NeWold Times

a 3rd Millennium R&D Publication

Volume 4, Issue 1

Spring, 2017

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The Aha Moment

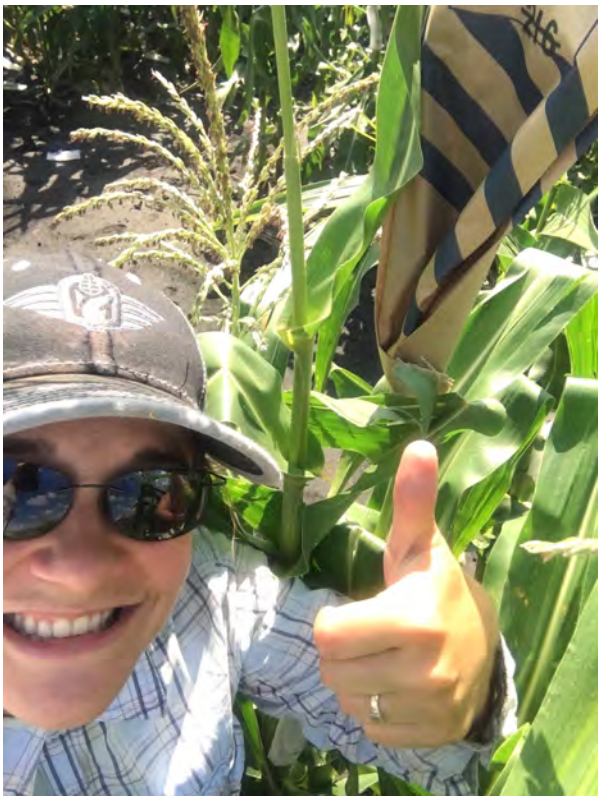
By Raechel Baumgartner Delgado

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

That third moment I mentioned in a previous NeWold Times article two years ago actually occurred in between the other two. I was a first-semester freshman, and in my Principles of Biology course, we were talking about Hardy-Weinberg Equilibrium. I remember staring up at the big screen, and I probably had my *I'm-thinking-really-hard-about-this* look on my face, because it wasn't completely making sense. Algebra. Five assumptions that never actually occur. p2 + 2pq + q2 = 1… *What?* I didn't think much about it for the rest of the day and went off to my other classes.

Even though I wasn't directly thinking about it, Hardy-Weinberg was rolling around in my brain. I know this because one night later that week, while I was dreaming away, I suddenly sat up with a wild and crazy look in my eyes. *I got it!* In my dream, I had been working through Hardy-Weinberg equations, and all of the puzzle pieces suddenly clicked together so hard that I woke up in such a manner that is normally reserved for sudden noises and scary things in the dark. *This. Is. AWESOME!* It was. I got to combine the love of Mendelian Genetics I had had since I was 11 with the love of simple algebra I developed when I was in high school (weird, I know).

The Aha Moment *(continued from page 1)*



My understanding of Hardy-Weinberg Equilibrium eventually morphed into a love of evolutionary genetics, which in turn shapes the way I think about plant breeding, particularly as it pertains to our long-term population building, *If we make THIS change, how will it affect the genetic frequencies down the road?* I think that a lot.

Corn breeding itself takes a lot of time. Getting to the testing stage takes about 3 years, and that's running at a fast pace! To have a commercially released hybrid, you're still looking at about 7 years minimum. If normal breeding takes so long, why have long-term breeding projects? Aren't they all long-term? Not really.

In addition to our normal line by line crosses for inbred development now (or 3 years from now), we have several population projects where we crossed up a number of lines to create a gene pool that captured different traits and as much genetic diversity within a heterotic pattern as we could. We continually cross plants and recombine within a population, spinning off lines for testing, and then recombining the yield trial winners. Why invest so much into this project? Thirty years from now, we expect these populations to be the primary source of genetics for our inbred development program.

How does this tie into Durayield? In our current Durayield breeding scheme, we apply multiple stressors to families under development, oftentimes creating a genetic bottleneck where only a few individuals from the family survive to the next step in the development process. This kind of a system, while effective immediately, can pose long-term problems in the future. What alleles and traits are you losing by chance in the process? Did you lose something by chance you may need? With our long-term populations, we can apply the stressors more slowly, gradually building up the frequencies of the alleles that will give us the traits we want. We can nudge the gene frequencies in the direction we want without actually losing the diversity we need for longevity in our germplasm base.

So now you know. When I am older than Ed is now, we will have a rock-solid set of populations that will result in a steady stream of amazing and high-yielding Durayield products, and life will be even better than it is now. *Boo-yah*.

Just for the record, the five assumptions are:

1. completely random mating
2. large population size
3. no migration
4. no mutation
5. no selection

We violate all of those assumptions in plant breeding!

Well, ok, mutation happens on its own in our program.

Changing Mindsets

by Ed Baumgartner

How do we change a mindset? We think that bigger is always better and that bigger delivers more innovation. I would like to challenge that thought process, in my personal experience of having gone through several mergers starting out in a family company which turned into one of the major companies that is undergoing yet another merger now.

