



Mississippi Corn Promotion Board 2021 Progress Report

Project

Title: Stepwise Evaluation of High-Tech Production Systems Contrasted to Existing Standard Production Systems

PI: Gurbir Singh

Department: Delta Research and Extension Center, Stoneville, MS

Project Summary (Issue/Response)



As corn acreage and production have increased over the last few years in the South, the need for continued evaluation and incorporation of technology adapted to the region is needed. In many instances, the grain yields produced exceed the calibration range of many soil tests while biotechnological advances are continuing at a great cost to the producer. When it comes to nutrient management strategies current fertilizer recommendations do not take into account the soil's fertility. Studies have shown that all the 17 essential elemental nutrients found within corn plants provide benefits in the growth and the quality of the kernels. Ideally, a balanced nutrient management strategy should increase both yield and corn kernel quality, along with improving soil health. Producers are faced with many decisions as to what inputs to incorporate and which of these inputs result in significant economic gains. Yield gains do not always lead to financial gains when the whole-farm enterprise is considered. Research in other regions of the country, particularly in the Corn Belt, has shown the yield gains but has not included the economic implications (No profit). Therefore the overall objective of the study was to determine, in a single variety of corn, the most suitable nutrient management strategy that produces optimal corn kernel quality and yield in Mississippi field production at two different location. The specific objectives were: to evaluate the interaction of planting configuration (SR, Single Row vs TR, Twin Row) and planting rates (32,000 vs 40,000 plants/acre) [Statistical Whole Plots] and various fertility inputs (N, P, K, S, and Zn) and fungicides [Statistical Subplots]; to examine the impact of treatments with stepwise additions from a standard system as well as a stepwise deletion from a high input system and; to summarize the impact of systems on grain yields, grain quality, and whole-farm economics by looking at both additions and deletions to the systems. Our hypotheses was that an optimal corn kernel quality and yield can be determined and demonstrated by applying a more suitable management strategy which will vary according to location and year in production. The results at Stoneville, MS for the year 2021 showed that in the addition trial population and nutrient addition treatments significantly affected yield while the row pattern had no effect on grain yield. The highest yield was recorded at 40K with the addition of all nutrients N2PKSZnY. For the deletion trial in the year 2021 at Stoneville MS, the highest yields were observed with a 40K population and twin rows pattern whereas nutrients and fungicide treatments did not affect yield.



Project Results/Outcomes



A multi-year and multilocation addition and deletion research projects were initiated in 2020 to evaluate high technology production systems for corn following soybean in rotation. In 2020 only one location that is Stoneville, MS at the Delta Research and Extension Center (DREC) was included in this project and in 2021 two locations Verona, MS at the North Mississippi Research and Extension Center (NMREC), and Stoneville, MS at the Delta Research and Extension Center (DREC) were included in this project. The Verona trials were rainfed, and include Leeper silty loam, Tuscumbia silty clay loam, and Catalpa silty clay loams soil series. The Stoneville sites were irrigated and has Bosket very fine sandy loam soil series. In 2021 at Verona MS, in the addition trial, all three main factors including plant population, row pattern, and fertilizer showed yield differences with the highest yield at 32K twin rows with N2PKSZnY treatment (Figure. 1). The deletion study at Verona had significant three-way interaction (Figure 1D) and the highest yielding was at 40K twin rows with N2PKSZnY treatment.

