a scarf, and even though it's too hot for it, head to an imaginary orchard to chat with someone who is about to narrate every apple experience you have for the rest of your life. I love her.

So, she's a professor at the School of Integrative Plant Science Horticulture at Cornell University. She got a bachelor's and a master's in plant science and a PhD in genetics and now leads Cornell's apple breeding program, one of the largest fruit breeding programs in the world and we're going to get to it.

But first, thank you so much to everyone wearing new Spooktober *Ologies* merch from [OlogiesMerch.com](https://www.OlogiesMerch.com). Thanks to all the patrons supporting and submitting questions at [Patreon.com/Ologies](https://www.Patreon.com/Ologies) and to the folks who leave reviews. I read every one such as this ripe, juicy submission from Georgie Corkery who wrote:

Ologies is the embodiment of "nerds are cool." In fact, this pod highlights that nerds are thrilling, diverse, sexy, wholesome, and quirky.

Georgie, and the rest of us big dorks, thank you for those reviews, we are all of those things. And those reviews really make my day, and they help the podcast so much. I read them all so keep 'em coming.

Okay. Pomology, it's a real word and it's a discipline and yeah, it comes from the Latin *pomum* for fruit, and it can be applied to the whole branch of botany that involves edible things. But pomology is typically used when talking about apples. This expert is as knowledgeable and as charming as they come so get ready for apple-picking tips, genetic mash-ups, taste test requirements, tart versus sour versus astringent, wild apples versus domesticated, recipe tips, oxidation anticipation and frustration in the nation, DNA trivia, compost treasures, maggot babies, the animal dung that changed history, how to have your own orchard, the sweet, sweet taste of scientific redemption, keeping doctors away, the loudest apple crunch on record, and what you're actually tasting when you enjoy this feat of breeding with professor, fruit geneticist, and pomologist, Dr. Susan K Brown.

Alie: I'm so excited to talk to you. Of all the apple experts in the [sings] woorld, I was most excited to talk to you so when you said yes, I was over the moon, like, "Yes, this is great!" So, thank you for making time, especially during the harvest or apple season, at least I think it is.

Susan: It's harvest season and my daughter gets married a week from tomorrow.

Alie: Oh my gosh, okay. We'll make this quick then, you've got a lot to do.

Susan: No, no, no. It's okay. It's okay.

Alie: So, she's having a fall wedding.

Susan: Yes, which everybody said that that would be mutiny in their family but when it's your only daughter you say, "Okay. Not good timing but we'll do it."

Alie: *[laughs]* Is she a fall person?

Susan: I think everybody is when you're in upstate because it's so beautiful here.

Alie: It's gorgeous. I wasn't sure, being from southern California where we have essentially one and half seasons, I wasn't sure when apple harvesting actually is. I want to say it's around now because that's when we used to go to apple farms and orchards when I was a kid in northern California. But when is, like, picking season?

Susan: Okay, so it can start as early as August but commercial... People really don't usually go to the orchards until September. But the peak, the big weekend, is Columbus Day weekend.

Aside: Just a side note, in the US, this is usually the second Monday in October, and the holiday was started to honor Italian-American heritage but about 20 years ago people were like, "Mmm, how do we feel about Christopher Columbus? Not good? Got it." And many cities started swapping the holiday out for Indigenous Peoples Day. But Columbus Ohio really could go anywhere with the day, so they've decided to honor veterans. What is my damn point? That no one has made another mid-October holiday all about apples. Boy howdy, I reckon we need one.

Susan: And that's when the bumper sales are out. But we have just so many different apple festivals, roadside stands, and large producers so wherever you go... You can't turn around without seeing an apple orchard.

Alie: Did you grow up going on field trips and things in orchards? I know I did and that it became a magical place.

Susan: We didn't so much because we didn't have a lot of apple orchards where I grew up but of course, my dad had apple trees and my mom's family was in farming so, you know, we were exposed to it. But, a bad story, my kids were little, and they came home and said, "Mom, we went to an apple orchard, and we had cider and we picked apples from the trees!" And my husband said, "Shame on you." *[laughs]*

Alie: *[laughs]* Because you had them or just because it was like...?

Susan: We had them but you're so busy and you're so overwhelmed with apples that the last thing you think of doing is taking your kids out. So, after that, we started making sure that they were always out. Little kids just like to be able to bite into an apple, throw it to the ground, and try another one. *[both laugh]* ["*They're everywhere.*"]

Alie: How did you end up doing this as a job? Not a lot of people get to immerse themselves in orchards and varieties and plants and fruit.

Susan: My mom was an amazing green thumb, so we always had a lot of flowers. My dad had a big vegetable garden. So, my mom started the fascination with plants because they really are just amazing.

And then my dad bred racing pigeons, of all things. So, homing pigeons will always come home but especially in Connecticut and other areas, they will take the pigeons, put them on a truck, drive them several hundred miles away, and then there's a lever that lets them all off at the same time, and you bet on whether your pigeons will come back before others. But he taught me about the genetics of different patterns and some of the things that you look for and he would talk about selection so he would say, "See them flying. The last one is a little weak," and sure enough, a hawk would come and get it, which was kind of a terrifying lesson for a child, *[laughs]* but you know, that was really great. And then my brother was a science teacher, and I was always around nature.

But when I went to the University of Connecticut and took my first botany course, I fell in love. And then I took my first plant breeding course and realized that I could create something, and I could create something that no one else had ever seen but even more importantly with fruit, that no one else had ever tasted. [*"The snozzberries taste like snozzberries!"*] So, my predecessor said that being an apple breeder is like being an explorer in an unknown land. So, when you bite into an apple that you created, it may be the world's best apple or it may be what we refer to as the "spitters," [*Alie laughs*] but you created it and to be able to do something that no one else has done and, you know, a lot of times, it isn't a success but when it is... Boy, is that gratifying.

Alie: Do you have to wait years before you know if something is delicious or a spitter?

Susan: Correct.

Alie: Augh! That is so much patience. How do you cultivate that much patience?

Susan: It's more impatience, I think. We learned ways to make it quick, quicker. So, if I talk to somebody who works in tomatoes, they're like, "Oh my god, it takes so long." But it used to take 20 to more like 40 years to where a variety you thought might be successful. And I was like, again, you could retire before you know you're any good. [*Alie laughs*] And so, I started looking at ways to use certain parents to make fruit occur quicker, to do cultural conditions to make them come into fruit, to use dwarfing rootstocks which allow them to produce fruit sooner.

Aside: More on rootstocks in a bit. It's bananas. It's apples.

Susan: And so, with the case of New York 1 or SnapDragon, one of our releases, it was the fastest from cross to commercialization. I think it was 11 years and that's still a long time but that's cutting it by three decades.

Alie: Holy smokes. Are you able to say, "I worked on this apple, and this apple, and this apple?" Do you have a running list in your head?

Susan: Of course. But the two that are receiving the most attention right now are SnapDragon and RubyFrost. SnapDragon in particular is the only, I think, official apple of an NFL team; it's the official apple of the Buffalo Bills.

Alie: [*laughs*] Oh my god! That's great.

Susan: So, I mean, that is cool. So, we are going to have a documentary out that's through Viewpoint and Dennis Quaid moderates it. But they videoed us from the idea of making that variety to the marketing that was involved and our marketing group has won many different awards. SnapDragon just recently won an award for outstanding fruit cultivar from my professional society which is the American Society for Horticultural Sciences. [*applause*] And the name recognition, they really did such a nice job tying in the S dragon logo, a tagline, "Monster crunch." So, we're doing things a lot different. And in the past, we didn't have money for marketing.

Aside: One thing that the marketing department did not count on was some weird lady with a niche podcast emailing to ask their mad scientist fruit highness to talk about her apples and not having a single SnapDragon apple in front of me, woefully, I had to comb the internet for descriptions which have included, "Spicy sweet. A hint of vanilla. Crisp flesh. Exceptional juiciness, and monster crunch." So, how many people have to grow a new apple before it's market-ready? Like, who has backstage access to new apples?

Susan: So, this was a closed release, something called a club. But every grower in New York state had the opportunity to join and then we stipulated that 25% of the proceeds had to go to marketing and that's made all the difference.

Alie: I was going to ask, who is behind big apple? If it takes 11 years for a quicker version to make it to market, like, who pays for the research? Is there, like, an Apple Council?

Susan: Oh no. So, Cornell University has been very generous about supporting my program, but it has become more challenging. There are only three major apple university programs in the US. You contrast that with, like, Japan and every province has its own apple breeder. We used to. In the past, even as early as the 1970s, there was a breeder in almost every state.

Aside: If you're wondering, how many provinces does Japan have? Like, seven? Or a hundred? Welcome to being me. Anyway, Japan, 47 prefectures. But if you're wondering how many ancient provinces in Japan, there were... 69. But back to apples.

