IMPROVING NITROGEN APPLICATION TECHNOLOGY UNDER KENTUCKY CONDITIONS, 2012.

L. Murdock, J. James, and D. Call - Plant & Soil Sciences Department
University of Kentucky, Princeton, KY 42445
PH: (270) 365-7541, Ext. 207; Email: lmurdock@uky.edu

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 2012 yields were good but were a little lower than normal due to some freeze damage and severe dry weather. There was an excellent response to added nitrogen (figure 3). The differences in nitrogen rates explained 90% of the differences in yield in the trial this year. This indicates that any information gathered from the trial should be very reliable.

Variable Rate Nitrogen (VRN)

The information gathered from the NDVI (normalized difference vegetative index) readings, and the nitrogen needed for optimum yields for 2012 are shown in table 1 for both the Pembroke and the Zanesville soil types.

As has been noted in the past, it appears that the technology will be more accurate on the well drained soils than on the moderately to somewhat poorly drained soils and more accurate 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.

Final Algorithms

Table 2 and Figure 1 summarizes all of the reliable data into a final algorithm for Kentucky on the moderately to well drained soils (Pembroke) for Feekes 6 growth stage.

Table 3 and Figure 2 summarizes all of the reliable data into a final algorithm for Kentucky on the moderately to somewhat poorly drained soils (Zanesville) for Feekes 6 growth stage.

These algorithms are calculated from all the years where the data was considered to be reliable. Years of data not included in the average were effected severely by extreme waterlogging on the

Zanesville site, severe freeze damage, or equipment malfunction. These data are not included in the final algorithm.

Nitrogen Rates And Yield

It appears that around 120 lbs/ac of N was the rate needed for maximum yields this year. The yields were good but lower than found in some years (Figure 3). The freeze reduced the yields and the extreme dry weather probably reduced the yields also.

TABLE 1. GREENSEEKER WHEAT ALGORITHMS 2011-2012

Feb. N	NDVI		NDVI Difference		March N needed	NDVI Algorithm	
Lb/ac	F5	F6	F5	F6	Lb/ac	F5	F6
PEMBROKE SOIL TYPE							
0	0.484	0.467	0.237	0.327	120	≥0.24	≥0.33
30	0.621	0.629	0.100	0.165	90	0.10-0.23	0.17-0.33
60	0.652	0.691	0.069	0.103	60	0.07-0.10	0.10-0.17
90	0.695	0.748	0.026	0.046	30	0.03-0.07	0.05-0.10
120	0.720	0.787	0.001	0.007	0	<0.03	<0.05
150	0.721	0.794	0	0	0		
ZANESVILLE SOIL TYPE							
0	0.399	0.388	0.330	0.379	120	≥0.33	≥0.37
30	0.525	0.461	0.204	0.256	100	0.20-0.33	0.25-0.37
60	0.612	0.571	0.117	0.146	90	0.12-0.20	0.15-0.25
90	0.672	0.643	0.057	0.074	60	0.06-0.12	0.07-0.15
120	0.666	0.653	0.063	0.064	30	<0.06	<0.06
150	0.729	0.717	0	0	0		

TABLE 2. FINAL ALGORITHMS FOR USE WITH GREENSEEKER FOR VARIABLE RATE NITROGEN APPLICATIONS AT FEEKES 6 WHEAT ON MODERATE TO WELL DRAINED SOILS IN KENTUCKY 2012	
Differential NDVI	**N (lb/ac)**
0.015	25
0.02	40
0.03	55
0.04	70
0.075	85
0.11	97.5
0.175	110
0.24	125

TABLE 3 . FINAL ALGORITHMS FOR USE WITH GREENSEEKER FOR VARIABLE RATE NITROGEN APPLICATIONS AT FEEKES 6 WHEAT ON MODERATELY TO SOMEWHAT POORLY DRAINED SOILS IN KENTUCKY 2012	
Differential NDVI	**N Needed (lb/ac)**
0.025	20
0.04	33
0.055	45
0.08	60
0.105	75
0.135	90
0.18	105
0.21	120

Figure 1.

