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Historical increases in grain yield have been attributed to genetic improvements by traditional breeding programs in conjunction with more efficient cultural practices[3]. Initially, biotechnology helped protect from potential yield loss from weed competition or insect feeding; however, it may have indirectly contributed to yield gain because the traits helped protect the rooting system, which could have allowed for a greater probability of nutrient and water uptake[2]. Using these three pillars, Monsanto is committed to helping farmers double corn, soybean, and cotton yields by 2030. This trial was designed to compare historic farming practices for corn and soybean with those of today; looking specifically at how breeding, biotechnology and agronomic practices have led to an increase in yield over time, as well as where it could potentially go in the future.

Materials and Methods: Corn Trial

A corn demonstration trial was conducted at the Monsanto Learning Center at Monmouth, IL to evaluate the yield response of corn to three different treatments representing past, current, and potential future production methods. Corn was planted May 17th, 2012 into soybean-corn rotated ground prepared with a chisel plow in the fall, followed by a soil finisher in spring. Nitrogen (N) was applied as 32% UAN at two levels per period treatment: a maximum N rate based on the amount of N needed to produce one bushel and a reduced rate to determine performance in low N environments.

Past Treatment: A 111 relative maturity (RM) non-traited corn product was planted at a seeding rate of 28,000 seeds/acre in 30-inch rows. Force® 3G insecticide was applied in-furrow. Weed management consisted of a pre-emergence application of Bicep II Magnum® herbicide, followed by post-emergence applications of Accent® and Hornet® herbicides. Nitrogen was applied at 220 lbs/acre (1.2 lbs N/bu) or 150 lbs/acre as 32% UAN.

Current Treatment: A 111 RM Genuity® VT Triple PRO® corn product was planted at a seeding rate of 36,000-38,000 seeds/acre in 30-inch rows. Weed management consisted of a pre-emergence application of Harness® Xtra 5.6L herbicide, followed by a post-emergence application of Roundup PowerMAX® herbicide. Nitrogen was applied at 200 lbs/acre (1 lb N/bu) or 140 lbs/acre as 32% UAN. Crops also received a foliar application of Headline® fungicide at the VT/R1 stage.

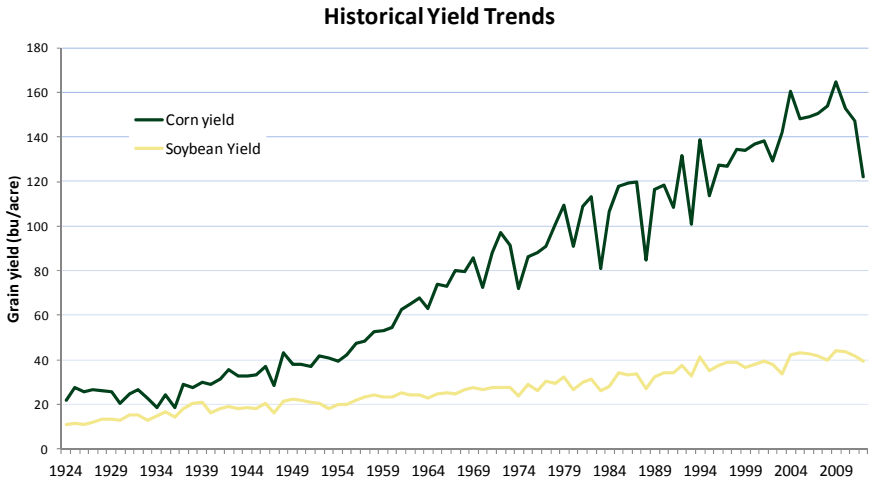

Figure 1. Historic yield data for both corn and soybean crops.
Source: United States Department of Agriculture National Agricultural Statistics Service (USDA NASS)

Potential Future Treatment: A 111 RM Genuity® SmartStax® corn product was planted at a seeding rate of 48,000 seeds/acre in a 22.5-inch twin-row configuration. Weed management consisted of a pre-emergence application of Harness® Xtra 5.6L herbicide, followed by a post-emergence application of Roundup PowerMAX® herbicide. Nitrogen was applied as either 280 lbs/acre split between 180 lbs/acre as 32% UAN combined with 100 lbs/acre applied in season (V6) as Koch Advanced Nitrogen® or 160 lbs split between 100 lbs/acre as 32% UAN combined with 60 lbs/acre applied in season (V6) as Koch Advanced Nitrogen®. GreenSeeker® technology was used to provide the 60 lbs/acre recommendation. Crops also received a foliar application of Headline® fungicide at the VT/R1 stage.