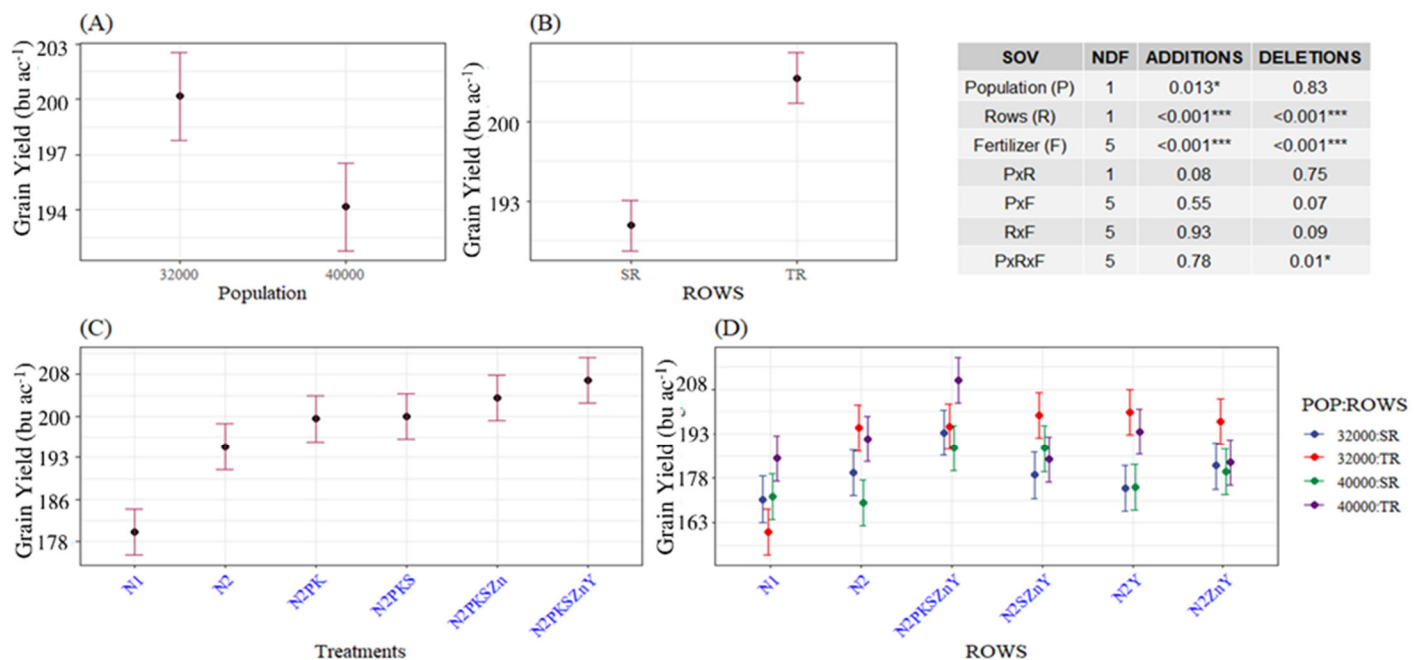


Figure 1. Verona (2021) in stepwise addition study main effects of population (A), rows (B), and nutrient treatments (C) were significant. In the deletion study, a three-way interaction between all three factors was significant (D). The vertical bars represent the length of LSD (5%).

Table 1: Treatment Structures and nutrient applications used at Stoneville and Verona, MS (Addition) †

Treatments	N Rate (lb/ac)	Phosphorus (lb/ac)	Potassium (lb/ac)	Sulfur (lb/ac)	Zinc (lb/ac)	Fungicide (Y/N)
N1	210	0	0	0	0	N
N2	280	0	0	0	0	N
N2PK	280	40	100	0	0	N
N2PKS	280	40	100	20	0	N
N2PKSZn	280	40	100	20	10	N
N2PKSZnY	280	40	100	20	10	Y

Project Results

In Stoneville for the year 2021, in addition, trial population (Figure 2A) and treatments (Figure 2E) significantly affected yield while the row pattern had no effect. The highest yield was recorded at 40K with the addition of all N2PKS2nY. For the deletion trial in the year 2021 at Stoneville MS, the highest yields were observed with a 40K population (Figure 2C) and twin rows pattern (Figure 2D), whereas nutrients and fungicide treatments did not affect yield (Figure 2F).

The stepwise addition trial at Stoneville MS in 2020 showed that rows patterns (Figure 3B) and treatments (Figure 3E) had a significant effect on the yield while the population showed no differences. Twin rows with N2PK treatment resulted in the highest yield. In stepwise deletion, trial treatments were the only factor that significantly affected yield (Figure 3F). The highest yields were recorded when 280 lbs N, 20 lbs S, 10 lbs Zn, and fungicide were applied. Overall, at Stoneville MS, the twin-row planting pattern outperformed single rows and 40K out yielded 32K. At Stoneville, corn responded positively to fungicide, and response to the addition of P, K, S, and Zn were variable. In Verona, twin-rows at 32 K resulted in better yields and there was a clear response to fungicide application. Since responses recorded were site-specific producers should determine soil deficiencies before deciding the appropriate nutrient management strategy.

