# IMPROVING NITROGEN APPLICATION TECHNOLOGY UNDER KENTUCKY CONDITIONS 2011

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**OBJECTIVE**

The objective of this experiment is to: 1) Adapt variable rate nitrogen (VRN) technology (Greenseeker) to Kentucky conditions and 2) Fine tune nitrogen recommendations under today's production practices and varieties for the most economical nitrogen rate on well drained and marginally drained soils.

***Variable Rate Nitrogen (VRN) Technology***

The Greenseeker is a real-time, on-the-go sensor/applicator that senses the health of the wheat crop at the time nitrogen is applied and then simultaneously adds the precise amount of nitrogen that is determined to be needed by the machine. The sensing and application technology part of the machine has been very accurate and reliable. The weak part of the process has been the algorithm (formula) that is placed in the software of the machine to tell it how much nitrogen to add based on the plant health (NDVI) readings.

Research at Oklahoma State University and Virginia Polytechnic Institute and State University showed favorable results by increasing or maintaining wheat yields while reducing nitrogen application rates. Both places had different algorithms. Using these two algorithms and adding another that was quite different, the results in Kentucky were not as favorable. Using this technology with existing software is not feasible in Kentucky.

**METHODS**

Basic research was begun to gain the information needed to develop an algorithm for Kentucky. Small plots using different nitrogen rates applied at different times on different soils was used in the process.

**RESULTS**

The results for the five years of research are beginning to show some consistency. The first year there was an Easter freeze which caused severe damage to the plants and the results of that year may be atypical of that found most years. The second year was more normal and the curves look much better. The third year, the results (N recommendations from the NDVI Readings) look acceptable for the Feekes 6, but questionable for the Feekes 5 readings. Last year the data on the Pembroke soil data looked good. The Zanesville site was abandoned due to poor stand from excessive wetness after planting. This year wheat was good but the sensor began giving suspect readings for the Feekes 6 reading so that data was not used. The sensor was subsequently found to be defective by Trimble and problems were corrected.

***Variable Rate Nitrogen (VRN)***

The information gathered from the NDVI (normalized difference vegetative index) readings, and the nitrogen needed for optimum yields are shown in table 1 for both the Pembroke and the Zanesville soil types. The algorithm for the Feekes 6 reading was not calculated due to a possibly defective sensor.

The changing NDVI reading with the changing N rates when compared to yield at Feekes 5 explained 70% of the yield changes in the Pembroke soil and 60% in the Zanesville soil. As has been noted in the past, it appears that the technology will be more accurate on the well

drained soils and at Feekes 6 compared to Feekes 5 growth stage. The fewer outside factors that affect growth (severe weather, drainage, diseases, etc.), the more accurate the NDVI readings will be. The height of the curve (difference between lowest and highest NDVI) is sufficient.

### ***Average Algorithms Over Years***

Table 2 summarizes all of the algorithm data for the Pembroke soil for both Feekes 5 and 6 growth stages. The average algorithm is calculated from all the years where the data was considered to be reliable.

Table 3 summarizes all of the algorithm data from the Zanesville soil as explained in the above paragraph.

### ***Nitrogen Rates And Yield***

It appears that a 90 to 120 lbs/ac of N was the rate needed for maximum yields this year. This is a little lower than is sometimes found. The yields were high but lower than found in many years. The excessive rains in May were probably responsible for this since no other problems were seen.