Results: Corn Trial

Results of the three period treatments on corn production are shown in Figure 2. As expected, yield increased from the past to current and then again from current to future treatments. While it is not possible to draw any definitive conclusion from a single location trial, it is hypothesized that advancements in breeding technology, the

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addition of *B.t.*-traited corn products, changes in herbicide programs, and also changes in N application products and methods resulted in higher yield potential as the treatment periods progressed.

To investigate the nutrient uptake advantage proposed by Moose and Below in 2009, N response between the older, non-traited products and newer *B.t.*-traited products were compared. The N efficiency shown in Table 1 was calculated by dividing the N rate by yield for all the observations in the Past and Current treatments. Percentage gain was then calculated by subtracting Current from Past and dividing by Past. There was a 25% average increase overall. Research has also shown that products have improved in their efficiency to use plant available N under both optimal and stressful conditions[1].

Materials and Methods: Soybean Trial

In 2012, a trial was conducted at the Monsanto Learning Center at Monmouth, IL to evaluate the yield response of soybeans to five different treatments representing a range of production methods from the past through potential future methods. Soybeans were planted May 18th, 2012 in a corn-soybean rotated field prepared with a chisel plow in the fall, followed by a soil finisher in spring.

Treatment 1: A 3.3 RM non-transgenic soybean product was planted in 30-inch rows at 180,000 seeds/acre. Weed management consisted of a pre-emergence application of Pursuit® Plus herbicide.

Treatment 2: A 3.3 RM non-transgenic soybean product was drilled at 200,000 seeds/acre. Weed management consisted of a pre-emergence application of DUAL® II Magnum® herbicide, followed by a post-emergence application of Cobra® herbicide and another post-emergence application of Assure® II herbicide.

Treatment 3: A 3.2 RM Genuity® Roundup Ready 2 Yield® soybean product was planted in 30-inch rows at 160,000 seeds/acre. Weed management consisted of a pre-emergence application of Valor® XLT herbicide, followed by a post-emergence application of Roundup PowerMAX® herbicide. A foliar application of Headline® fungicide and Warrior II with Zeon Technology® insecticide was made at R3 growth stage.

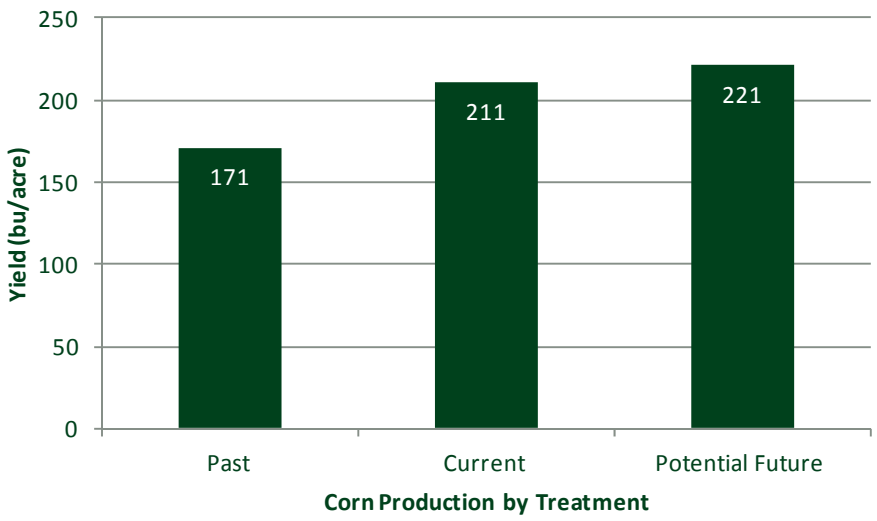

Figure 2. Corn yield shown by treatments: Past, Current, and Potential Future.

N Efficiency	Low N rate	High N rate
Past	0.88	1.29
Current	0.69	0.93
Percentage gain in N response	22%	28%

Table 1. Nitrogen efficiency for Past and Current Treatments at both high and low N rates.

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Treatment 4: A 3.4 RM Genuity® Roundup Ready 2 Yield® soybean product was planted in 30-inch rows at 150,000 seeds/acre. Weed management consisted of a pre-emergence application of Valor® XLT herbicide, followed by a post-emergence application of Roundup PowerMAX® herbicide. A foliar application of Headline® fungicide and Warrior II with Zeon Technology® insecticide was made at R3 growth stage.