So, Cornell has made quite a history in the apple world, and they support a lot of agriculture research of this ilk. The breeding programs are also funded by the New York Apple Growers who all tax themselves and then pitch in for research. Susan says that one group of growers called Crunch Time Apples got together the marketing for SnapDragon even though they all have full-time jobs getting apples to your fruit baskets and your sack lunches.

Susan: But they were confident in the varieties, and they were confident in our program and the data that we had. It's been a wonderful partnership. It's just, we kid around a lot but to see drone footage of some of our packing houses and the people, and to hear customers say, "That's my favorite apple," it just doesn't get better than that.

Alie: Who gets to name it? Because SnapDragon is *such* a good name. Do you have to vote?

Susan: Well, we were able to have input but in the past, we used to name them. We, the breeder or the university used to name the apple. And I will tell you that it's hard to name something because you can't name it if it's been used before and there are, on record, over 14,000 names.

Alie: Oh my god. That's so many.

Susan: So, we're going to start becoming like the pharmacy XYZ or "Xalta" but when I first heard the name SnapDragon I was like, "That's a flower," because, you know, I'm in horticulture. But then they showed the logo, and they showed the taglines, and it resonates with kids and it's very memorable. So, that was one where they suggested several different names, and a grower, Mark Russell, really felt that SnapDragon was the best name, and he led a campaign to make that be the case. And then RubyFrost is a good name, but it just doesn't resonate as well. A friend of mine, a Minnesota breeder, came up with Honeycrisp and that was a great name because it's sweet and it's crisp but then so many people, myself included, started using crisp that a group from Ohio that has a private program, they called an apple, Ludacrisp.

Alie: [laughs] When you see that, you've got to be like, "That's got to be the crispiest," just because it's so out there.

Aside: You're wondering about other apple names. I was too. To the point that I scrolled through a list of several, several hundred to find the ones that might tickle us. And even though it was past my bedtime I kept scrolling through because there are so many tasty little treats such as Hoary Morning, Northern Spy, Cockle Pippin, Flushing Spitzenberg, Slack-Ma-Girdle, Sleeping Beauty, Ronk, Dazzle, Bloody Ploughman, Cheese, just cheese, Scrumptious, Pumpkin Sweet, Pitmaston Pineapple, Scarlet Cranberry, Sack and Sugar, one named Water. There's also Poorhouse and Rambo. So, next time you need to name a pet, or a car, or a firstborn, look no further than a big ass list of unhinged heirloom apple names. Speaking of which, let's go back in time.

Alie: A huge question I have is, Johnny Appleseed, a legend, a myth. Knowing what little I know about apples I understand you just cannot throw seeds down and all these different apple varieties will sprout up. Right?

Susan: Right. There's a book that's really good, I think it's called *Johnny Appleseed: The Man, the Myth, the Legend*. So, Johnny Appleseed became glamorized by Disney, and some of the books that were written, kids' books, about him. There really was that gentleman, except he used apple seeds. So, when you cut open an apple, so if it's SnapDragon or Empire, or whatever your favorite apple is, when you cut open the apple, those seeds have, let's say Empire as the parent, but 50% of the genes come from whatever the bee brought in as pollen. It could be a crabapple, it could be Golden Delicious, it could be Delicious, it could be any number of things and sometimes even seeds within the apple have different combinations of parents. So, that's why when you plant an apple seed, you don't get that variety, you get a descendant of it, but it's not going to be anywhere near that same variety.

So, the only way that you can make a genetic copy of an apple tree is to use clonal propagation. That's where you take a bud or a piece of fruiting wood and you put it on a rootstock. [*"Bring me the axe!"*] It's like making a genetic Xerox or copy of that tree. So, each bud is a genetic replica and if you use a hundred buds, you'll get a hundred trees and they're all the same as that original seedling. So, when you think about it, McIntosh was discovered in the 1700s. Every tree that has been propagated dates back to that original ancestor.

Alie: Woah. Are all the SnapDragons that you might find, do they come from a single tree that really had the best traits?

Susan: Right. [*Alie gasps*] Well, so... They do, and they don't. So, the first tree started everything, you have a first generation, you have a second generation. But the original source of it, like when they do those anthropology studies, the Eve is that original tree.

Aside: This refers to a matrilineal line of ancestry or the so-called mitochondrial Eve of African origin that researchers date back to 140 and 2,000 years ago. Journalists kind of coined that biblical term because it made headlines but Allan Wilson, a biochemist who cofounded this theory, did not like the reference to an Eve character and he preferred the term, Lucky Mother, which I think is more sweet and crisp. But on this topic, let's kick it back to the late 1700s.

Susan: Let me go back to what you had asked about Johnny Appleseed. Johnny Appleseed was interesting in that rather than bringing buds or trees to the colonists, he was bringing apple seeds because he could get them from a cidery. So, when you press cider, the apple seeds are left, they have bags of them. He would collect those bags, and he was a shrewd businessman so he would find a piece of land, he would plant those seeds, and now he is having a combination of trees that aren't name varieties, but he can give to settlers very inexpensively. He did that to spread the word of the Swedenborgian religion.

Alie: Oh!

Susan: And interestingly, Johnny Appleseed thought it was morally wrong to graft two different trees together. [*"Abomination!"*] I don't know why [*chuckles*] but he did. And so, he used the seeds as a way to get his foot in the door and then to try to spread the word of his religion.

Alie: So, where did they come from before colonists in America?

Susan: Okay so, great question. The original origin of apple is in northern China, Kazakhstan, and other parts of the Soviet Union.

Aside: Just a tiny bit of history here. So, the apples you're eating are *Malus domestica*, unless you're foraging in the valleys of Kazakhstan where wild apples, *Malus sieversii*, still dangle from 100-year-old trees, some are several storeys high. Wild apples there vary completely from tree to tree because remember, the pollination of apples is a total crapshoot depending on what a bee brings in from its butt. So, the wild apple sizes and textures and tastes are all over the place but evolutionarily, the local bears preferred the sweetest biggest ones, and they would clamor up trees before the winter to get them, kind of naturally pruning the trees with these giant hungry claws. Then they would leave with bellies full of apple seed to disperse like confetti as they lumbered toward hibernation. So, those seeds tended to grow into bigger, tastier apples, which the horses love. And guess what sweet pooping beasts people rode across the Silk Road? Well, camels. But also, horsies, who love apples.

Now, this great Silk Road was a network of trade routes, and it stretched over 4,000 miles between the coast east of now Beijing through China, India, Iran, Turkey, North Africa, and Russia, into eastern Europe. This series of sandy and hilly and foresty highways were the way to go for 1,500 years up until about 600 years ago. And just like we have Flying J truck stops to buy 32-ouncers of Baja Blast, the Silk Road had inns and stops, and they were called caravanserais. You just stop along the way. 4,000 miles! That's so many pee breaks, no drive-through burritos, no podcasts, just your camel named Gary and some guy carting a barrel of buttons who is telling the same story about the time he fought a drunk goat and the goat won... That is a long road.

Susan: And then they traveled by the Silk Route to Europe but each time they were traveling, if seeds were dropped or if animals like horses ate them, they would germinate and then they would cross with species that are a relative of apple in that region. So, we call that introgression. So, if you've done any Ancestry and Me, if you look at the apple, you can see the different areas that it was colonized in.

When the settlers came to North America in pursuit of religious freedom and hopefully wealth, they brought seeds with them, sometimes they brought trees. But the trees from the UK and other places weren't adapted to America. So, when the colonists came here, they found several different native apples, but the native apples were tiny little crabapples and as Thoreau explained, "They were sour enough to make a jaybird scream." So, sometimes they cross-pollinated with some of the seeds that colonists brought. But at that time, people were using seeds and apples as a source of safe drinking material and not necessarily hard cider. The water had problems with, you know, animals and food safety and so the government asked you to plant four acres of apples because you could make cider and have a form of liquid that was safer for you. But then other people say, well, Johnny Appleseed was successful because he brought liquor to the colonists [*Alie laughs*] but you know, there are nuances to the story.

Alie: Well, the differences between regions whether it's Kazakhstan or the UK or Washington State or upstate New York or in the mountains of southern California, are there any differences like Terret noir with grapes?

Susan: Yeah, we don't really call it that, but I think in the future that may happen. There's actually been some really cool studies that even in a relatively close area, so let's say within half a mile of one another, you can have massively different effects on the volatiles that an apple gives off, the sweetness, sourness combinations.

Aside: So, just toss an apple and you'll hit research about flavors of apples like the 2017 paper, "Sweet taste in apple: the role of sorbitol, individual sugars, organic acids and volatile compounds," which notes that "After sorbitol and soluble solid content," like glucose, "the most important contribution to apple sweetness comes from the scent of several volatile compounds, mainly

esters,” derived from acids, “and farnesene,” which smells like green apple and it attracts apple worms. But yes, even with a similar geography, apples can vary in smell and taste.

Susan: So, we do have that effect, but we also have regional preferences. So, if you grew up in... Well, I have to ask you, growing up in southern California, what was your favorite apple?