**TABLE 1. GREENSEEKER/N WHEAT DATA AND ALGORITHMS 2010-2011**

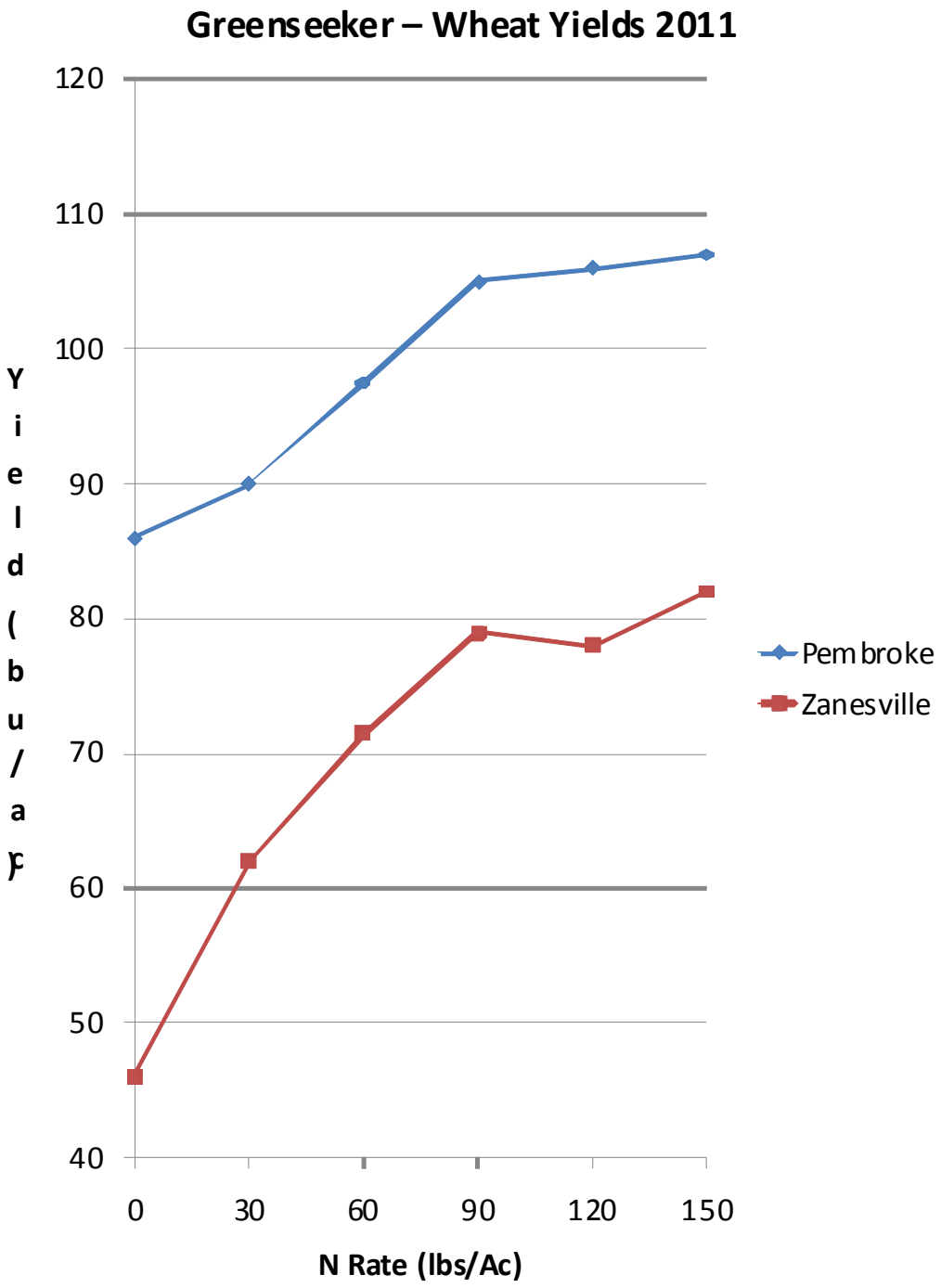
| Feb. N | NDVI | | NDVI Difference | | March N needed | NDVI Algorithm | |
|---|---|---|---|---|---|---|---|
| Lb/ac | F5* | F6* | F5* | F6* | Lb/ac | F5* | F6* |
| **PEMBROKE SOIL TYPE** | | | | | | | |
| 0 | 0.664 | 0.803 | 0.164 | 0.014 | 120 | ≥0.17 | Unreliable data |
| 30 | 0.743 | 0.808 | 0.085 | 0.009 | 90 | 0.09 - 0.17 | NDVI Readings |
| 60 | 0.773 | 0.815 | 0.055 | 0.002 | 70 | 0.06 - 0.09 | |
| 90 | 0.812 | 0.806 | 0.016 | 0.011 | 30 | 0.02 - 0.06 | |
| 120 | 0.821 | 0.817 | 0.007 | 0 | 0 | <0.02 | |
| 150 | 0.828 | 0.783 | 0 | 0 | 0 | | |
| **ZANESVILLE SOIL TYPE** | | | | | | | |
| 0 | 0.585 | 0.702 | 0.181 | 0.067 | 120 | 0.17 | Unreliable data |
| 30 | 0.652 | 0.744 | 0.114 | 0.025 | 90 | 0.11-0.17 | NDVI Readings |
| 60 | 0.732 | 0.750 | 0.034 | 0.019 | 60 | 0.04-0.11 | |
| 90 | 0.749 | 0.761 | 0.017 | 0.008 | 30 | 0.02-0.04 | |
| 120 | 0.722 | 0.769 | 0.044 | 0 | 0 | <0.02 | |
| 150 | 0.766 | 0.751 | 0 | 0 | 0 | | |

***Feekes Growth Stages**

| TABLE 2. NDVI ALGORITHMS FOR GREENSEEKER OVER ALL RELIABLE YEARS FOR PEMBROKE SOIL TYPE | |
|---|---|
| **Feekes 6** | **Feekes 5** |
| **Avg. 2008-09-10** | **Avg. 2008 and 2010** |
| **March N Needed NDVI Algorithm** | **March N Needed NDVI Algorithm** |
| 140 = >0.24 | 130 = >0.21 |
| 110 = 0.11-0.24 | 105 = 0.11-0.21 |
| 85 = 0.043-0.11 | 75 = 0.06-0.11 |
| 55 = 0.022-0.043 | 45 = 0.03-0.06 |
| 25 = 0.008-0.022 | 20 = 0.01-0.03 |
| 0 = <0.008 | 0 = <0.01 |

| TABLE 3 . NDVI ALGORITHMS FOR GREENSEEKER OVER ALL RELIABLE YEARS FOR ZANESVILLE SOIL TYPE | |
|---|---|
| **Feekes 6** | **Feekes 5** |
| **Avg. 2007-08-09** | **Avg. 2008 and 2011** |
| **March N Needed NDVI Algorithm** | **March N Needed NDVI Algorithm** |
| 130 = >0.22 | 120 = >0.15 |
| 105 = 0.14-0.22 | 100 = 0.10-0.15 |
| 75 = 0.07-0.14 | 80 = 0.06-0.10 |
| 45 = 0.04-0.07 | 50 = 0.03-0.06 |
| 20 = 0.01-0.04 | 30 = 0.01-0.03 |
| 0 = <0.01 | 0 = <0.01 |

**Figure 1.**


Greenseeker – Wheat Yields 2011
120
110
100
90
80
70
60
50
40
Yield (bu/ac)
0
30
60
90
120
150
N Rate (lbs/Ac)
Pembroke
Zanesville