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3MG R&D in the Vanguard of Agriculture

By: Erin Rodriguez

As our first annual field day arrived, a sense of exhausted euphoria exuded from the staff. We had pulled together and worked hard to create a successful event. The weeks of preparation and planning were done. The running around had been reduced to a walk, and we were primed and ready to enjoy the fruits of our labor. We were excited about presenting our Durayield products to our customers. Furthermore, it was thrilling to have achieved what many doubters thought impossible: we developed a group of corn hybrids that thrive in the tropics. The implications of this development reach farther than the borders of our farm- they extend to an ideal and vision that we are working hard to achieve. We can facilitate a more sustainable system within the sphere of agriculture.

As our field day came to an end one of our attendees thanked us for our work in aiding the development of self-sustaining Caribbean nations. This person acknowledged that this was not only needed but something that he had not seen from other companies, let alone one that is owned by an American. He went on to say that he was impressed with our business model and could easily see the future of our company being a productive and successful one. Of course this is nice to hear, but more importantly it reinforced what we already knew. We need to work in collaboration with local farmers to make these island nations less dependent on imported food and more sustainable in its agriculture. We can do this by developing systems, products, and networks that will aid in the feeding of the island's animals and in turn its people.

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Life's Genetics Markers

By: Raechel Baumgartner

There are a heck of a lot of things we don't know about genetics. Anyone who tells you otherwise is delusional. Yes, the corn genome has been sequenced. Yes, we know what some genes do (I would argue that we know some of what some genes do). And yes, we learn more about genes every day. But you want to know something else? There are a heck of a lot of other things that go into a phenotype than just the genes.

First, there's this formula I learned in class: Genotype + Environment = Phenotype

As I advanced in school, that was changed to G + E + GxE (that is, Genotype by Environment Interaction) = Phenotype

I also pulled this one out of Biology class starting in high school, the so-called "Central Dogma" of biology: DNA is transcribed into RNA and then translated into proteins. Some exceptions to this rule have since been discovered (link).

I remember two moments very clearly in my genetics journey (well, three, but the third is a topic for later).

The first: I was sitting in sixth grade science class when my teacher started talking about Gregor Mendel and teaching us simple genetic inheritance using the Punnett Square. (link: wikipedia) This little light bulb clicked on over my head, "That's what my Dad does!" All the puzzle pieces assembled, clicked together, and a love of classical genetics was formed in my 11-year old brain. It just made sense.

Fast forward about 10 years for moment #2. I was sitting in a graduate-level class called "Transmission Genetics" about halfway through the semester. A different professor had just taken over to teach the next section, and he started talk about Epigenetics.

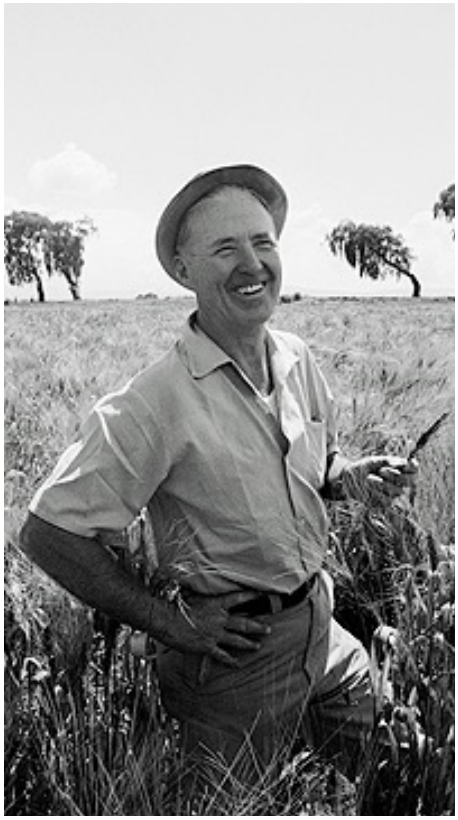
Epi- : over, above, beyond, on top of …genetics.