Alie: I grew up in northern California, but I’ve been down here for like, 25 years. But I would say [*shaky voice*] way back when I was a youngster, there weren’t as many cool varieties, they were still being grown in laboratories. But I’ve always been a green apple person so like a Granny Smith.

Susan: Okay, so Granny Smith was going to be my guess.

Alie: Yeah, yeah.

Susan: How about Gravenstein?

Alie: I don’t know it! Oh wait, is that the kind of striated one, or no?

Susan: It’s striped. They have an annual Gravenstein conference out in California, I know that.

Aside: I totally knew this, but I couldn’t think of the name, and I blanked, I was nervous. Also, if you wanted to go to the 50th anniversary of the Gravenstein Apple Fair, sorry losers, you missed it, it was this past August. But hey, there’s always a 51st. So, when you see a Gravenstein apple, just think, hey, wow. This is a descendant of an apple found in a monastery which captured the fancy of a guy named Count Carl Ahlstedt who shipped a branch back to his brother, Count Frederik the Younger, in the mid-1600s. And now, you’re just eating one on a bench, waiting for your connecting flight out of Dallas.

Susan: So, there’s all sorts of nuance, stories of where an apple came from, and a lot of the people that like heirloom varieties. Heirlooms can be really good but there’s a reason that they’re no longer grown. Either they didn’t produce enough for growers, or they had a certain Achilles’ heel issue that made them less than profitable. But they have a romance and a history to them so who doesn’t want to try Thomas Jefferson’s favorite apple?

Aside: If you must know, this was likely the Esopus Spitzenburg, which sounds like a physics professor but it’s actually a crimson apple that’s oblong and sweet-tart, with a little spice.

Susan: Or you know, the apple that your mom had in her backyard. But then sometimes, people will try these apples and go, “Gee, I thought it was a lot better than that when I was a kid.”

Alie: [*laughs*] They’re like apples have come so far that you’re like, “Oh, this isn’t... Eugh. No, thank you.” I’m sure there are a lot of teachers that are like, “Really? A Red Delicious? Really? Of all the apples?” That’s such an iconic, “Give a teacher an apple” and it’s also probably a lot of people’s [*speaks through the corner of mouth*] least favorite apple, no offense.

Susan: Yeah. It’s losing popularity in Washington. The acreage is definitely going down [*“Time’s up.”*] but what the original Delicious was actually a really good apple. So, there are some genetic changes that occurred naturally, and I use the example of a famous woman professor at Cornell. Barbara McClintock looked at Indian corn, and she said, “Why are these kernels different colors, different patterns?” She hypothesized that there was something called transposable elements, or jumping genes so that these genetic elements could insert themselves into DNA, and if it was near a gene for color, it could change the expression of that gene. So, that’s why you see light colors, dark colors, striped, spots. And we have those transposons in apple too.

Aside: So, a transposon is also called a transposable element, or TE, and essentially, it means that parts of a DNA sequence can jump around an organism’s genome. This *massive* discovery that

changed the way we see genetics is also known as jumping genes, a term that kind of sounds like it could play the banjo.

But yeah, its discovery is credited to one Cornell University botanist, Dr. Barbara McClintock, who got her PhD in the 1920s even though her mom didn't want her to attend college because it would make her unmarried. Also, from what I gather, she didn't get along very well with her mom and my hypothesis is that her mom was a bitch. But anyway, she was studying what was then known as Indian corn but today it's more commonly called flint corn and it's a crop that was first domesticated by Indigenous peoples of what's now Mexico, some 9,000 years ago.

So, after much maize research, Barb published this groundbreaking paper about genes switching positions and leading to new mutations. She strode up to a podium of a symposium in 1951, back when women couldn't open their own bank accounts and she was like, "Y'all get ready for some crazy corn shit," and according to historical account, the room went... quiet. Dead silence. Dr. McClintock said the reaction from her peers was "puzzlement and even hostility" and that she was startled to find out they didn't understand it and didn't take it seriously.

And then finally, nearly two decades later, someone else discovered TEs, or transposons, in bacteria. And they were like, "Hey, remember that lady that we talked shit on? She was totally right. How about that? Hm! What a world." So, what did Barbara McClintock get from this? Well, the 1983 Nobel Prize in Physiology and Medicine, they were like, "We fucked up." She also got this aside. Also, if you go to the Smithsonian National Museum of Natural History in Washington DC, you can gaze upon her very microscope and some ears of her corn because it turns out that transposable elements comprise about half of the human genome and up to 90% of corn genes, like in flint corn, Susan explains.

Susan: And they're also for color because that seems to be a gene that mutates easily. It could be from cold weather or it could be from hard pruning but there are genetic changes in the very small shoot tip. And when you get more color, you can lose the ability to produce a lot of volatiles. So, the original Delicious was very poorly colored and striped, and then each time it mutated for color, it lost, in the opinion of some researchers, some of the quality that the original one had.

Alie: Oh! So, it's sort of more fashion and less function or taste?

Susan: Right, exactly. *[laughs]* Perfectly put.

Alie: As someone who is a Granny Smith type of person, and I tend to go toward the more tart ones, why are green apples so tart and just thinking about them makes you start drooling and red apples tend to be less tart?

Susan: Okay, so that's not quite accurate but I understand where you're coming from. So, Granny Smith does have a very tart perception. And there actually was a Granny Smith that threw out her apple pie trimmings and that apple came up in her compost pile and that's how it became, in Australia, an interesting apple for the world.

Alie: Nooo!

Susan: Yeah! So, what's cool about green apples is we've tried to develop a really good green apple for the northeast because Granny Smith takes too long of a growing season to grow here. But when you cross green apples, you don't get beautiful green apples, you get kind of putrid, pea green, you get yellow, you get all sorts of different things and sometimes you don't get that acidity. So, a lot of red apples can be acid. But the reason that most apples on the marketplace are sweeter is that 70% of the population, at least in North America but I think worldwide, prefer a sweet apple, and only 30% like one with more acidity.

Alie: Really? I'm in the minority with that!

Susan: Yeah! *[laughs]* I'm in the minority too.

Aside: I thought, "This is a cute story and it's sad that it's not true." So, I went down the rabbit hole to find out the actual origin story of the Granny Smith. It turns out that a woman in Australia was baking a lot of apples and throwing the cores out her windows. So yes, *[chuckles]* the story is totally true, which healed my heart, it restored my faith in charming, agricultural narratives, I was so happy to fact-check that. Also, I saw a photo of Granny Smith and it was just as you'd picture her; big, billowing black dress and a bonnet shading her wise face which is a grid of laughter lines and puckered from crabapple eating. Also, I do love that apple.

And it turns out Granny Smith apples are pretty popular. The conceptual artist, Yoko Ono debuted a piece in a London gallery in 1966. It was this tall, clear plexiglass stand holding a fresh Granny Smith apple and below it a tiny plaque bearing the word, "Apple." The title of the piece was "Apple" and a *Vanity Fair* art critic wrote of this historic artwork in glowing terms, praising its reflection on "The passage of time marked by the apple's decay and periodic renewal as it replaced through the course of the exhibition." For its 1966 debut, it was priced at \$400 which is roughly \$4,000 today. And apparently, one of the people who came to the art show picked the apple up off the stand and bit into it and then just calmly placed it back. Yoko Ono recalled, "I was so furious, I didn't know what to say. And it all showed in my face: how dare this person, you know, mess around with my work?" That person... was John Lennon. You know the rest.

Anyway, Granny Smith was growing some French crabapples and now we have Granny Smiths. But what about crabapples? Do they have a ton of acidity? Why does my face suddenly suction inward like someone who got a deal on cheek fat removal?

Alie: What about crabapples? Do they have a ton of acidity?

Susan: They don't even have just acidity, they have astringency. So, the tannins that make red wine good, that make tea have that little zing to it, those tannins are present in apples but specifically in crabapples. And the term 'tannin' was because they actually used those compounds to tan leather.

We breed crabapples for ornamental use for landscape trees but what I love to do with classes, because everybody thinks, you know – and I'll get back to your question about how do you breed something good – but students always think if it looks good it's going to be good because Americans buy with our eye. If it's really red, we think it's going to be great. And so, I'll pick apples that I know aren't good and put them in a basket and have the students pick. But one day, I decided I was going to give them a red-fleshed apple with a lot of acidity and a lot of astringency, and I asked for permission to videotape them, and the reaction was priceless. *[Alie laughs]* They were like, "That's not fair!" And I was like, "That's what we bite into sometimes." But I did that with my children when they were little, I would throw crabapples in their lunch and then they'd come back and the kids loved them because they're like Shock Tarts or Airheads, Warheads because the flavor in those is sour apple flavor.

Alie: I was going to ask about that with apple candies and sodas.

Susan: Yeah, malic acid. Yep.

Alie: Is that what's giving the flavor or that tartness?

Susan: Uh-huh, yeah.