Treatment 5: A 3.4 RM Genuity® Roundup Ready 2 Yield® soybean product inoculated with Vault® SP was planted in 20-inch rows at 130,000 seeds/acre. Weed management consisted of a pre-emergence application of Valor® XLT herbicide, followed by a post-emergence application of Roundup PowerMAX® herbicide. Multiple foliar applications were made: CoRoN® 25-0-0 at R1 growth stage, Headline® fungicide at R1 and R5 growth stages, and Warrior II with Zeon Technology® insecticide at R1 and R5 growth stages.

Results: Soybean Trial

Results of the five period treatments on soybean production are shown in Figure 3. The largest yield advantage was recognized between Treatments 2 and 3 with a 23 bu/acre yield increase. The major difference between Treatments 1 and 2 versus 3 through 5 is the seed used. The introduction of the Genuity® Roundup Ready 2 Yield® soybean platform, as well as improvements in production practices had the most positive effect on yield potential based on trial results.

There is essentially no yield difference between Treatments 3 and 4, which is favorable given the only difference in

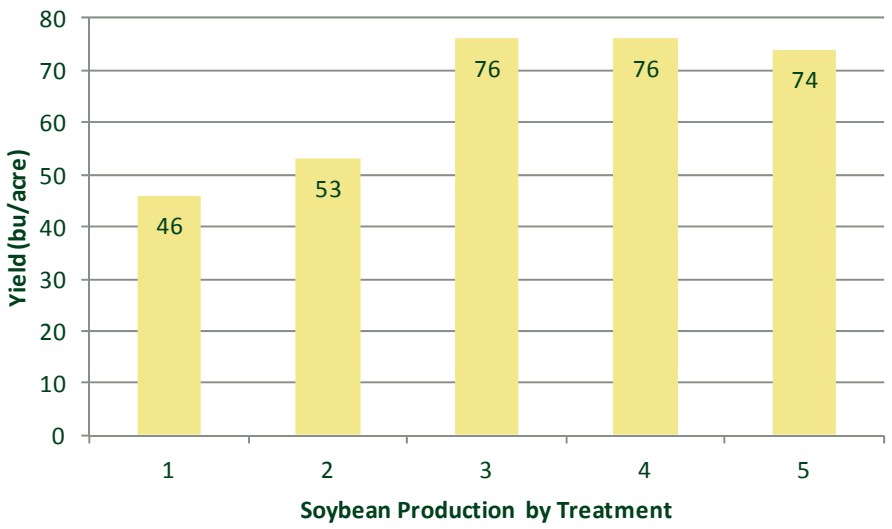

Figure 3. Soybean yield shown by period treatments 1-5 (1 representing oldest, 5 representing potential future, as described in text)

treatments is the RM of the products and the seeding rate, which was actually reduced by 10,000 seeds per acre. Past data from Monsanto Learning Center trials would suggest that the narrower row spacing and more intensive management practices in Treatment 5 would lead to increased yields. However, the extreme heat and drought experienced in 2012 may have negated the gains we typically see.

Summary Comments

Overall, yield levels have increased over time in both corn and soybean due to better management practices, breeding improvements, and biotechnology.

Breeding for higher yield potential in corn appears to have also contributed to more efficient use of plant available N in both optimal and stressful N environments. Based on the experimental average, a 25% increase in N efficiency for modern products over older products was observed. As Monsanto continues toward the goal of doubling corn yields by 2030, breeding practices and biotechnology traits should continue to be focused on N utilization.

Weed management systems (particularly in soybean) were revolutionized by the Roundup Ready® trait that allowed for simplified solutions that limited weed competition within the crop. In soybeans, the Genuity® Roundup Ready 2 Yield® platform keeps the simplistic approach to post-emergence weed control, but also begins to build upon genetic improvements in yield potential through biotechnology. Moving forward,

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implementation of high-yield management strategies such as foliar fungicide, early planting, and especially the use of Roundup Ready® products is the key to further driving yield improvement.

RESOURCES

[1]Castleberry, R.M., et. al. 1984. Genetic yield improvement of U.S. maize cultivars under varying fertility and climatic environments. Crop Science vol 24:33-36.

[2]Moose, S.P., and F.E. Below. 2009. Biotechnology approaches to improving maize nitrogen use efficiency. p. 65-77. In: A.L. Kriz and A.B. Larkins (eds.), Molecular genetic approaches to maize improvement. Biotechnology in Agriculture and Forestry, Vol. 63. Springer-Verlag Berlin Heidelberg.

[3]Russell, W.A. 1974. Comparative performance for maize hybrids representing different eras of maize breeding. Proceedings of the 29th Annual Corn and Sorghum Research Conference, Pub. 28:81.

The information discussed in this report is from a single site, non-replicated, one-year demonstration. This informational piece is designed to report the results of this demonstration and is not intended to infer any confirmed trends. Please use this information accordingly.

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