Heritable traits and characteristics that are not caused by genetics and that do affect transcription (and therefore translation and therefore phenotype). (link: wikipedia) "A whole new set of things that I'm just learning about now that are heritable and not genetics?" I thought. "You mean I can have a gene and it not be expressed (or be expressed) because of some other factor, and that

non-expression (or expression) can be passed on?"

At this point I threw up my mental hands and wondered what the heck the point was of all the time, effort, and money that went into gene sequencing, especially because it had a "be-all, end-all, we're gonna know everything in the genetic code and be able to design stuff" kind of perception.

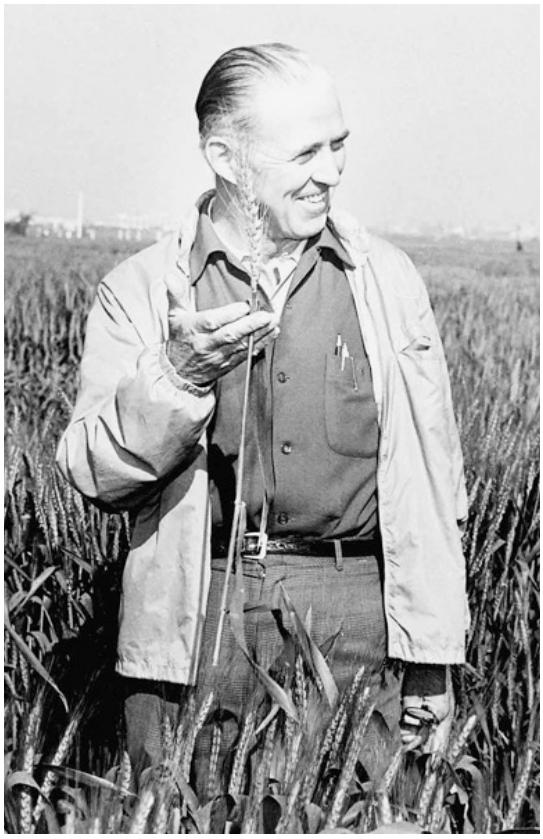
I realized in that class how happy I was that I was studying to be a plant breeder. My philosophy? I don't have to know why or how everything works. My job is to see if it does work and run with that. The why and how come later.



The thought process that led to the Durayield concept

By: Ed Baumgartner

Living and working in Puerto Rico provides a different prospective not only in life but also in plant breeding. Everything you know is challenged. After first few years of working in Puerto Rico I realized that we could consistently create specific stresses on a crop. This was whether we intended to apply them or not. I began to think that this is a perfect place for a managed stress environment as long as insects and heat were part of the managed stresses that were desired. As a plant breeder you want to apply the various abiotic and biotic stresses during the development process to develop strong new inbreds and hybrids. Most of us are taught that you need to breed corn where it will be sold and grown. I agreed with this mindset early in my career but as time went on, I realized that this was not a correct thought process. Most of my colleagues in corn breeding will say that you need to develop corn where it will be grown, however they are selecting hybrids to sell from their development programs based on how widely adapted they can be grown. The wider the adaptation for the hybrid, the better the corn hybrid in their world. What about the needing to breed corn hybrids where they will be sold concept?



Before starting our breeding program at 3rd Millennium Genetics in Puerto Rico, I began researching successful plant breeders and their methodologies. Prior to becoming my own boss, I was required to follow breeding strategies that my employer required. Most of these would not work in our new program because they were all based on the mindset that breeding needed to be done in the target environment and winter nursery was used only to advance a generation without selection or for hybrid seed make up to test the next summer. Being a University of Minnesota graduate, I started with the Father of the Green Revolution, Norman Borlaug. He has a very interesting story that went well beyond plant breeding. I recommend reading books written by Noel Vietmeyer about Dr Borlaug's life (link). Dr. Borlaug utilized Shuttle Breeding to develop his new wheat rapidly. This technique of using a target environment and then a stress environment to select in for varietal development really hit home for me. These new wheat varieties became widely adapted through this breeding method and were able to be deployed in various parts of the world where they were needed to stave off famine. If you read the books on Dr. Borlaug's life, you will see that he was not the most popular person in academia and other public institutions. He pushed the boundaries of what was accepted practice all the time. That's what we need to do now to get to the next level of production. We need to question all of the accepted standard practices of corn breeding.

