Using NDVI for BioStimulant Assessment
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RD4AG is working to expand knowledge on the modes of action and effectiveness of biostimulants in agricultural crops. One of the tools we rely on is the Normalized Differential Vegetative Index (NDVI) to assess live green vegetation in our BioStimulant product performance trials.

With the advent of numerous innovations, there is more opportunity than ever to improve our ability to evaluate the health and well-being of plants in the field. Achieving accurate and useful field assessment data can be challenging and costly and the data is often fraught with background noise from human error and subjective variabilities. NDVI measurements can help us monitor research plots more efficiently. These measurements can also lead to a larger analysis of vegetative properties to assess BioStimulant impact including; leaf area index, chlorophyll concentration, plant productivity, vigor, fractional vegetation cover, accumulated rainfall, basic nutrient response, crop condition (identify diseases), yield potential, stress, biomass, herbicide efficiency and the list could go on.

NDVI uses the photosynthetically active radiation spectral region of plants in the near-infrared and red (visible) spectral region. The chlorophyll reflectance value needs to be determined in order to understand the NDVI readings which are based on the reflectance values from the plants using the two different wavelengths. Chlorophyll is known to strongly absorb visible light from 400nm to 700nm for use in photosynthesis therefore, NDVI functionally obtains the equivalence of simple infrared/red ratio as shown on the figure below.

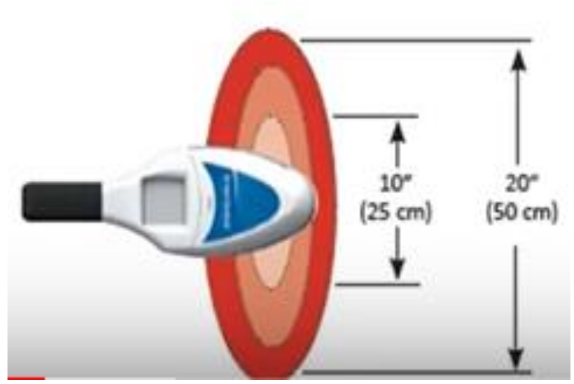
$$\mathrm{NDVI} = \frac{(\mathrm{NIR} - \mathrm{Red})}{(\mathrm{NIR} + \mathrm{Red})}$$

NDVI is directly related to the photosynthetic capacity and thus energy absorption of plant canopies. Our instrumentation is the Greenseeker handheld crop sensor by Trimble (Fig. 2.) and its sensor displays the measured value in terms of an NDVI reading (ranging from 0.00 to 0.99) on its LCD display screen as described in their website. Therefore, the greener plant material there is the higher the NDVI reading is which complies with the principle of having low red-light absorbed by the chlorophyll in the plant and high near-infrared light reflectance.

The Greenseeker is an active light source optical sensor which means it provides its own light so that the time of the day will not be a factor affecting the measurement. There are some environmental variables that can have an impact on data quality. If wind is blowing plants sufficiently to change which side of the leaves the sensor is reading, there can be substantial differences, especially in crops that may have small hairs or different textures on the undersides of foliage. Naturally, the sensor does not differentiate between weed and crop species so care must be taken when weeds are present to assure accurate data.

Operational use after calibration and charging consists of holding the device with the sensor directed at the foliage, pressing the trigger button, and walking at a steady pace through the target plot areas maintaining a specific height range of 24” to 48” (60-120 cm) above the crop canopy (depending on the size and type of the crop).

Fig. 3 to the right, Illustrates the sensor’s oval field of view showing how the size is proportional to height and approximates 10” (25cm) wide at 24” (60cm) above the ground and 20” (50cm) wide at 48” (120cm) above the ground, Trimble. An error message will be displayed on the screen if you are too high or too close to the crop.



The sensors on the instrumentation are emitting brief bursts of red and infrared light and automatically measuring each type of light that is reflected from the plant to obtain the NDVI reading. The device will display an NDVI value once per second during operation and reaches a maximum interval of 60 seconds, therefore, we want to record at least 10 seconds for each plot to collect a representative data set. After walking the desired area, release the button and the sensor will display the final average value of all the readings that were taken.

In order to establish favorable results, consistency in the plant population and agronomics are key components to success. It is important that only the same crop and relative growth stage be compared. In other words, taking a reading of one plot at 6 leaf and another at 30 leaf is not an accurate comparison. Intuitively, comparing a wheat reading with a spinach reading does not provide useful information. The algorithms in these instruments require at least 50% of the field of view of the sensor to be covered by vegetation for accurate measure of “Greenness” that equates to productivity. Bare ground typically reads 0.13, so less than 50% plant coverage of the soil in our experience is most useful in evaluating weed control if weeds are dying or breaking through the program. If we want % ground cover with plants, we are now using imagery and color thresholding as discussed in RD4AG’s white paper on Canopy Coverage by Connor Osgood. For plant productivity evaluations of crops, we tend to wait for the crop to grow a bit larger before we start the NDVI assessments in our trials. Since NDVI also depends on the geometry of illumination and anisotropy of the target we continue to evaluate crops using the same standard procedure and hence maintain the position of the target of interest within the swath of the instrument at a specific range so we have consistency that can be relied upon to tease out subtle differences in crop performance.