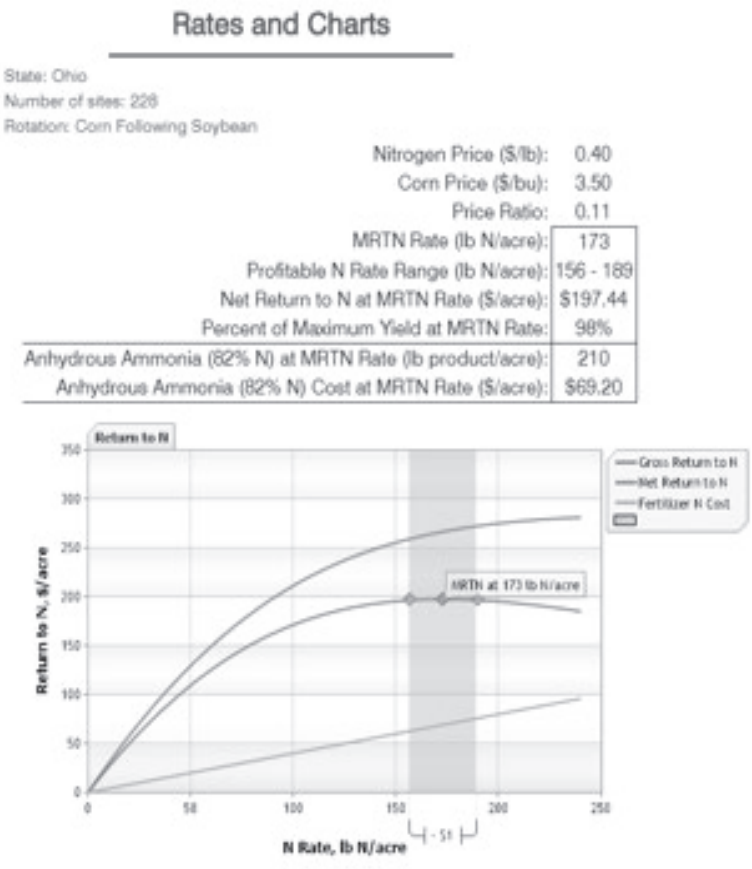
Ohio Learning Standards Emphasized: Biology – Cells (cellular processes); Physics – Waves (wave processes); Environmental Science – Earth's Resources (ecosystems, soil and land), Global Environmental Problems and Issues (sustainability, food production and availability).

Background

What is the right N rate for corn in Ohio? **(See https://agcrops.osu.edu/newsletter/corn-newsletter/2015-16/what's-right-n-rate-corn-ohio for more information.)**

Corn is a crop that has different nitrogen requirements throughout the growing season. Corn grows through a series of vegetative stages then into reproductive stages once silks appear. During the reproductive stages, the cob fills with kernels, that become seed that may be used the following year or as an ingredient in food for animals and/or humans, as well as fuel in the form of ethanol.

The vegetative and reproductive stages of corn are numbered and include the following:
VE which is emergence from the soil. V1 –V10+ are marked by the appearance of leaves, up to VT or tasseling. The reproductive stages include: R1 which is marked by the appearance of silks; R2 is called blister, the kernels are small and fluid filled (mainly with water); R3 is called milk, the fluid turns whitish as the kernels begin to accumulate starch; R4 is called dough, the starch becomes thicker in the kernels and they become larger; R5 is dent, the kernels now have a visible dent; R6 is considered the point of maturity and a "black layer" appears where the kernel meets the cob.



Current university N management recommendations are made using the Maximum Return To Nitrogen (MRTN) Calculator, hosted by Iowa State University: http://cnrc.agron.iastate.edu/. This tool allows producers to take factors like rotation, N source, price expected at the end of the season, and cost of the N input into account to optimize the use of N in their system. The calculator uses field trial data generated in each state to calculate the optimum N rate. The screenshot is showing the output for an Ohio field in a corn-soybean rotation where the grower is expecting to receive $3.50/bu of corn and has an N input cost of $0.40 per pound. The profitable N rate range for this field is between 156-189 lbs N applied.