The thought process that led to the Durayield concept

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I find it interesting that the breeding methods of the first Nobel Peace Price winner in Agriculture are not taught in US plant breeding classes. He must have really irritated his peers with his unconventional success.

I have had many opportunities to visit with successful corn breeders to try to understand what works for them. One of the common themes between all of them was selection under stress. Most accomplish this through selecting under higher populations to create drought and other stresses. Then I thought the real proof in a good plant breeder would be to research the research most widely used lines in the industry over time. The incredible part of this research is that some of the most widely sold hybrids had inbreds in them that were developed during difficult drought periods, were descendants of lines developed in drought periods, or were developed in areas prone to drought year after year. (Link) After this revelation, I began to think that we need to focus on creating real drought situations during the inbred development process rather than creating a possible drought like scenario with higher populations. I believe that higher population breeding to create drought stress has led us to reduced ear flex or fixed ear hybrids that are so popular today. No doubt they can yield at the proper population for the specific hybrid and with the right weather conditions. You get what you select for in a plant-breeding program. So why not select for more yield under actual or real life environmental stress conditions rather than a more plants per acre stress? It is logical that some of the genes captured under high plant population breeding add to drought and stress tolerance in the corn hybrid. It is even more logical to breed corn under drought and other stress conditions to capture the most possible gene combinations for broader tolerance to these abiotic conditions.

I began to ask the following questions: What are the relevant environments in a breeding program? Are all stresses in a given environment relevant? Do we need to select under more than one stress at a time? Do diverse stresses help develop the best inbred/hybrid? Where would we be yield-wise if we created drought stress differently during corn inbred development? If we develop highly stress tolerant corn will we lose top end yield? Would we need the plants per acre we use today if we did not use higher plant densities for drought selection? Would our corn plants only produce same amount of grain per stalk as they did 40 years ago? Would we have hybrid corn plants that produced two or three good-sized ears per stalk now rather than one? What would our seed field yields and seed quality be when inbreds are developed in difficult environments? Would our seed field yields be more predictable?

I welcome your feedback! I will respond to as much feedback as I can in subsequent issues of NeWold Times and continue the Durayield thought process.

In case you missed it, here is a brief recap of our field day

1. It was a long and winding road to get here.
2. If you start to lose hope, listen to your wife! (And as one attendee added, your daughter, too)
3. The last ten years have involved a lot of sweat, blood, and tears (some of which were tears of laughter).
4. Never let your education get in the way of what you can learn by using your eyes in the field.
5. Lunch was really good. (Thank you, Nelson!)
6. This stuff really works!! (And if you weren't here, you'll just have to ask the people who were)

3MG R&D in the Vanguard of Agriculture

(Continued from page 1)

Puerto Rico has enough food to feed its people for only 2 weeks. This is because 85 per cent of the food consumed on this island is imported. This phenomenon is not particular to Puerto Rico, but rather it is prevalent on all the Caribbean islands. By designing a new model for consumption and production, we are part of the vanguard in creating a more self-sufficient Puerto Rico and eventually Caribbean.

Our holistic approach is innovative in its simplicity; we want profitability and sustainability for the entire food chain. Our goal is for the producers, the developers, and the consumers to share the benefits of using our Durayield non-GMO seed. We are not simply selling seed; we are selling a comprehensive product and system. We work with our customers by advising them on how to integrate into a tropical environment and how to prosper in this environment. We are aware that this is no easy task because so many before us failed. Now that we have succeeded, we want to share this success with the agricultural community and by extension society.

For us the whole globe is a community, and we are devoted to the service of that community through agriculture. We are encouraged in our labors. We are grateful to those who support us and believe in our vision. Together we can change the way we feed the world.

NeWold Times

3MG R&D

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Founded in 2012, 3MG R&D has been involved in the creation of innovative products that we hope will be in the forefront of the seed market. Guided by our principle that we can develop food crops that combat environmental pressures naturally and economically, we continuously research new solutions using a mix of millennia-old breeding techniques with high-end modern genetic technologies.