in cotton production. The overall goal of this project is to encourage producers' adoption of this new precision nitrogen management technology and system on their farms to reduce nitrogen fertilizer consumption and potential nitrogen losses, improve cotton productivity, and thus improve water quality and growers' profitability in the Mississippi River Basin. In Louisiana, this project was established on three producers' fields in Tensas Parish (Fields A, B, and C) where soil texture within field was highly variable. Initial deep core soil samples were collected prior to planting for determination of soil nitrogen in the form of nitrate and ammonium, and other chemical properties. A total of 45 cores were collected from each field; each core was separated into 0-6, 6-12, 12-18, 18-24, and >24 inches depths. Coordinates of these 45 cores from each field were recorded to retrieve the locations during the post-harvest deep core sampling. Three different N management systems were compared in large strip plots (40-ft wide run x 1000-ft long): producer's current N management system (N1), a VRT based on GreenSeekerTM optical sensing system and a fertilizer rate algorithm derived from multiple years of previous research data (N2), and similar VRT optical sensing system as N2 but adjusted for soil productivity zones (N3). The N1 represented the standard practice of the participating producers in terms of nitrogen fertilizer management; the application rates for Fields A, B, and C were 100, 125, and 135 lbs N ac-1, respectively applied one time at or immediately after planting. Strip plots under the N2 and N3 treatments received the first nitrogen application at rates of 50, 75, and 65 lbs N ac-1 for Fields A, B, and C, respectively. The second application was done at early bloom stage. The nitrogen rate recommended by the VRT optical sensing system (N2) ranged from 2-30, 5-90and 2-50 lbs N ac-1 but when adjusted by soil texture (N3), the nitrogen application rates ranged from 0-60, 0-120, and 0-80 lbs N ac-1 for Fields A, B, and C, respectively. For in-season field data collection, each strip plot was divided into 10 subplots wherein normalized difference vegetation index (NDVI) readings and leaf tissue samples were collected at early square, early bloom and mid bloom growth stages. At harvest, grab samples of seed cotton were collected for lint yield percentage determination. The parameters that will be presented and discussed to compare the performance of these three nitrogen management systems include cotton lint yield, total nitrogen fertilizer applied, agronomic nitrogen use efficiency, and net return to nitrogen fertilizer use. The relationships among leaf nitrogen content, NDVI readings, post-harvest soil nitrate and ammonium, and lint yield will be also presented.

Program 4PA-2

▸ Development Of Sensor Based Detection Of Crop N Status For Utilization In VRN Fertilization

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Early season detection of corn and cotton N status as an in-field indicator of spatial N availability and fertilizer N demand has been difficult with proximal sensors. Fields containing significant variability in soil properties which influence variation in soil N availability are the best candidates for variable adjustment in the optimum fertilizer N rate across fields. A variable rate application of fertilizer N should be strongly tied to matching supply and demand for available N. Excess use of purchased N fertilizers can lower profitability as well as result in environmental consequences due to leaching of nitrates into groundwater or transport to surface waters as well as potential gaseous losses . Our objective has been to evaluate selected vegetation indices for their ability to detect early season crop N status. Relating canopy reflectance back to N content of plant tissue allows for the establishment of a quantitatively linked indicator. Published indices have the ability to detect biomass, greenness, and chlorophyll with varying degrees of success and known ranges in tissue N sufficiency are useful in determining adequacy of available N or fertilizer supplied N. Four fertilizer N rates were applied to cotton (0, 40, 80, and 120 lb/a) and corn (0, 80, 160, and

240 kg N/ha) on plots 12 rows wide at 38" spacing between rows all with a length of 125'. A urea ammonium nitrate solution (UAN 32% N) was banded using a liquid applicator equipped with no-till coulters and attached liquid knives set at 9" from the row and 3" deep. Half of the fertilizer N rate was applied following planting, and the remaining half was applied following leaf sampling at first square for cotton and whole plant sampling at the V5 growth stage for corn. Four replicates were utilized and the experimental design was a randomized complete block. Strategic acquisition of canopy reflectance was performed with a YARA N Sensor mounted on a 3-point tractor hitch and set at a height sufficient to collect canopy reflectance data from rows 2 thru 4 and 9 thru 11 at an off-nadir viewing angle. Reflectance was recorded at bandwidths of 450, 500, 550, 570, 600, 630, 640, 650, 660, 650, 660, 670, 680, 700, 710, 720, 740, 760, 780, 800, 840, and 850 nm. Early season sampling was targeted including weeks of cotton squaring 1, 2, and 3 and the V5 stage of corn growth. Coincident to canopy reflectance, the most recently matured cotton leaf samples and whole corn plants were sampled for the determination of total leaf N and whole plant total N content, respectively. An automated dry combustion analyzer was used to determine total N content on duplicate samples per plot following oven drying at 65 oC and grinding through a 40-mesh sieve (0.425 mm) in a Wiley mill. Selected vegetation indices compared included the Normalized Difference Vegetation Index (NDVI), Green Normalized Vegetation Index (GNDVI), Normalized Difference Red Edge (NDRE), and Canopy Chlorophyll Content Index (CCCI). From 2009 through 2011, the CCCI had a more consistent and superior relationship than other tested indices with cotton leaf N sampled during the first 3 weeks of squaring. For example, r2 values between CCCI and leaf N for the first week of squaring were 0.87 (2009), 0.68 (2010), and 0.67 (2011) compared to NDVI r2 values of 0.66 (2009), 0.31 (2010), and 0.36 (2011), GNDVI r2 values of 0.68 (2009), 0.39 (2010), and 0.39 (2011), and NDRE r2 values of 0.75 (2009), 0.58 (2010), and 0.43 (2011). Bandwidths most sensitive to varying N supply and cotton leaf N, were 550 nm and 700-710 nm for early season measurements. Leaf N values during the first week of squaring relative to 50% of total applied N rates from 0 to 120 lb N/a ranged from 3.28 to 4.33% in 2009, 4.07 to 5.10% in 2010, and 4.25 to 4.74% in 2011. For whole plant tissue N concentration in corn at V5, CCCI outperformed (r2=0.83) all other indices (0.64-NDVI; 0.75-GNDVI; 0.72-NDRE). Similarly, corn leaf N detection was most strongly related with CCCI with an r2 of 0.79 compared to 0.63 for NDVI, 0.73 for GNDVI, and 0.70 for NDRE. All indices resulted in a strong relationship (r2 values >0.93) with whole plant N content of corn as described with a quadratic regression model. In conclusion, the CCCI index which utilizes a red edge component and is adjusted for biomass, consistently resulted in strong relationships with cotton and corn tissue N analyses and content in the case of corn early enough in the season when a strategic fertilizer N application could be made. Both indices utilizing a red edge component most consistently resulted in stronger relationships to plant N for early season sampling. An on-farm study was initiated in 2012 where the CCCI index was used at pinhead square to map variability in perceived N availability and then equated to a fertilizer application map. Using an as applied map and ARCGIS software, the average fertilizer N rate following application was derived for each treatment. The farmer applied variable rate treatment based on soil CEC averaged 98 lb N/acre, sensor based was 77 lb N/acre, and sensor based adjusted for historical yield was 67 lb N/acre. Lint yield as influenced by N fertilization technique averaged 840 lb/acre for soil CEC, 873 lb/acre for sensor alone, and 872 for sensor plus adjustment for historical corn yield. The results for sensor based fertilization are encouraging given that yield was increased slightly while lowering the quantity of N fertilizer needed to achieve a given yield.