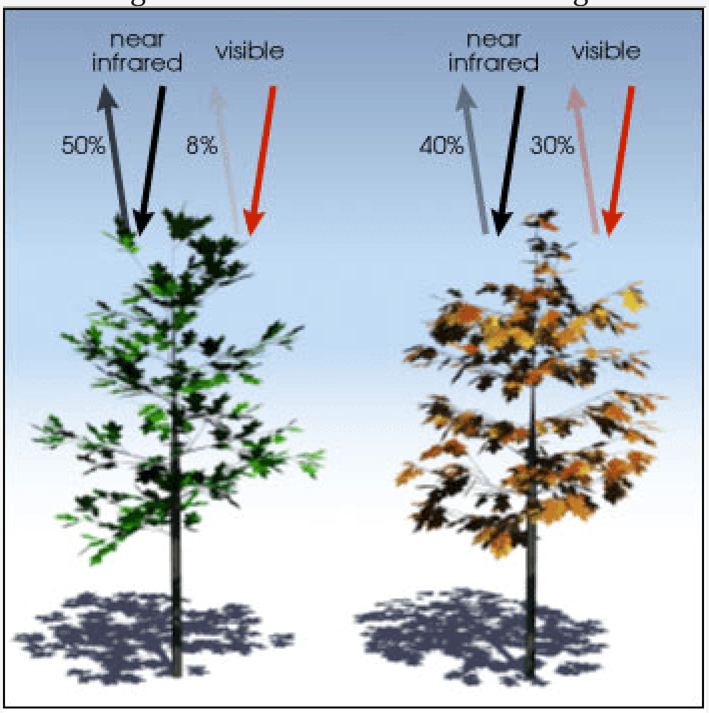
NDVI DEFINITIONS (RED, BLUE, ENHANCED)

RED NDVI

Normalized Difference Vegetation Index is a spectral band calculation that uses the Visible (RGB) and Near Infrared (NIR) bands of the electromagnetic spectrum. True NDVI also known as Red NDVI is defined below and has been used in scientific research for over 40 years and was invented by Rouse et al. of the NASA/Goddard Space Flight Center in 1973. The basic concept is that chlorophyll in plants absorb red light during photosynthesis and healthy plants reflect very strongly in the NIR band. Red NDVI is a number ranging between +1 and -1 with +1 indicating healthy vegetation and -1 indicating dead or extremely stressed vegetation. The Red NDVI vegetation index has been widely studied and adopted by the scientific community as a means of measuring crop health:

$$NDVI = \frac{NIR - Red}{NIR + Red}$$

As can be seen in the example below, when natural sunlight illuminates the leaves on a healthy plant or tree, as indicated by the tree on the left, the red band absorbs more light and reflects more NIR light producing a larger NDVI value. In contrast, the tree on the right absorbs less Red light and reflects less NIR resulting in a lower NDVI value.



$$\frac{(0.50 - 0.08)}{(0.50 + 0.08)} = 0.72 \qquad \frac{(0.4 - 0.30)}{(0.4 + 0.30)} = 0.14$$

Red NDVI can be used as a very good indicator for determining whether a plant or crop is healthy or under some form of stress. Once it is known that a plant is under stress, the exact stress mechanism should be investigated further. Additional testing should be done since NDVI alone may not identify the specific stress mechanism. Aerial remote sensing and NDVI maps can be used as an aid or a tool in the agronomist's toolbox but do not replace the need for further testing and investigation if potential problem areas are identified.

BLUE NDVI

This is a variant of the NDVI equation that replaces the red channel in the NDVI equation by the blue channel in an attempt to use a single camera to estimate NDVI. In CMOS sensors used in RGB cameras the red channel is sensitive in both the red as well as the NIR spectral bands. A NIR cut-off filter is used to eliminate the NIR spectral component that would otherwise be super-imposed with the red spectral component in the red channel. In Blue NDVI cameras the NIR cut-off filter is removed and replaced with a red band cut-off filter. The red channel is then used to measure NIR radiation. Since the red light has been eliminated by the red cut-off filter it is no longer available for use in the NDVI calculation. Instead, the blue channel is substituted for the red channel in the Red NDVI equation. Although blue light is also absorbed during photosynthesis by chlorophyll it is also absorbed by anthocyanins which are pigments that protect vegetation from overheating. Absorption of blue light by anthocyanins and scattering of blue light in the atmosphere interferes with crop stress detection using Blue NDVI. Replacing red light by blue light in the NDVI calculation degrades the sensitivity of the index. It is well known that Blue NDVI is less sensitive to crop stress than Red NDVI, shows less contrast between stressed versus non-stressed crops, and incorrectly yields high Blue NDVI values for materials that are not photosynthetically active. Due to these limitations Blue NDVI has not been adopted as a crop stress monitoring index by the scientific community. Its main appeal is that it can be computed with a single camera and hence can be less costly than multi-camera multi-spectral systems.

$$NDVI = \frac{NIR - Blue}{NIR + Blue}$$

ENHANCED NDVI

Also known as ENDVI, is an NDVI variant that has little, if any, scientific basis. It is computed with re-purposed camera systems as described above. Due to the bands it uses in the computation it suffers from the same limitations as Blue NDVI:

$$ENDVI = \frac{(NIR + Green) - 2 * Blue}{(NIR + Green) + 2 * Blue}$$