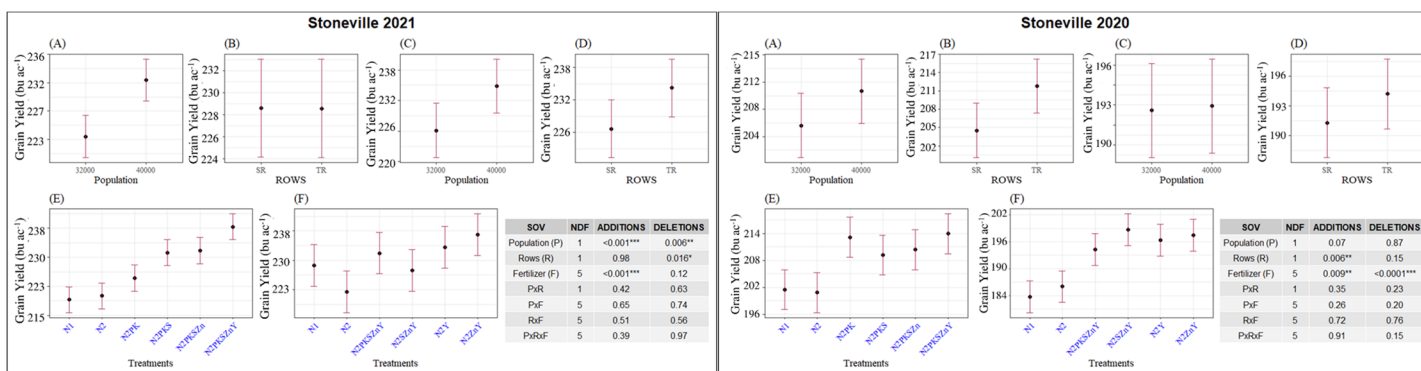


Figure 2. Stoneville (2021) in stepwise addition study population (A), and nutrient treatments (E) were significant, and rows (B) showed no effect. In the deletion study population (C) and rows (D) were significant, and no effects of treatments (F). The vertical bars represent the length of LSD (5%).

Figure 3. Stoneville (2020) in addition study rows (B), and nutrient treatments (E) were significant, and population (A) showed no effect. In the deletion study population (C) and rows (D) were not significant, and treatments (F) showed an effect. The vertical bars represent the length of LSD (5%).

Project Impacts/Benefits

Station research and on-farm research have both shown benefits from increased seeding rates and N rates in corn. Often the small increases in grain yields from increasing N rates has not been profitable even though the differences are significant. On-farm big plot research has shown grain yields increase up to 40,000 (40K) seeds/acre. Current research is being completed to take seeding rates in the Mid-South to even higher levels. After several years of research, going above 45K is not giving higher yields but is decreasing profits. In the same study, increasing N rates above recommended levels has also not resulted in higher grain yields but does reduce profitability. The current project is planned for continuation at two locations in Mississippi for 2022. The combination of input factors is vital to profitable corn production in the Mid-South. The study puts together in one study many of the fertility and production-related inputs that pose questions for producers each year. The overall impact is to increase profitability and this may be obtained with current yields. The producers often seek higher yields but greater profitability should be more important. While higher yields are important, the unit cost of production is more important. The proposed research also shows the impact of just adding extra fertilizer when it may not be needed. Applying fertilizer for the sake of application may not be profitable. Soil sampling and belief in the product delivered is equally important to profitability. Producers should know the philosophy of the person/company handling their fertilizer needs and remember that they are in business to sell a product. Applying unneeded fertilizer can be a detriment to the environment and pocket book.

Project Deliverables

Dew, J., Oglesby, C., Sharma, R., Singh, G., Fox, A., McCoy, J., Dhillon, J.D. 2021. An evaluation on the effects of additions and deletions of specific nutrient management strategies on corn yield at different plant densities. Graduate Student Symposium Mississippi State University. Oct. 23, 2021.

Results from this project will be presented at the upcoming Mississippi Academy of Sciences Annual Conference 2022.