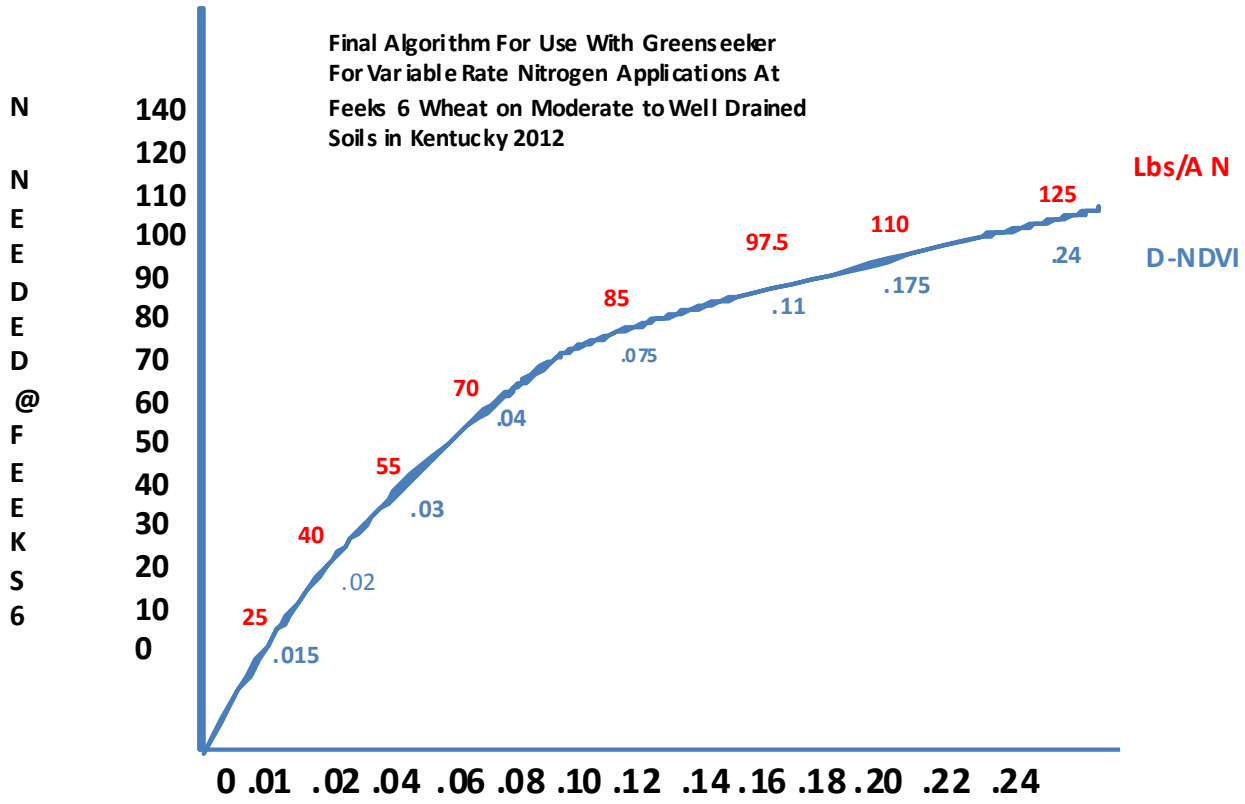

Final Algorithm For Use With Greenseeker For Variable Rate Nitrogen Applications At Feeks 6 Wheat on Moderate to Well Drained Soils in Kentucky 2012
N NEEDED @ FEEKS 6
140
120
110
100
90
80
70
60
50
40
30
20
10
0
Lbs/A N
D-NDVI
25
.015
40
.02
55
.03
70
.04
85
.075
97.5
.11
110
.175
125
.24
0 .01 .02 .04 .06 .08 .10 .12 .14 .16 .18 .20 .22 .24
DIFFERENTIAL NDVI

Figure 2.

