NITROGEN AND IRRIGATION MANAGEMENT IN COTTON BASED ON THE NORMALIZED DIFFERENCE VEGETATION INDEX ON THE TEXAS HIGH PLAINS

Amee R. Bumguardner
Katie L. Lewis
Texas A&M AgriLife Research
Lubbock, TX
Glen L. Ritchie
Texas Tech University
Lubbock, TX
Kevin F. Bronson
USDA ARS
Maricopa, AZ
Murilo Maeda
Texas A&M AgriLife Extension
Lubbock, TX

Abstract

Nitrogen (N) is required in the largest amount by most all plants (Marschner, 2012). Plant available N in the soil is very limited and can be lost easily due to environmental conditions (IPNI, n.d.). Normalized difference vegetative index (NDVI) is a tool that can be used to manage water, N, crop development and to predict yield at peak bloom (Li et al., 2001; Zhou and Yin 2014). In order to detect N deficiencies within the plant, leaf canopy reflectance can be measured via remote sensing equipment to estimate chlorophyll content within the leaves (Thomas and Gausman, 1977; Chappelle et al., 1992; Blackmer et al, 1994). In this experiment lint yields were determined in Lubbock, Tx at the Texas A&M AgriLife Research station in 2018 and 2019. The main objective of this research was to determine the relationship between cotton lint yield and NDVI across multiple irrigation levels, varieties and N fertilizer rates. The irrigation levels were a low evapotranspiration (ET) rate of 30% and a high ET rate of 70%. The two varieties used were DP 1820 B3XF and DP 1823 NR B2XF. Urea-ammonium nitrate (UAN) was applied prior to planting (pre), 3 weeks following emergence (early) and at pinhead square (late) at different rates which included:
1) 15 lb acre^{-1} N applied pre (15-0-0);
2) 15 lb acre^{-1} N pre + 30 lb acre^{-1} N early + 30 lb acre^{-1} N late (75-0-0); and,
3) 15 lb acre^{-1} N pre + 60 lb acre^{-1} N early + 60 lb acre^{-1} N late (135-0-0).

NDVI data was collected using the Holland Scientific GeoScoutX data logger and the Holland Scientific Crop Circle sensor ACS-211.

Soil nitrate-N (NO_3^--N) in 2018 ranged from 9 mg kg^{-1} at the shallowest depth (0-15 cm) to 5 mg kg^{-1} at the deepest depth (30-60 cm), and in 2019 soil NO_3^--N ranged from 14 mg kg^{-1} at the shallowest depth (0-15 cm) to 21 mg kg^{-1} at the deepest depth (30-60 cm). Lint yield within variety and irrigation level was significant in 2018 and 2019. Under high irrigation in 2018, lint yield of DP 1820 and DP 1823 with the split application treatment of 75-0-0 was greater than the pre-plant fertilizer treatment of 15-0-0. Under low irrigation in 2018, lint yield of DP 1823 with the split application treatment of 75-0-0 was greater than the 15-0-0 and 135-0-0 treatments. Under high irrigation in 2019, lint yield of DP 1820 with the split application treatment of 75-0-0 was greater than the 135-0-0 treatment, while lint yield of DP 1823 with the split application treatment of 135-0-0 was greater than the pre-plant treatment of 15-0-0. Under low irrigation in 2019, lint yield of DP 1820 with the split application treatments of 75-0-0 and 135-0-0 was greater than the 15-0-0 treatment. A possible reason that the highest split application treatment of 135-0-0 was not greater than the 75-0-0 and 15-0-0 treatments, may be due to high levels of N in irrigation water. A relatively poor relationship was observed between NDVI and lint yield for both 2018 and 2019. Under high irrigation in 2018 NDVI had a greater relationship with lint yield 51 days after planting (DAP) (R^2=0.791) at the growth stage of squaring/first flowering with the variety DP 1820, while DP 1823 had the greatest relationship at the flowering/boll development growth stage (91 DAP; R^2=0.486). Under high irrigation in 2019 NDVI had a greater relationship with lint yield at the flowering growth stage (56 DAP; R^2=0.616), while DP 1823 had the greatest relationship at squaring (42 DAP; R^2=0.606). Under low irrigation in 2018 NDVI had a greater relationship with lint yield at the squaring/first flowering growth stage (51 DAP; R^2=0.292) with the variety DP 1820, while DP 1823 had a greater relationship at the open bolls growth stage (126 DAP; R^2=0.380). Under low irrigation in 2019 NDVI had a greater relationship with lint yield at the flowering/open bolls growth stage (69 DAP; R^2=0.569) with the variety DP 1820, while DP 1823 had a greater

relationship at squaring (42 DAP; R^2=0.281). There was not a consistent growth stage that had a greater relationship with NDVI and lint yield in either year. The poor relationships between NDVI and lint yield may be due to the limited range in lint yield across N treatments. Similar results to Bronson et al. (2005) and Raper et al. (2013) were determined in which NDVI had a moderate to poor correlation to lint yield. Future research for this study includes looking at boll counts, plant height, soil moisture, and canopy temperature in order to look more closely at the relationship with plant yield. We will also expand into looking at the relationship between red edge and lint yield.

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