Giant Pumpkin Genetics- An interview conducted by Frank Finders with Joe Ailts in 2014.

- 1.How relevant are genetics to the average grower? We all day dream of crosses, discuss " genetics" online and hope to create or at least grow that next top seed. Are we just kidding ourselves and have most modern pumpkin seeds similar potential that is already hard to reach for an average grower, and has that potential been there all along? Has it been just out of our reach due to our faulty or lacking growing techniques? Or do we actually contribute to the evolution of the Atlantic giant, and are we improving its genetic make up for size thru selective breeding?

  To the competitive giant pumpkin grower, genetics are everything and they are nothing. "Everything" meaning that the Atlantic Giant genetic variety is the only choice for growing a truly competitive fruit. Of course, anyone "in the game" already knows this. But when the neighbor asks you how you grew that thing..."is it a special seed?"...well, darn right it is. *Cucurbita pepo* has no chance of threatening a world record. We know that *Cucurbita maxima*, Dill's Atlantic Giant, is the exclusive gene blueprint necessary to grow the world's largest fruit. As such, genetics are everything.

  "Nothing" refers to your question about kidding ourselves...it is my humble opinion that a seed from a 1700lb fruit grown on the East coast has essentially the same genetic potential as a 1700lber grown on the West coast, with the assumption that each were pollinated by a similarly-sized pollen donor. We, as growers looking to maximize every variable within our locus of control, spend hours poring over the "genetic potential" of 17xx vs 17yy vs 16zz vs 18qq, speculating a thousand reasons why one may be superior to the other. At the end of the day, we simply do not have a means to objectively assess whether any particular seed line has a definitive advantage over any other. Comparing seedline's progeny records, ultimately the only tool at our disposal for quantitative performance comparisons, simply cannot reliably predict superiority of one seed over another. To answer your question directly, this is where I believe "genetics" does not have relevance to the competitive enthusiast.

  Regarding "genetic potential" having been there all along, this serves as a topic ripe for debate. Would Howard's seeds from the early 80's been able to push a ton if managed by today's growing practices? Ask a hundred growers and the consensus would probably be an overwhelming "no". But what gives us that confidence? What, on a genetic level, is different about the seeds 30 years ago vs what we have today? Genetics is such an incredibly complex area of science that even the brightest minds on Earth may not be able to propose a reasonable explanation for what our hobby has experienced. For what its worth, I do believe that selective breeding, practiced as growing the seeds from the heaviest pumpkins and crossing them with similarly heavy seeds, has increased the capacity of top weight potential in a curiously exponential year-over-year growth trend. Combined with evolving growing practices and a deluge of novel external inputs, there appears to be a synergy between genetic and

environmental factors that have allowed us to do the truly remarkable in a remarkably short time.

- 2.How valuable is it to look at the size and weight of a pollinator? Does the size of a fruit say anything about the qualities that a plant brings as a pollinator or father? Or should we choose a pollinator based on its family and ancestry? In other words does the size of a pollinator matter or is its family tree/genetics more important? Some folks only grow seeds with a big pollinator, does this narrow their choices down and exclude potentially great seeds? Or is this a way of weeding out bad seeds and playing it safer.
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- To clarify, I am aware of no evidence that suggests pollen donors have an influence on the growth characteristics of the pumpkin they pollinate (exception: a successful fertilization process is necessary to avoid fruit abort). So to put this issue to rest (until proven otherwise), pollen only has genetic influence on the next generation (seeds).
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- To that end, I believe there is some value in considering pollinator characteristics depending on your personal goals. If maximum weight is the goal, I believe choosing a seed whose parentage is a cross of maximum weight pumpkins is the most objective choice you can make. I call this simple analysis "cross weight average" and while it's a nifty tool for numbers geeks, there's no proof that using it will grow you bigger pumpkins. That said, here's an example- the 220 Debacco (2009 Wallace x 1725 Harp) is a cross of two very large fruit. Sure, each were world records, but I'm more focused on the fact that when you add them together (2009+1725=3734) and divide by two (1867), that number represents an average "cross weight" that is within 10% of the current world record. The 220 seedline has demonstrated that despite its small size, the seeds inside were a combination of upper echelon pumpkin genetics that have been born out in its progeny. If you are a believer in idea that selective breeding (seeds from heaviest x seeds from heaviest) contributes to a continually improving Atlantic Giant gene pool, then planting seeds with the highest "cross weight average" is the strategy by which your genetic potential is maximized.

- 3.Although touched upon in previous questions, is phenotypic variance due to genetics or environment? Explain either choice.

  The nature vs nuture argument has been hotly contested since the discovery of the gene. However, biological science has evolved to the point where this question is no longer relevant. Scientists know beyond a doubt that phenotypic traits (size, color, shape, etc) are a result of genetics and environment (Is it possible to have a peanut butter and jelly sandwich without the peanut butter?). To complicate matters, scientists have now discovered that not only does the environment dictate growth and development directly (water vs no water affects outcome, right?), environment also has effects on the genes themselves, turning certain ones on and

others off. This rapidly emerging field of science is called "epigenetics", and is focused on understanding how things in the environment influence the genetic blueprint. Despite all this scientific advancement, we're a long ways off from realizing the implications for growing bigger pumpkins.