Our service businesses work with several start-up venture capital-type firms each year. They have innovative new product concepts to be developed and tested. Many fail, but some have truly ground breaking concepts and ideas. What happens to these successful companies when they demonstrate positive production effects for their products? They are generally purchased by a larger company with a great marketing organization to supply the agricultural industry with the next new ground breaking product. The entrepreneurs are handsomely rewarded for their efforts, and the game-changing product is being firmly placed in the marketplace. This is a good thing. The public benefits and the entrepreneurs are free to go back and start something new again once their non-compete contracts expire if they choose to do so.

My concern is that we are allowing the reduction of the number of large players through the current consolidation activities that can purchase these start up companies for the value they represent. This could reduce the value they represent in the marketplace due to reduced competition to purchase these types of companies in the future. This reduced value could slow innovation in the future. If there is less gold at the end of the rainbow, will the venture capitol flow as freely to allow the development of new ideas and products? When you move beyond the money part of this discussion then you think about the reduced number people that would analyze the next great product to determine if there is enough value in the new product to pursue it. Will there be enough people in the remaining companies looking for the latest ideas to capture the truly innovative ideas available?

The positive side of all of these mergers taking place at the same time is that there will be a lot of talented people being creative again. They have to be as they were part of the excess headcount that had to be released to meet the financial side goals of the mergers. Too young to be retired and too much left to pursue in their lives to sit on the sidelines. I am sure we will see a surge of companies that will start up with a passion to do things differently in our industry. I welcome this. I also believe that the agricultural community will look for something other than mega companies to work with on their farms. The true future innovation will come from these new companies with a passion to deliver helpful products to the farm with less cost. They will do this because they are truly on the farm listening to what the farms need to be successful in the future. They interpret what the farms need even if the operators of the farm are not saying it by being there on the farm and having the discussions.

Organic Farming for the Future

by Erin Rodríguez

We often talk about the shifting attitudes in agriculture. In the last decade we have seen a change in not only attitudes but also a change in the way we grow our food. Like any transition or change there is much debate about what is best, what is viable, and what is realistic. One of those changes is the growing number of farmers who are engaging in organic farming. According to the USDA NASS Organic Sector Production Report, between 2008 and 2014 organic production in the US almost doubled from 3.2 Billion to 6 Billion dollars. We are witnessing a change in the way America farms. Of course, it is not all farmers. The majority of the acres currently grown are non-conventional seed using non-organic farming practices. Although it is true that organic farms comprise only .7 percent of the total farms in the US, this number is growing consistently. Some may think my claim is a bit premature. However, the rapid growth of this sector is a good indicator of shifting paradigms. The question is this: what are the pros and cons of organic farming, and is it a viable method for the feeding the world's growing population? Questions such as nutritional superiority, health benefits, cost and yield are the crux of this debate.

The question as to whether or not organic products have a higher nutritional value than their non-conventional counterparts is one that is continuously being studied. A 2014 meta study conducted by the Newcastle University in England found that organic foods were more nutritious citing higher levels of antioxidants that naturally occur in organic products. However, a 2012 meta-study published by the Annals of Internal Medicine states that although pesticide levels were greatly reduced in the systems of consumers of organic products, there was no significant differences in nutritional benefits by organic product consumption.

The absence of pesticides and synthetic fertilizers have also been identified as factors for the health benefits associated with consumption of organic products. The elimination of pesticides and synthetic fertilizers have shown to have various benefits to both health and the environment. Levels of contaminants found in humans, livestock and soils are significantly reduced through organic farming practices. The health benefits of organic production is particularly apparent in meat and dairy products. Although more research is needed, some studies have found that by minimizing these contaminants we see fewer health problems such as a reduced incidence of eczema in infants.

Organic Farming for the Future

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One of the main sticking points for most consumers is the cost of organic products. Some experts claim that these costs are closer to what is the "true cost" of food production. However, organic farming requires less costly inputs such as expensive fertilizers and pesticides. The labor costs on the other hand, go up. These crops require a higher skilled work force and a more intense labor load to produce. The need to pull weeds, prepare the soil, and pest control are just some of the areas that require more work under an organic paradigm.

Yield is another important component of this debate. All farmers want a high yielding crop. Traditionally, farmers have associated the transgenic and non-conventional products with higher yields. In general, they are correct. The USDA NASS studies have shown that organic products do not compete with their non-conventional counterparts in this regard. However, many conventional products yield as well as the non-conventional products. Through advancements in technology and management practices, organic farmers have been consistently increasing their yields without the introduction of synthetic inputs. There is still room for growth in this area.

Organic farms comprise less than 1 percent of the farms in the US. Although there has been considerable growth in the last decade, they are still a very small portion of the agricultural sector. As the benefits of organic farming become more apparent and the demand for these products continue to grow so must our understanding. It is a pretty safe to say that at this particular juncture in time, organic farming will not feed the world's population. However, it is growing, and the benefits of this type of farming are being studied and understood better. Maybe someday we will be able to feed everyone food free of pesticides, and have a planet to inhabit for many centuries to come.

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We thank our staff at all our locations for providing us with support as well as many of the photographs used on our articles. Keep on contributing!

NeWold Times

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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.