Alie: You know, I don't know if you remember this, but for a while, there was a soda called Slice and they had an apple flavor. And I don't know what happened to it, but I've always wondered, why isn't

there more apple gum or apple sodas? Grape and bubblegum are everywhere, orange is everywhere. What's up with the apple?

Susan: Well, with apple juice, you have applesauce, the fruit leather is basically a lot of apple. I don't know.

Aside: Neither did I. So, I spent way too long researching the history of the carbonated soda, Slice, which debuted in the mid-'80s and contained 10% fruit juice and later, quietly, no fruit juice. But it had weird flavors including Apple Slice which was only on the planet for two years but I suppose it made an impression on me, partly because I had it on a road trip with my Uncle Ron to go sledding and I got carsick on the mountain roads and I will never forget the sight of the empty Apple Slice can rolling around the floor of the car. But Slice was supposed to make a comeback this year and people, I'm waiting.

Meanwhile, Mexico is like, "Hello, we have Sidral Mundet and Manzanita Sol" two apple sodas for you. And I guess there's also Martinelli's Cider, which is sparkling apple juice, but we have a whole episode on apple cider called Ciderology including the hard stuff. And yes, of course, it's linked in the show notes. But yes, more apple-flavored things please! The public is demanding it as of right now.

Susan: It's a mystery. Especially Concord- I'm going to get in trouble with the New York audience, but Concord grape juice is great. But as a parent, having toddlers spill Concord grape juice on your rug is not a highlight of your day.

Alie: I was going to ask, what's with that one apple that tastes like grapes? Where did that one come from?

Susan: Are you referring to the Gräpple?

Alie: Yes, yes.

Susan: Okay. So, that's interesting because it's actually an apple that's soaked in Concord juice-type flavoring.

Alie: No.

Susan: Yeah. And if you're not allergic to apples, there are some allergens in apples that people are very seriously allergic to. You can be not allergic to apples and not allergic to grapes but there's proven documentation of people allergic to Gräpple apples.

Aside: So, allergic folks, what if you're sitting there just asking the universe, "Why? Why? Why?"

Susan: they serve a purpose to the plant by trying to fight off and service defense but people that are highly sensitive will develop an oral allergy. Interestingly, if you're allergic to white birch pollen, you're more prone to have an apple allergy because the two allergens are very similar in structure. That blew my mind because it was like, "But babies don't get sensitized to birch pollen," but I guess they do. And I think in the Netherlands, they funded research on anti-allergens, no allergenicity in apple because people were having anaphylactic reactions to them.

Alie: Could that be regional at all?

Susan: Yes, it could be.

Alie: Oh wow. Speaking of cross varieties, what about Papples? Pear-apples? Are they apples or pears?

Susan: Oh, umm... So, I'm curious where you heard the term.

Alie: Papple?

Susan: Yeah.

Alie: *[laughs]* I know that they're called Asian pears but I-

Susan: Oh, okay! I'm glad I asked. So, Asian pears are pears, they're just- There are two types of pears, European and Asian. The Papples aren't pear-apples, they're just pure pear.

Alie: Ahh! Because they're round, we've been sold the bill of goods.

Susan: Right. And because all of us... We always like to push the envelope a little bit, so breeders have crossed pear and apple. And while there isn't a product ready for market, we're learning a lot about genes. There are a lot of genes in pear and apple that are very similar but there are some that are very different. We're learning more about how we could further intercross those. But where we have had success intergenerically is the apricots and the pluots, which are plum-apricot or apricot-plum hybrids.

Alie: Yeah, those things are good too. I'm down with it.

Aside: All of this inter-botanical fiddling, Johnny Appleseed's ghost right now is livid at us. *["I'm so pissed."]* Speaking of the dearly departed, what about extinct apples?

Alie: Are there any that are just legendary that hopefully someone discovers a seed packet in a dusty museum or something?

Susan: Okay, so again, because...

Alie: Not that that would help.

Susan: Yeah. *[laughs]* And that's the problem. There are a lot of really passionate fruit detectives that go around trying to find lost trees. I spoke with someone last week about this very topic and I explained that heirlooms play an important role but what people don't realize is that the USDA has a massive collection. In fact, in Geneva, New York right down the street from us, they collected over 3,000 different apple varieties and that serves as a living library. The importance is not necessarily every apple that ever existed being saved but specific genes of interest. And so, like, if you think about it, if you're one of six children, ideally you would want to preserve each and every member of the family but as long as there's one descendant, the majority of your genes are preserved.

Aside: Child-free folks please bookmark that fact for any holiday encounters in which relatives discuss your reproductive intentions. I hope that you have horny, baby-making siblings.

Susan: So, that's what happens with apples. You have different manifestations and different types of it but when you look at a lot of these older varieties that are found, they are derived from a relatively small number of ancestors.

Alie: Oh, so there is a certain loss, but you take what you can get.

Susan: Correct. And apples are remarkably diverse. That's why I love working on them because I couldn't work with a crop that had to be bred for uniformity. So, rice, you want it to be uniform; corn, you want it to be uniform; wheat. *["Boring."]* But apples, you know, walking down any particular row, you're going to see so many manifestations of quality, of tree shape, tree size. We have apple trees that grow horizontally, we have apple trees that grow more like Brussels sprouts. So, there's just all sorts of wild variation and it's great for research studies but it also, if we can answer some of those questions, it'll help us be even better in the future.

Aside: I'm sorry, apples that grow like Brussels sprouts? How in the gravity does that happen? Well, I just watched too many videos on orchard planning and as it turns out, they can grow apple trees that are tall and supported by wires and they look like columns of leaves and fruit. It's called tall spindle growing, it's wild. I always picture apple trees as these big round bushy things in orchards. Like, if they could talk they'd be like, "Boop-da-doop-ba-doo-doo-doo."

Alie: How do you feel about getting apples at the farm or the orchard versus at the grocery store? Do you have a preference in terms of where you get your apples? Have some been in cold storage for a while? Does that affect the taste?

Susan: Okay. So, proudly, cold storage was developed at Cornell.

Alie: Hey!

Susan: And the idea was that cold storage mimics, you can, a lot of times, we had root cellars or basements or really prehistoric, they used to try to preserve foods in caves. So, cold storage is essentially kind of like trying to simulate the atmosphere of a cave. So, the idea is you lower the temperature enough that the apples are kept cold but don't freeze. Surprisingly, you can be at 32 and still not freeze the apple.

Aside: So, in Celsius, that would be 0. Is that not freezing? So, light frosts usually won't do much harm but for prolonged periods, not great for an apple or the tree unless pomologists like Susan are on it.

Susan: But then you control the amount of oxygen and CO2 that the apples are giving off and regular storage just controls the temperature. A controlled atmosphere controls the level of these gasses, and it creates a chance for apples to be in a kind of suspended animation. So, you can have an apple that's been in storage for three years and is phenomenal but if it's a new variety, or if picking wasn't done at the proper time, you can have a really good apple that doesn't perform as well as it should. So, that's a whole science, that's a postharvest physiologist.

Alie: A postharvest physiologist! That's another ology. There could be a whole second episode!

Susan: I know! *[laughs]* So, I collaborate... I'm very proud of our accomplishments at Cornell. My research technician Kevin Maloney is an important part of the team, but we interact with plant pathologists, we interact with entomologists, which I know you've covered, food scientists, plant physiologists, and postharvest physiologists. It really takes a village to produce an apple and we couldn't get where we are without that kind of collaboration.

Alie: Oh, I'm sure! You might have fungal blights, or you might have introduced pests, not to mention climate scientists. Is there one thing in particular that is most threatening to apple crops and varieties right now?

Susan: Climate change, absolutely, and labor.

Alie: Oh, right. Are they all hand-harvested?

Susan: Yes. And it's interesting. We did the documentary, and the producer went, "They're still harvested by hand?" And I was like, "Yep." Because the technology is getting better and some of the technology kind of blows your mind that there are machines that almost look like frisbees that come up and pick apples.

Aside: Okay, so apple-picking machines are weird, okay? Some look like rows and rows of ceiling fans stacked on top of each other, just rotating past trees like a carwash. And I saw another article describing 14-foot-tall robots with camera eyes and a half-dozen arms, each topped with a suction cup. But why all these workarounds?

Well, in Washington State alone, each year they pick 12 billion apples, by hand. How much does that cost? No idea. But according to the Seasonal Jobs page on the Department of Labor's website, you can make about \$18/hour or between \$30,000 to \$40,000 per year working full time although the jobs are, as the website states, seasonal jobs. According to one help-wanted description I read, you need prior picking experience, and the abilities to work on ladders up to 12 feet tall, climb up

and down a ladder while carrying a full bag, have no problems with balance, be able to work in conditions including rain and temperatures from 35° to more than 100°, be able to bend, stoop, stand, and lift up to 60 pounds of apples for the entire work day. One farmer looking into more robot technology told a newspaper ruefully, “The younger generation doesn’t aspire to be an apple picker. Right now, we’re trying to figure out how we can keep enough employees to get our crops picked until this technology evolves.” I’m not a roboticist but I guess one solution might just be to pay them more.