- 4.Inheritance is something we all hope for when we grow a seed. Growing the seed out of a big and heavy fruit, and hoping that its offspring inherited those traits and may even be better. If we like most traits out of a fruit, but it has one or more that is less desirable , like for instance growing a dill ring, or going light, how do we go about breeding this out of this particular line?
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- This is a challenge because we do not know concretely which characteristics are truly "genetic" and which are genetic traits subject to environmental influence (read: epigenetics). Dill rings are a characteristic that appears to be passed on through inheritance. As such, growers have labeled it a "genetic" trait. However, not all seeds from parent with dill rings will exhibit the characteristic. This may be due to a recessive characteristic or it may be due to an environmental influence (moisture, temp, nutrients, etc). While there may certainly be a genetic code that leads to a dill ring, there may also be multiple environmental triggers that turn it on or turn it off. Unfortunately, we do not know what these are, if they do exist. Given these unknowns, the best way to avoid a dill ring is to avoid growing seeds that have it in their history.
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- On the topic of pumpkins that weigh significantly heavier/lighter than their estimation, this too is an incredibly complex milieu of genetic and environmental factors. Skin density and skin thickness, the two primary factors that govern variance in estimated vs scale weights, are likely controlled by many genes. In the realm of genetics and breeding, the more genes you have involved in a specific trait, the more challenging it becomes to isolate that trait. What this implies for us as hobbyists is that we just don't have the ability to run multi-generational breeding programs with thousands of seedstocks to begin meaningfully isolating a characteristic of this complexity. It might be accomplished if we chose to grow and cross only those seeds that demonstrate significant % heavy character, but the grower populace is more focused on top weight crossing.

- **5. Squash has suffered a lack of growers and it is clearly seen in the on average lower weights then pumpkins. What are the main differences between squash and pumpkin besides color and seeing that many if not all current pumpkin lines have squash in their ancestry, what is the importance of squash, can squash surpass pumpkin the future? Or even catch up?**
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- The squash story might be the best evidence we have supporting the selective breeding theory. As a believer in the selective breeding theory, if squash had followed the same selective crossing pattern and frequency of growth that pumpkins had, I see no reason why they too wouldnt have similar results. Genetically, they have essentially identical blueprints as pumpkins, save for the color gene. If this is indeed the only major difference, then squash have the same capacity for

weight as pumpkins, but due to falling out of favor, are 20 years behind the curve and may never see the same top weights as pumpkins.

- **6.Is the popularity of seeds changing to fast? After every season there are several new top seeds that get grown the year after. Unless they grow a monster right away they are forgotten. Have we lost or never discovered some of the best seeds and genetic combinations because of our crazy standards and wishful thinking. Should one choose a proven seed or take an educated guess and hope for the best with a new cross? Do two great parents guarantee a great seed?**
- To reiterate, without a way to measure the capacity of a seedline, there's no way to determine if we've lost or never discovered better seeds. It is certainly true that the pace at which seeds gain and lose favor has quickened with time. With top weights growing at a seemingly exponential rate, coupled with an exponential growth in the number of growers putting those seeds in the ground, the hobby as a whole is evolving very rapidly. I believe an intriguing question to ask is "if the 1725 Harp or 1068 Wallace (seedlines that show up in many of today's top lineages) had no seeds in their cavities, would the 2013 all time top ten average be similar?" Purely speculation here, but my belief is yes, the all time TTA would be similar. This ties back to my belief that there is not a significant amount of variance in the potential of the top seeds out there. This belief leads into the next question regarding great parents making a great seed. Anyone who has grown one of these things knows there's no guarantee. But as I described earlier, if one wants to maximize genetic potential, I believe that growing seeds with maximum cross w e i g h t average is the path to doing so. Think about it from this overly simplistic perspective…if you wanted to grow a pumpkin that had the highest probability of deep orange color, which cross would you choose…deep orange x deep orange, deep orange x cream, or cream x cream? I'll surmise we are in 100% agreement on this.
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- **7.What would be the best way to breed for color? Either Orange or green. And how would you go about increasing size along with that. The holy grail for many a grower: Big and Orange, or Big and Green. Some seeds have done it, but there's non that do it all the time.**