According to Ohio State University Extension, corn uses large quantities of N from the 8 leaf stage through tasseling. N uptake can be 4 to 8 pounds per day during these stages. Corn gets the N it needs from the soil and through fertilizers

that are applied to supplement what the soil can provide. Most of the N should be applied prior to the 10 leaf stage, since N uptake is much less after pollination. To reduce loss of N to the environment, fertilizers can be applied after the corn is emerged but before it is rapidly growing using a process called side-dress. This technique is used to apply fertilizer alongside the row of corn near the roots so it will be available for plant uptake. Side-dressing usually occurs anytime between planting and V10.

There has been interest in trying to see if we can better predict if we need to apply N at side-dress using remote sensing data. The NDVI value, or the reflectance of red and near infrared light, can be one way to measure plant color and health. The more red light the plant absorbs, the healthier it is and the less N may need to be applied. N is a major component of plant chlorophyll, and chlorophyll is the major molecule that helps with photosynthesis and light absorption.

Using the Greenseeker
Watch "How to use the GreenSeeker Handheld" at: https://www.youtube.com/watch?v=6q1lRMwkgVs

Tips for using:
-Write down info as it is collected! The device does not collect and save.

-Refer to the Greenseeker Quick Reference Card and follow these steps.

1. Pull the trigger to start a new measurement. Sensor automatically turns off after 10 seconds when used in handheld mode.
2. Pull the trigger to clear the screen and begin a new measurement.
3. Hold the instrument level to the ground and 24-48 inches above the crop, for best results.
4. The GreenSeeker readings range between 0.1 - 0.99
5. 50% crop canopy for best results. Soil has much less N than green vegetation.
6. The sensor does NOT differentiate between crop and weed species.
7. Take a reading over the N-rich reference strip (Nitrogen applied to the row for comparison purposes)

Record your reading:

Measurement	**Plots 101 and 203 (0 lbs N/acre)**	**Plots 102 and 205 (50 lbs N/acre)**	**Plots 103 and 202 (100 lbs N/acre)**	**Plots 104 and 201 (150 lbs N/acre)**	**REFERENCE: Plots 105 and 204 (200 lbs N/acre)**
Average NDVI Reading					

Use the fertilizer estimation chart to do the following:

a. **Identify the reference curve:** Find the curve that matches the NDVI reading from the N-rich REFERENCE strip (Plots 105 and 204).

b. **Identify the normalized rate for each plot:** Use your average NDVI readings from each plot as the x value, and find the point on the reference curve where this occurs. Follow over to the y-axis to determine the Normalized N rate, and record below.

c. **Identify the crop factor:** Use the table to see what your crop is and your yield goal or potential.

Where the yield potential column and the crop row intersects, that is your crop factor. For the sake of this activity, let's say we are using **dryland corn** with a maximum yield of **225 bu/ac**. This results in a crop factor of 298. Record that for each plot below in the row called Crop Factor.

d. **Calculate fertilizer rate:** Multiply the normalized N rate by the Crop Factor to determine the **estimated** fertilizer rate needed in pounds of N. This is an estimation of the amount of N needed to achieve the yield goal.

Measurement	**Plots 101 and 203 (0 lbs N/acre)**	**Plots 102 and 205 (50 lbs N/acre)**	**Plots 103 and 202 (100 lbs N/acre)**	**Plots 104 and 201 (150 lbs N/acre)**	**REFERENCE: Plots 105 and 204 (200 lbs N/acre)**
Normalized N Rate					
Crop Factor					
Estimated Fertilizer Rate					

Reflection:

1. How do the results collected using the NDVI sensor compare to those from the UAV?

2. What impacts could this technology have on water quality?

The map below shows the plots for this N-rate trial. The units are in lbs/acre.

Plot 101	**Plot 102**	**Plot 103**	**Plot 104**	**Plot 105**	**Plot 201**	**Plot 202**	**Plot 203**	**Plot 204**	**Plot 205**
0	50	100	150	200	150	100	0	200	50

education projects.org
The Ohio State University
College of Food, Agricultural, and Environmental Sciences
USDA United States Department of Agriculture
National Institute of Food and Agriculture