Susan: But a human hand is amazingly effective, and a lot of the hand labor is much faster. When you’re picking, a robot has to know – and this is something I try to tell people so that when they go to pick apples, they do it right – everybody wants to pull the apple down from the tree, so they yank it and the whole tree shakes. But what you want to do is lift the apple up and then twist and that stem will come off easily and you don’t damage the tree.

When pickers are picking, they’re picking with both hands. But then, nowadays, when you buy apples, you probably never notice but the stems are clipped because if a stem is too long and it hits into another apple in the picking bag or the bin, it causes a puncture and that can rot. So, the pickers actually carry little snippers. They have to pick the apple, cut off the stem, and then put it in the bag.

Aside: And yes, you do want a little bit of a stem because it’s like a cork that prevents tiny, little micro-critters from nesting in your apple because no matter how nice you are, those micro-critters are not welcome.

Alie: And if one rots, that adage of “One bad apple,” does that emit certain gasses?

Susan: Yeah, it emits ethylene which further enhances ripening but enhances spoilage, so the one bad apple is definitely true. If you have a basket of apples and they’re rotting, usually you’ll find a decayed one on the bottom. But you can also use apples to make things ripen better. That’s why you don’t want to keep apples and bananas together, [*“Oopies and boo-noo-noos.”*] they’re going to make each other ripen. But you can put an apple next to a bromeliad flower and the gas from the apple will help the bromeliad flower.

Alie: Really?

Susan: Yeah.

Alie: I’ve got to figure out what a bromeliad flower looks like.

Susan: [*laughs*] It kind of looks like a pineapple.

Alie: Oh! I’ve got to look into that.

Aside: Okay, yeah, I looked these up and imagine like a long-leaved houseplant like a snake plant, but then there’s like a hot pink squishy pinecone in the middle, kind of like, “Heyyy, I’m a plant with a wacky hat. Do you love it?” Let’s move on to something with less botanical glamor though.

Alie: I saw that you have a paper on russetting. Is that what we call apple rust, is that the oxidation?

Susan: No. Apple rust isn’t the oxidation either. Apple rust is a disease that causes little orange circles on the leaf, and it’s called cedar apple rust because the cedars are an alternate host, the disease doesn’t occur unless you have cedars and apples in pretty close proximity. Apple browning is a form of oxidation but it’s when the flesh is cut, and certain compounds interact and cause the oxidation reaction or browning. Now, people always complain about apple browning and I love the comments because they’re like, “Just cut it off.” [*both laugh*] It’s like, you put your apple down,

talk on the phone, it's brown. All you have to do is use a little knife and cut the surface and underneath it is perfectly fine.

Aside: Okay, I found some firsthand advice from a *Serious Eats* article which offered the tips of soaking cut apple slices in a saline solution of half a teaspoon of salt per cup of water and then you rinse off the salty taste before you serve them. Or you could submerge them in plain water which prevents the apple slices from having so much exposure to oxygen. Or you could introduce some citrus, which has ascorbic acid, and it keeps the pH lower, which can reduce oxidation. Or like Susan says, you can stop being a baby and just deal with it or cut it off. Also, this whole thing has nothing to do with apple russet; turns out that's a texture thing and I love it.

Susan: Apple russeting, you know that potatoes are russeted, they weren't always. That's why, like, Yukon Golds don't have the russet.

Alie: Oh! Okay.

Susan: So, the russeted potatoes, that is just like cork cells. When you buy pears, certain pears have russet and those again are just cork cells, they have no detrimental effect. Well, in the olden days, they liked russet because they can desiccate but they can also hold their shape better. So, in fact, I have in my office right now, a fall russet that has a modern taste and I hope it'll be one of the next apples we name because the quality is exceptional.

Aside: So, think of an Asian pear or a D'Anjou pear, kind of like a matte, rough, fibery finish.

Susan: But that genetic difference is complex. I've made crosses hoping to get russeting and I got none and then I made crosses not to get russet and I got fully russeted offspring. I went to get my PhD in quantitative genetics so I would know everything [*both laugh*] and guess what? [*laughs*] And that's what makes it fun because you can say, "I thought that this was going to work." So, you were asking, how do you get quality? So, when you think about... And this is simplifying it, apples have upwards of 54,000 genes.

Alie: Oh my gosh.

Aside: How many do you have? Mm, like, less than half of an apple's, according to most recent calculations.

Susan: So, when you look at genetics, if you ever took genetics, they're always looking at Mendel and a 3:1 or a 1:1 ratio, or if it's more complicated, a 9:3:3:1 ratio. But in essence, it's not just the genes, there are transcription factors, things that turn on the machinery; there are promoters which amplify what's going on; there are interactions between all sorts of genes. So, stuff we thought was really simple, you can do studies now and there can be 60,000 gene differences between two different groups. And so, it's challenging but it's exciting because once we crack the mystery on one complex, we may make greater efforts. But the russet was one of my graduate students, Ben Gutierrez, being really brilliant in that he used one of those transposable elements or genetic sports to look at an apple that naturally, half the fruit can be russet, and half the fruit isn't.

Alie: Oh my gosh!

Susan: So, he was able to look at the differences on the same fruit but that were expressing the genes or not expressing and that made a really clear-cut study of what was going on.

Aside: Imagine if that man supervillain Harvey Dent/Two-Face was in apple form and was created by scientists [*spooky voice*] tinkering with nature. And back to that, what are transcription factors and promoters? So, a transcription factor is a protein that controls when DNA tells messenger RNA to do something based on maybe if it's good timing. Promoters also control gene expression.

Alie: Has it changed a lot in recent years as it's easier to sequence genomes or look at some of those genetic mechanics?

Susan: In some ways. I was thrilled when I came on the job, we didn't have many molecular markers, we did the first genetic apple map here. But the problem is that markers are only as good as how broad they are. So, if a molecular marker is developed in a particular population but it doesn't work in another population, you have to know that because you could throw out material that's perfectly good. A lot of times when you look at papers, you'll see... So, a QTL is a quantitative trait locus, that just means that a lot of different genes are responsible, and their interaction is controlling that trait. So, think of height in humans, there's not an easy trait.

Aside: So again, a quantitative trait locus is a spot on a gene where you might have a single nucleotide polymorphism; an A versus a T, or a C versus a G. So you, or in this case an apple, can have a different appearance or flavor or size – which is a phenotype, or how the genes are expressed – based on really complex variations in single fragments of DNA that could be in different combos in different spots or even on a few different chromosomes. And you'd think that if you have the brain and the technology to figure out which genes do exactly what, you would have the entire puzzle laid out for you.

Susan: But when we do QTL studies, that particular portion or marker associated with that trait may only explain, like, 11% of the variation.

Alie: Oh, so you're just trying to chase information out, not always will be a good lead.

Susan: Right. So, we use the markers to help us fine-tune things. So, for example, you can't cross an apple with itself. So, some varieties you can self, humans we can't self. But apples you have to cross with a genetically distinct apple variety and there's a mechanism that keeps genetically similar individuals from setting seed. But if you make a cross and the cross doesn't work, is it because it has too close genes for interaction or that the weather was crappy, the pollen wasn't good? So, it allows us to say, okay, I'm going to look at the molecular marker for s-incompatibility alleles and I can tell if this is going to be compatible or not.

Aside: So, if it's just not happening, Susan can look under the hood, genetically speaking, and try to figure out which genes have thrown a wrench in things.

Susan: And then if it doesn't set fruit, we can look at other issues or if I only want to produce red apples, I can screen but the problem is, a lot of the traits that consumers, growers, and I are most interested in, are those that are complex so, yield, flavor. It's really hard to tie down because some of the flavor perceptions are the human perception and you can't necessarily get at that. So, for firmness, we're still chasing firmness and it's because we know that a crisp apple gives off a sound [*apple crunch*] and they started doing measurements of sounds when people bite.

Alie: [*laughs*] That's so specific!

Susan: Yeah, but we all have different-sized mouths, we have different tooth structures, we eat apples differently.

Aside: PS, the Guinness Book World Record for apple crunching was set in Germany in 2017 when a bite of an apple clocked in at 84.6 decibels which is louder than a garbage disposal. All credit should go to the apple grower and not just a guy who bought an apple and bit it. But why does it matter though? Well, according to the 2014 study in the *Journal of Food Quality and Preference* called, "Effects of the sound of the bite on apple perceived crispness and hardness," in taste-testing, when a sneaky ambient sound filter and the crunch factor is muted, "Crispness was perceived as significantly lower with any of the sound reductions." So, if you don't hear the apple crunch, you

think you got a soggy apple. This is the kind of hell that apple growers go through to make us happy.

Susan: They're going back to it; they're actually starting to interpret that more and we're doing a lot more interactions with people. But some people perceive astringency more than others, I'm one of those and I'll say to my research support specialist, Kevin, "Boy, this is really astringent," and he's like, "It's not astringent. Did you have coffee?" So, he and I perceive it differently.