- Either Orange or green. And how would you go about increasing size along with that. A: The holy grail for many a grower: Big and Orange, or Big and Green. Some seeds have done it, but there's non that do it all the time. I believe the best way to isolate a specific trait is to continually self-pollinate a line that most consistently exhibits that trait. This applies to both orange and green characteristics. Unfortunately, self crosses have suffered a bit of a negative stigma within our hobby. Whether its fear of recessive traits coming to the surface, "inbreeding depression" or that it's just not as exciting as out-crossing, "selfing" remains an undervalued strategy in Atlantic Giant breeding. However, when the goal is trait isolation, selfing is the most powerful and effective tool in the toolbox. Chasing the holy grail of big/orange or big/green would require a similar strategy. Identify the seeds that are the most ideal combination of heavy weight and

color preference. The 1610 Lieber is a example that comes to mind. It was beautiful orange, a scale buster, and it was already self pollinated. Perfect setup for big/ orange isolation. Next, solicit buy-in from the grower community at large to plant these seeds and encourage each grower to self the cross. Select the best performers for next year. Rinse and repeat. With large numbers of growers following the same philosophy, eventually lines would emerge that may consistently demonstrate the qualities of interest. The only way for this to happen is for a group of growers with a common interest to organize themselves, publicize their mission to the growing community, and get as many people on board to follow the strategy as possible. This would apply to any goal of trait isolation, whether it be color, size, % heavy, what have you.

- **8. Every cross made comes with different potential. The only measure of success we really have, is to look at its offspring . The heavy hitters out there can make it look easy, growing one monster after another, year after year. How is the ratio between grower skill and genetic potential when it comes to growing a seed? Does the success of a heavy hitter point to a great seed or does it just confirm his or her skills?** My firm belief is that it is 99% grower skill, 1% genetic potential. These are arbitrary numbers, not rooted in any formal study. But the point is simple- Every grower today is on a level playing field when it comes to genetic potential. With easy access to seeds from pumpkins within 10-15% of the world record (anything over 1700lbs), success in the patch boils down to maximizing environmental factors. Grower skill is a major contributor, as is climate, soil health, disease pressure, and, what in my mind is truly the "secret" to growing a big one: time in the patch. Allow me to digress for a moment, if I may. It has been said that it takes 10,000 hours to master a skill. Success in a giant pumpkin patch is no different. A consistent theme amongst all growers who have reached the highest pillars in our hobby is their time dedication to making it happen. This secret is really no secret at all, but rather a commitment. I cannot think of any other competitive sport/hobby that involves genetic potential where the cream of the crop genetic pool is so readily accessible. With this is mind, success is limited only be environmental factors, many of which are controllable to some degree. Literally anyone can grow a world record if they commit to it (with a few stipulations, of course).

- **9.Seeds out of a single pumpkins can differ from one another, some grow orange, some white, some are duds. The less variance and the more it does what we want the more desirable a seed becomes. What happens when a pumpkin has three or more colors? And can we make sure we get the result we expect or is there a risk with every seed we plant? What seed with what ancestry have the highest risk?**
- It is important to recognize that every "litter" of seeds taken from a pumpkin has a spectrum of variability encoded within it. Just as pigs will have runts, so will pumpkins. Just as dogs will have puppies with differing colors, so will pumpkins. Nature stirs the pot like this for a very good

reason. A random roll of the genetic dice in every offspring creates an opportunity that a particular genetic combination will be better suited to survive and recreate itself in the next generation. Our current genetic pool has a lot of variation in it, as you alluded to in your question. And as I described earlier, the only path to minimizing this variability is through organized selective breeding programs. It's a huge undertaking. Until such time, we simply need to accept that our seed pool will have inherent variability and the result we hope for can never be guaranteed.

- **10.What is the future of giant pumpkin growing. Are we going to reach our ceiling genetically any time soon. Is progress going to stall eventually and then come to a halt?**
- This is the million dollar question. In the 90's, it was believed that 1000lbs was the ceiling. Zehr's proved us otherwise. In the early 2000's, 1500 was the new ceiling. Ron proved us otherwise. We grew to accept that the bar is perhaps more easily raised than we previously thought. Ron proved another point with 2009. 1500 is the new 1000. A pumpkin that would have set a world record a decade ago may not even earn you 10th place. As a trained scientist, I am continued from page 5 6 truly amazed by what this hobby has accomplished in a very short timeframe. I believe that any formal biological research institution would look at the way in which world record weight growth has tracked and stand with mouths agape. Its hard to predict what the ceiling may be, primarily because we don't have full or even partial knowledge of what the primary limiting factors are. Are we limited by the environment? Or is it a genetic ceiling? I speculate that the largest hurdles are environmental. As a comparator, many experts in the grain production industry believe that current corn hybrids have the genetic potential to surpass 500 bushels/acre. With many farmers averaging 150-200 bushels/acre, this implies that corn growers have only realized less than half their seed's potential! Does this same principle apply to giant pumpkins? That's an impossible question to answer currently. Regardless, I'm excited to be fully immersed in the "golden age" of giant pumpkins. Those of us in the hobby right now are experiencing milestones that will most certainly become part of the fascinating history of this hobby. Generations to come will look back upon what a tight-knit group of enthusiasts were able to accomplish with little more than passion and dedication. That's a pretty darn cool thing to be a part of.