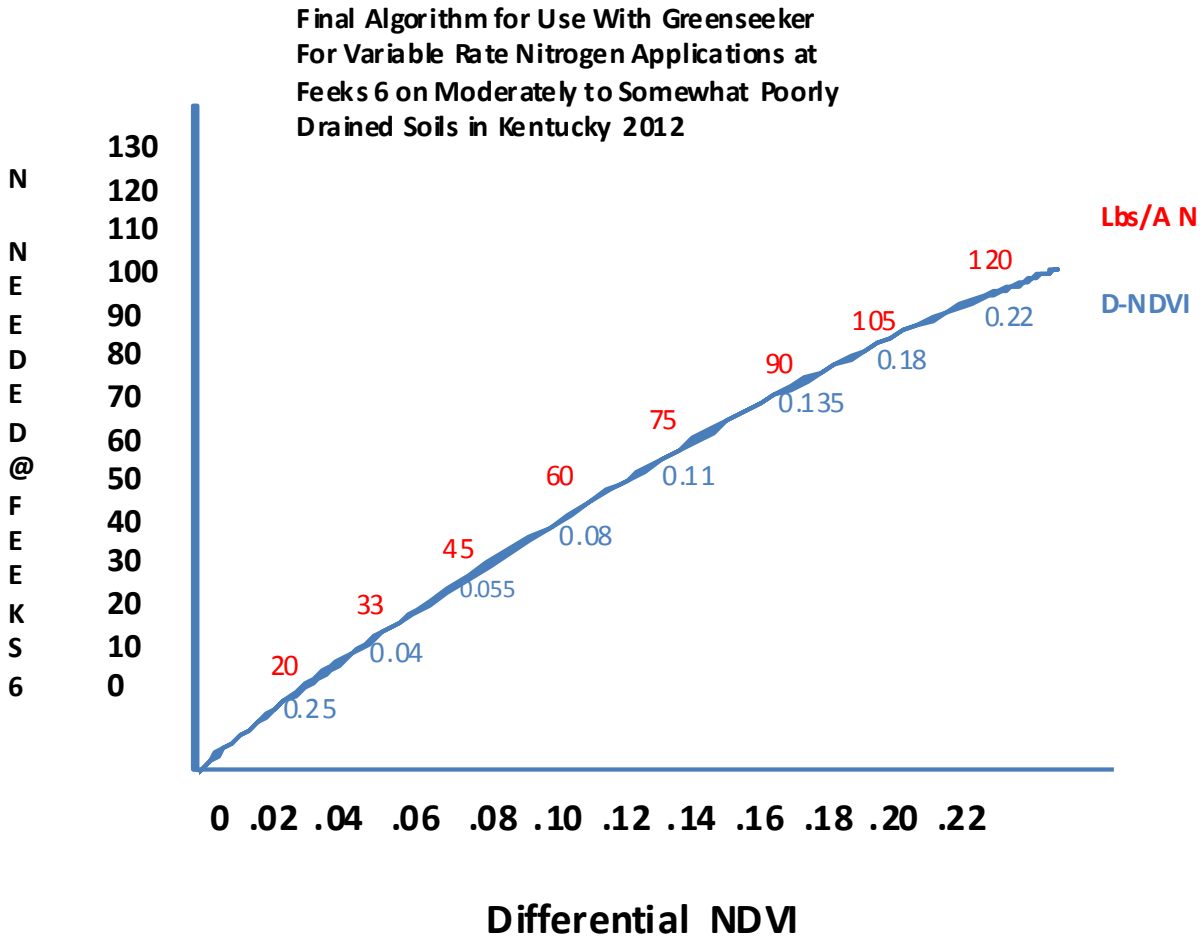
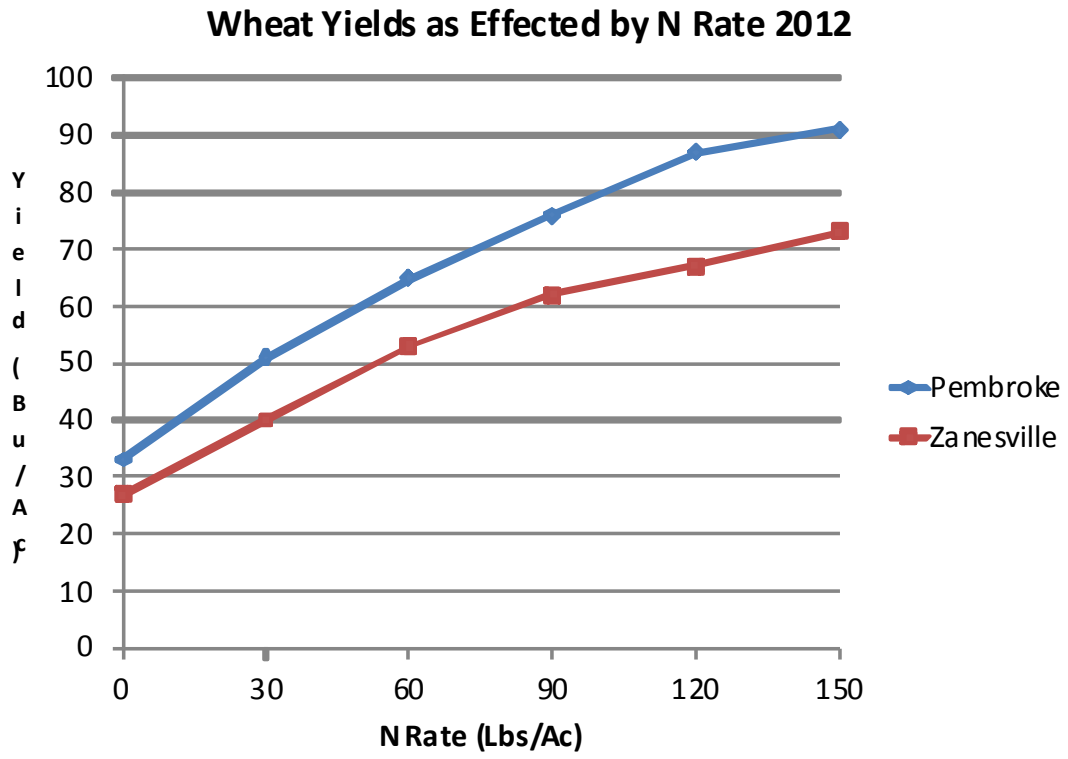

Final Algorithm for Use With Greenseeker
For Variable Rate Nitrogen Applications at
Feeks 6 on Moderately to Somewhat Poorly
Drained Soils in Kentucky 2012
N NEEDED @ FEEKS 6
130
120
110
100
90
80
70
60
50
40
30
20
10
0
Lbs/A N
D-NDVI
20
0.25
33
0.04
45
0.055
60
0.08
75
0.11
90
0.135
105
0.18
120
0.22
0 .02 .04 .06 .08 .10 .12 .14 .16 .18 .20 .22
Differential NDVI

Figure 3.


Wheat Yields as Effected by N Rate 2012
Yield (Bu/Ac)
100
90
80
70
60
50
40
30
20
10
0
0
30
60
90
120
150
N Rate (Lbs/Ac)
Pembroke
Zanesville