And then there are certain compounds or notes that... So, this russet apple has a note of black licorice or fennel but what's interesting is you either hate it or love it, there's no middle ground. So, I had people from Turkey saying, "If you made this apple in our country, you would be queen." And I said, "Well, I like the sound of that." And then somebody else bit into the apple in my office and not only did she spit it out into the trash can, but she was trying to clean her tongue in front of me. [laughs]

Alie: Oh god, she did not enjoy that.

Aside: Just a side note, black licorice flavor comes from glycyrrhizin from the root of a bean plant and it's 50 times sweeter than sugar. And since most people pass on their share, you might be left holding the bag, gleefully so. Some of that preference is genetic and some is based on your memories in association with the smell of fennel or licorice.

Watch out, pump the brakes, slow your roll, gorging on black licorice can drive your potassium levels down and might result in pseudohyperaldosteronism, irregular heartbeats, or even cardiovascular failure. The FDA and the American Heart Association tell you to take it easy dude and after the age of 40, you've got to limit yourself to less than two ounces of black licorice a day. And I have never been less afraid of anything in my life, personally. Just like, "Eugh, no thanks."

Alie: We just did an episode about Gustology, about taste buds and people tasting different levels of bitterness and being supertasters. I don't know if you have to have, on a tasting panel, several people.

Susan: Oh no, absolutely. And you also, if you have when you said, one bad apple, we'll have growers involved in tasting to determine the right harvest date and if there's one apple you may get seven negative votes because each of them took a slice from the bad apple and then everybody else is rating is differently and you know something is wrong and there's an outlier. And then there are some people who are just not good testers. So, there are all sorts of studies about how to make a taste panel that's good.

Aside: I read one study that noted the apples are served to the evaluators under tinted lighting to mask how green or red they are, so they avoid visual biases. Another paper said that they recruit experienced subjects in sensory science and fruit growers familiar with apple tasting notes.

Alie: That's so funny to brag like, "I'm one of the better apple tasters. It's a lucrative business, I get paid to eat apples." [Susan laughs] Can I ask you some questions from listeners? They know that you're coming on.

Susan: Oh, sure.

Alie: Amazing. We'll breeze through some of them just like lightning round.

Aside: Okay, so we'll be doing a lightning round of your questions. But first, we donate to a charity of our guest's selection. Usually, I tell you all about it here and I include a link, but we haven't gotten Susan's choice yet so just trust that when we do, we'll toss a bushel of money at them. We'll

link it on our website and in the show notes once we know it. The donation is made possible by sponsors of the show. Thank you, sponsors.

[Ad Break]

Okay, let's pick through your questions and chew through the answers.

Alie: Grace Robisheaux, Emily, Samantha McGarrigle, Janice Rattigan, and Paulina Krasińska want to know, in Janice's words: Do you have any tips for a backyard orchard? Emily wants to know: Should I grow apples in my backyard? Is that even possible?

Susan: Oh yeah, absolutely. But I always say this because a lot of young couples have thought of a wedding gift as an orchard and I say, "Do you want to stay married?" *[both laugh]* So, apples, you know, our apple growers are pros. You had asked earlier about buying from apple growers or the grocery store. Grocery stores are great, they're convenient, but I like to support our local industry, they're the champions, they are multigeneration farms. But also, they do such a good job producing apples.

So, when people ask me, "Can I grow trees?" Yes. But you have to consider – there are some bulletins that Cornell provides, and other associations do – but you have to have a certain amount of light, you can't have deer trouncing through your yard because apples are number one on their to-snack list. If you have woods nearby, you get certain pressures. And then, do you own a ladder, a shovel, a spray? You're going to have to spray and if you think you're not going to spray, then you're going to have to use a knife to cut out all the wormholes. So, it's challenging. You could do it. There are people who are passionate and do a great job. But for the average person, why do you want to add that stress to your life?

Alie: Right. What kind of stuff do you have to spray on them and is that why we rub an apple on our thigh before we eat it?

Susan: *[laughs]* The only reason I'm laughing about that is we all do that; I always say that my thigh is the healthiest. *[Alie laughs]* But some of the reason we do that is when you see a film on an apple, sometimes that's just, it's called bloom and it's a waxy substance so when you rub an apple against your thigh, you'll notice it's nice and shiny. It does get off surface dirt and pesticides, but I want to make this point because people buy organic apples thinking that they're not sprayed but they are very much sprayed, they're just sprayed with different compounds. Some of them are less caustic and some of them are more caustic than what is used. Growers don't spray any more than they have to because they're businessmen and women and they live on the farm so they're not spraying anything extra because their kids are playing outdoors.

So, yes you can grow in the backyard but it's going to be a steep learning curve at first. But if you enjoy getting apples then in the long run, you're paying less buying them from the grocery store or growers than you would trying to produce them yourself. The other thing, because of storage, do you want to have baskets and baskets of apples in your cellar or garage? There was a story recently in the newspaper and the guy goes, "I'm a pariah. They're like, 'Oh no, he's going to give me apples again.'" *[laughs]*

Alie: *[laughs]* That is so good to know that it's just like, you know what? Don't worry about it, don't worry about it. You don't have to grow this. Just go to an orchard, put on a scarf, put on your boots, go have some cider. Just once a year spend a couple of days at an apple orchard instead of every single day. *[laughs]* That's so good to know!

Aside: Again, we have a Ciderology episode, get into it. On the topic of apple orchard chores, patrons Holly Giorgio-Dundon, EffortlesslyWeird, Ellen Storm, Sophie Philpott, Derek Peloquin, Destiny, Matt Ceccato, Kieran, and Anna Easton shared similar questions as Leah Anderson who

asked: How can I keep the apples on my trees from getting eaten by worms and wasps without spraying?

Alie: You mentioned too, spraying. Are worms the common pests and do those worms turn into moths?

Susan: Oh, okay good. So, there are many different things we have to spray for but sometimes people will see a grower spraying and go, "Oh my god, that's a pesticide," but it could be calcium. We spray trees with nutrients boron, copper, urea, which is a form of nitrogen, to help the trees grow. We put some dormant oils on during the dormant season, if you've ever had scale insects, that can be problematic, so that's used. We do spray because we're located in a wet region and spraying tends to be wet, there are certain sprays for fungal diseases like apple scab. You can have apple scab on your tree and live with it but if it gets bad, the trees will defoliate, which is why so many crabapples don't have leaves around here.

But you also have to spray for insects. Now, with the apple maggot, which is responsible for a lot of the worms that you see in an apple, there are sticky spheres that you can hang in your tree that have a lure and it will attract those insects and you may get away with less sprays. Or you can use, in the case of scab-resistant variety, but you're going to have damage and then some of that damage, if the fruits fall to the ground, it allows the insects to reproduce and... Not for the faint of heart.

Aside: I was like, what do these maggots turn into? The most common species in the US is *Rhagoletis pomonella* which pupate and emerge as flies; smaller than a housefly, bigger than a fruit fly with zebra-striped wings. So, I was like, okay, what are the flies called? They're called apple maggots, even though they're in adult form, which honestly is a little infantilizing. But maybe to them, it's cool, like a rap name, like a little baby. I like to think that they're in an apple just doing sexy body rolls or maybe the worm. Also, sidenote, the singer and beloved genius Fiona Apple was born Fiona Apple Maggart. And yes, she did grow up in the Big Apple. Onward.

Patron Abbey asked: What can I do with crabapples? It makes me sad to see them on the ground, too many for even the squirrels! Earl of Greymalkin echoed this question but without the mention of the squirrels, or sadness.

Alie: Paul Hoffman wanted to know: Don't eat apples that have fallen on the ground, why? Is that a myth or should you not eat fallen apples?

Susan: No. We don't allow fallen apples to be used in products because there is a particular fungus that someone recently discovered that isn't inactivated by heat. So, you could pick up what we call drops, and you could wash them but sometimes that fungus can go into the center of the apple. So, if you see a moldy core, that can cause a product called patulin, which is not good to have in food products.

Aside: So, the mycotoxin patulin has some evidence as a carcinogen and it can withstand temperatures of up to 194°F or 90°C. The scariest of ghouls this season, an apple fungus. [*spooky voice*] Spooktober! More like Sporetober... I'm scared.

Susan: But this pathogen, this fungus that doesn't get heat-inactivated, you could make hard cider, you could make cider, you could make applesauce or apple butter and despite using heat, it's going to stay alive. [*"It's aliiiiive!"*] And so, it's just easier to throw those fruits out. The other thing, when you think about it, if fruit drop and deer love apples, guess who has been visiting around that soil site? So, that would be a form of *E. coli* if there were droppings on the ground near your apple.

Alie: Oh okay, so not worth it.

Susan: Right.

Alie: Not worth it. What about, Nichole Helton said when their daughter was three years old, they gave her a whole apple to eat as a snack and then they were like, where's the core? And she's like, "I ate it." So, can you eat the seeds?

Aside: Listen, a lot of you tremble in the face of apple seeds and I get it, Spencer James Parks, [phonetic] Jessica Fowler, Matt Hirschl, Elissa Khoo, James Nance, Aileen Lands, Olivier Calas, Andrea Devlin, Aimee Bee, Natalie Murphy, Annmarie Everhart, Destiny, Tiny Nature, Lizzy, Emily Staw-fur, Allison Menard, Rachel, Brenna Pixley, and first-time question-asker S D Lennox.

Alie: Kelsey Lore wants to know: Are there apples that are poisonous? Can you eat the seeds? What's going on with apple seeds?

Susan: Okay. So, a lot of different plants produce compounds that allow the plant to survive, the seeds to survive. So, apple seeds, plum, and apricot seeds have some compounds that can get metabolized into something similar to cyanide. But we're not talking, eat and apple seed, die. [*both laugh*] I don't know if you guys remember but they used to use laetrile from apricot kernels to use as a form of preventing cancer or fighting cancer. So, I had somebody call me up and say, "Dr. Brown, how many apple seeds should I eat to prevent cancer?" And I said, "You're using the 'Doctor' in my name a little too literally. I wouldn't do that."

Aside: Just a side note, the average person would have to finely crush and consume the seeds of about 20 apples to actually do harm to themselves, so if you accidentally swallow one here and there just remain chill. You're going to be okay.

Susan: It was fine that your daughter ate the core, it passed through undamaged probably or broken up. But the seeds have to be bitten or blended so, like, making smoothies, don't throw the core in there because it's likely to get broken up. But you would have to eat massive amounts of apple seeds to have a negative reaction.

Alie: Okay. I wonder if anyone has ever tried to do any poisonings via apple slush. I imagine it would not taste very good, to get enough...

Susan: No, I've not ever heard of any apple seed poisonings.

Alie: That's good. No suspicious circumstances, foul play. A ton of people wanted to know...

Aside: Bethan Greer, Alycia King, Scarlet P, Amy Hickman, Holly Cole, [ph] Ellen Faen, Paige Van Horn...

Alie: Does the phrase, "An apple a day keep the doctor away," I know you're a doctor, but you just gave us the caveat that you are not here to dispense medical advice for legal reasons. [*Susan laughs*] But polyphenols, antioxidants...

Susan: My graduate student looked at, there are certain compounds that are only found in apple or found in a high degree in apple, and they're called dihydrochalcones, which is a mouthful, and they work with glucose metabolism. So, they're actually being investigated for diabetes and glucose in your bloodstream. I've had people who that say that once they started eating an apple a day, their A1C lowered. Gold's Gym used to say, "Eat an apple, you'll lose weight," because if you eat an apple before a meal, you're more prone to eat less. But there are so many beneficial compounds in apple. Quercetin is something that's good for mental health but I'm not necessarily the test case for that. [*laughs*] [*"I get it."*]

Alie: I mean if it makes you happy to have a SnapDragon crunch, I'd say that's an antidepressant effect right there.

Susan: That's right. and the fiber and they satiate. So, there's a lot of truth to that saying.

Aside: The saying originated in 1966 at the aphorism, “Eat an apple on going to bed and you’ll keep the doctor from earning his bread,” which honestly sounds more anti-doctor than pro-apple but is it true? Let’s check the literature.

So, there exists this 2015 *Journal of American Medicine* paper titled, “Association Between Apple Consumption and Physician Visits,” and these glorious souls surveyed over 8,000 people and found that 9% of them ate an apple a day. And though the apple eaters tended to have higher levels of education and lower levels of smoking, “Evidence does not support that an apple a day keeps the doctor away; however,” hello, preventative medicine visits are much different than a guy riding a horse to your house for some bloodletting and, “the small fraction of US adults who eat an apple a day do appear to use fewer prescription medications,” the study found.

Another paper found that in patients over 50, an apple a day had comparable effects to statin drugs in lowering LDL cholesterol. Apparently, apples have a bunch of phenolic acids and antioxidants, and a lot of goodness is in the peels. So, consider keeping those on. I myself like the peel part of the apple best and when people peel apples, I have on many occasions asked to eat the bowl of peels and as a result, I’m likely immortal. Just take a nibble out of studies such as the 2013 paper, “Whole apple extracts increase lifespan, healthspan and resistance to stress in *Caenorhabditis elegans*,” nematodes, in the journal of *Functional Foods*. This study notes that,

Animals treated with whole apple extracts were more resistant to stresses such as heat, UV radiation, [herbicide]-induced oxidative stress, and pathogenic infection, suggesting that cellular defense and immune system functions also improved. Our findings indicate that, in C. elegans, whole apple extracts slow aging, extend lifespan, improve healthspan, and enhance resistance to stress.

Okay, granted this was in worms but hey, as we learned in the Benthopelagic Nematology episode, we’re using *C. elegans* to find all kinds of weird, spooky shit.

Alie: Oh, that’s so good to know. I love apples. I actually have a bunch in my refrigerator and there are a ton of people, Cate Muenker, Emily, Kari Henke, Kyla C...

Aside: Also, Scarlet P.

Alie: Want to know: What’s the best way to store apples? Is it in the fridge?

Susan: Yes, absolutely. So, when you store them out in a bowl on the table, they’re going to go downhill pretty quickly. But if you can keep them in a crisper drawer in your refrigerator or if you have a spare refrigerator, they can be put in a plastic bag, but it should have holes in it. You don’t want to store apples near onions, they’ll pick up the bad flavor and for some reason, apples and carrots are contraindicated in terms of storing together but they’ll last so much longer.

Aside: So yes, the gentle farting of ethylene out of apples can make your adjacent oranges wither faster. And even carrots, lettuce and broccoli are susceptible to apple influencers. But don’t blame the apples, they don’t deserve you as a hater.

Alie: You know, we had a guest on here, a dendrologist who is a fan fav, Casey Clapp, loves trees, notoriously hates apple trees.

[clip from Dendrology episode]

Casey: Apples are just completely pointless. But it’s just like [frustrated] ah! Everyone who buys apples, and like, “I’m going to eat it as a snack.” I’m like, you’re just going to get hungry. You should bring cheese. You should at least get cheese and some peanut butter. I’m not going to eat it but go ahead.

Alie: I've never heard someone who was such an apple-phob.

Alie: Casey Clapp thinks that apples are an elaborate propaganda campaign. *[laughs]*

Susan: For what?

Alie: I guess for the apple industry. I think maybe he is opposed to the Johnny Appleseed apocryphal stories, perhaps. But Paul Smith wants to know, Casey is not a big man, he just wants to know: Do you think you could take him in one-on-one combat, if that's something you'd be willing to do? *[Susan laughs]* An arm wrestle maybe? I think this might convince him to love apples.

Susan: Well, let's hope so. He should try more apples. But we have people that only look at kale, or only look at grapes and we have running commentary back and forth about fruits and vegetables and which is superior. But most of the vegetables that you're eating are actually fruit so, we win.

Aside: Just in case you've never heard the classic Spooktober episode about pumpkins, let us just dip real quick into that convo about Cucurbitology with the esteemed Anne Copeland, author of the book *Pumpkin Pumpkin*.

[clip from Cucurbitology]

Alie: And now, what about some varieties of pumpkins?

Anne: Oh, there are a lot, a lot, a lot of pumpkin varieties. Now, a pumpkin is not a typical fruit. It's also not a vegetable.

Alie: Oh, it's not a vegetable?

Anne: No, it's not a vegetable.

Alie: It's a fruit?

Anne: No- Well, sort of. A pumpkin, believe it or not, is a berry.

Alie: Ohhh, what?!

Anne: It's a berry! [laughs]

Alie: How? Why?

Anne: It's a berry! [laughs] Because it said, "I'm going to be a berry," and it's berry true. [both laugh]

Aside: It's a frickin' berry, y'all! It's a frickin' berry. I looked it up and so are cucumbers and avocados are a berry, bananas are a berry, eggplants are a berry. These are berries! They are fleshy, seeded fruits formed from a single flower containing one ovary, Boom. Berries. Anne says that the biggest flimflam she's here to debunk is that pumpkins are not a vegetable.

Alie: You win! I am going to get Casey's opinion and see... Because we recorded that years ago, and I'm sure he's gotten a lot of clapback so I'm going to send him some of your research and see if he has a statement, if he wants to correct that, if he wants to rescind.

Aside: This just in, Casey Clapp was available for comment, and you'll have to listen until the very end to learn his current thoughts on apples.

Susan: But no arm wrestling, I broke my shoulder a year ago so... *[laughs]*

Alie: Okay, that's off the table, off the table. No wrestling at all, maybe it'll be a battle of wits.

And you know, the last thing I always ask is the hardest part about your job, or maybe if you have a least favorite apple, or something that's just, even though you have the best job in the world, there's got to be something annoying about it.

Susan: Oh yeah, meetings. *[both laugh]* Meetings, paperwork, reports. My mom was cute because she said, "What do you do in the winter?" And I said, write papers, write reports. And she goes, "They pay you to write?" *[both laugh]* So, you know, I love being out in the orchard, I love talking with growers, talking with consumers so that's the highlight. But everybody always goes, "Oh, it must be so beautiful to be out here!" But on a day like today in the fall, it was gorgeous, but we're out there when it's raining, when it's sleeting. So, there's a lot to that.

But for me, it's the fascination with everything that you can discover, and we have colleagues, they'll come down and we said, we're playing detective today, we're going to try to figure out this problem. And you can impact the industry as well and consumers benefit. But when you're asking favorite, I'm going to tell people to try different apples outside of their comfort range because there's a good chance that if you grow up eating McIntosh or Golden Delicious, you like that apple, but your kids might like something different. So, that's important. And then in terms of least favorite apple, if I say it, I'm going to get nasty letters. *[laughs]*

Alie: Can you say what you don't like about it?

Susan: So, I'm not a big fan of Rome Beauty.

Alie: Okay.

Aside: We got it out of her!

Susan: Which is a big apple in Ohio, and it is a good processing apple, but I told the growers when we were releasing these apples, "Just give me some of your Rome acreage."

Alie: *[laughs]* You're like, I think we're done, we're done with growing as many of those. And I should ask, first-time question-asker Abbi Lawson, I will throw in one more listener question here, wants to know: What are your favorite things to do with a glut of apples? So many people want to know, Anika's Cat Arya: Does the pomologist have any good recipes to use apples in the fall? What is your favorite recipe? What do you recommend?

Susan: Okay, time to be truthful because my children will write in. *[Alie laughs]* An apple breeder, any apple breeder, any fruit breeder tends not to make a lot of products with their crop because I eat apples from sunrise to sunset. I turn green and the last thing I want to do is make a pie. I'm getting better now that, you know, the kids are older. But I worked with Amy Traverso on a cookbook, Owen Woodier, there are so many good cookbooks. If you go to your state's apple association or the US Apple Association there are free apple recipes online. You know, apple crisp is something really easy to do. Sautéed apples with cinnamon and fresh whipped cream. I say, the easier the better.

Aside: If you'd like to peruse this very detailed and smart guide to apple recipes it's called *The Apple Lover's Cookbook* and we'll link it in the show notes. Please send me your pies. Just kidding, don't. I check my PO Box, like, every three weeks, honestly.

Susan: But for a while my kids used to have to remind me to bring apples home because while I was enjoying them, they weren't getting enough.

Alie: *[laughs]* They're like, "Mom, you should have a purse full of apples at the end of the day. Come on!" Do people ever ask you as a doctor of pomology if there's something about knowledge in an apple?

If that biblical story somehow rings true for pomologists, that the more apples they eat, the smarter they get?

Susan: *[laughs]* I have enough people who would give me grief so they would argue against that adage. *[laughs]* It probably loosens some of those IQ points.

Alie: *[laughs]* And besides that must drive you crazy because I understand it was a pomegranate, something got mistranslated, right?

Susan: Right, the words in Latin were very similar.

Alie: I guess *pomme* and *pomme de terre* and pomology, they're all in the same family there, right?

Susan: Right.

Alie: This has been such a joy; I cannot tell you how excited I am I got to talk to you! I'm having a real fangirl moment. *[Susan laughs]* You're such a huge name and genius in apples.

Susan: Oh, thank you so much. This has been phenomenal. Remember, I always say, support your local farmer. But also, that there are people like me in every crop that you eat so when you sit down to dinner, some crazy man or woman spends half their life trying to improve that crop for you.

Alie: Eat your fruits and veggies. Love your fruits and veggies.

Susan: *[laughs]* That's right. It was a pleasure.

So, ask kind people crispy questions and shine one on your thigh for Dr. Susan K Brown. I hope you're about to layer some plaids, go out, hit an orchard. I, myself, plan on being cozy, even if I get heatstroke. There are links on our website at AlieWard.com/Ologies/Pomology with more about Susan and her work and links to so many studies we discussed as well as links in the show notes.

We're @Ologies on Twitter and Instagram, I'm @AlieWard on both. We have *Smologies* episodes which are shorter, kid-friendly versions that are safe for all ages, those are linked in the show notes as well. Thank you, Zeke Rodrigues Thomas, Jarrett Sleeper, and of course Mercedes Maitland for working on those. Erin Talbert admins the *Ologies* Podcast Facebook group and I've known her since we were 4 and one of my favorite mems together is taking a field trip to Apple Hill outside of Placerville, California when we were just tots. If I had a time machine, I'd go back and visit those days. Noel Dilworth is our scheduling producer, Susan Hale is our ever-powerful managing director who also fact-checks, makes sure everyone gets paid and handles merch. Emily White of The Wordary makes our professional transcripts. Kelly R. Dwyer works on the website. Happy birthday to the Fanciest of Nancys, your PodGram who celebrated on October 16th. And many thanks to lead editor Mercedes Maitland of Maitland Audio who travels the long and widening road every week to make sure these episodes reach their destination, which is your brain. Nick Thorburn wrote the theme music.

And if you stick around until the end of the episode, I promised you the thoughts of Dendrology episode guest and cohost of his own tree-themed podcast, *Completely Arbortrary*, Casey Clapp. I reached out and within an hour or two, I opened my email to an audio message from him.

[audio message from Casey]

What's up Alie! This is Casey Clapp talking to you about apples. You reached out. I am happy to have a conversation or at least present to you a little bit of my thoughts. First off, my thoughts on apples, nothing has changed in the day-to-day. They're a freak of nature, is what I'm saying.

However, I have recently, Alex and I specifically, we went back and redid our episode on the apple tree, and you know what? I have to admit, in the grand scheme, my opinion on apples has changed because I learned that the original apple, the OG apple from Kazakhstan, had a fascinating history of development through the peoples that used to live there and still do today and still have apples as a huge part of their culture. And now, we have bred these apples in the strange, wild way that we do today.

So, the apple as we know it, are you going to plant an apple in your house and eat all of them because you think you're going to have a nice orchard? Probably not. Plant a big tree that's going to do cool stuff anyway and let an orchardist take care of the really intense apples that everyone loves. I think the apple is a wonderful example of how animals and humans and time and plant all have worked together to create this thing that now, today is a monstrosity. But I guess, you know, I just go back and forth.

Anyway, apples are pretty cool. In fact, I'm going to eat one right now just because well, I have one. Hope you're doing well!

Casey Clapp, cohost of *Completely Arbotrary*, alongside Alex Crowson who is also a really good musician and I've listened to Alex's latest album, "Sorry, I Missed You," probably several hundred times. Good dudes. Also, I think Casey... I think he just has a really fast metabolism and requires some protein with his snacks, that's not the apple's fault but we should do a study on it.

Also, one more secret. I had been really, really sick the last few months and one day I got some mail from my sister Janelle, and it was a bunch of Halloween socks, because I love Halloween socks, that made me so happy. And also, in the package was a bag of sour green apple gumballs. For a second, I was mystified, I was like, "Why did she send me these?" Then I remembered, when she first got her driver's license and I was 14, we would run errands to the store for my mom but take every back road possible and just drive around listening to this old U2 tape. And then at the store, they had those gumball machines so for a quarter I'd get a green apple one, and then on the ride home I would chew it and blow the green apple flavor into Janelle's face because little sisters are the worst. And she would plead with me not to but then it became tradition.

So, last month when I opened this care package to see these green apple gumballs, augh! It all came rushing back. And my heart leaped, and I've been chewing them and those times driving around in the summer with the window down, apple gumball fumes in the breeze. Man, that's another stop on the old Alie Ward time machine of classic mems. Okay, go have a snack but not if it's been rotting on the ground. Okay, happy Spooktober. Berbye!

Transcribed by Aveline Malek at TheWordary.com

Links to things we discussed:

[Apple Festivals in 2023: Where, When and More to Find an Apple Festival Near You!](#)

[Apple Varieties Guide by Harvest Date - Which Apple to Pick and Why!](#)

[Every Apple You Eat Took Years and Years to Make](#)

[Why It Takes Decades To Breed New Apple Varieties](#)

[Snapdragon apple wins outstanding cultivar award](#)

[New York Apple Growers sets out the growing and marketing plan](#)

[Crunch Time Apple Growers offers unique apples](#)

[National Park Service: Fruit Varieties: Apples](#)

[MAIA-L \(Ludacrisp®\) - Midwest Apple Improvement Association](#)

[BOOK: Johnny Appleseed: The Man, the Myth, the American Story](#)

[The A, Bee, Cs of Apple Pollination](#)

[The Religious Motivations Behind How Johnny Appleseed Grew His Apples](#)

[The Last Wild Apple Forests – Almaty, Kazakhstan](#)

[Gravenstein - Wikipedia](#)

[Why Your Supermarket Sells Only 5 Kinds of Apples](#)

[Barbara McClintock and the discovery of jumping genes](#)

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[Apple genome - Wikipedia](#)

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