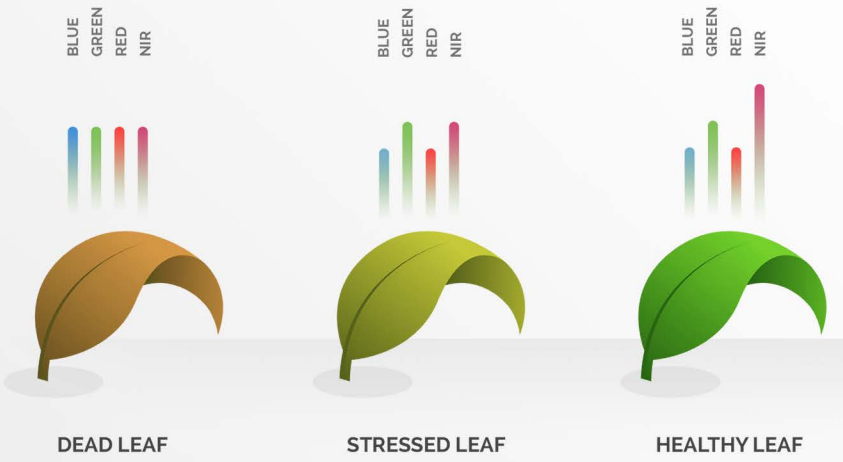
General (VIs)

How do vegetative indices work?

Plants and soil, just like any other matter, reflect light and energy. Reflectance patterns of visible and near-infrared (NIR) wavelengths change throughout the season depending on plant development, health and vigor. Vegetative indices help quantify these factors based on ratios of reflectance intensity at various wavelengths. This opens the door for improved management decisions that increase production efficiency and profitability.



Broader vision of the field than when sampling...

Unlike ground sampling specific points based on one instance in time to draw general conclusions of your field, drone technology and remote sensing enables you to get a complete representation of the field and its spatial variability across multiple instances in time.

Don't forget ground truthing!

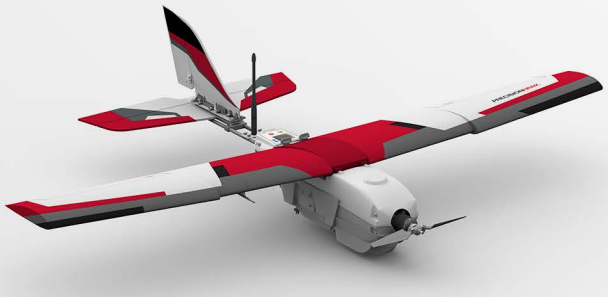
Vegetative indices are informative tools that illustrate spatial variability within fields. The current algorithms analyze drone images and result in maps that outline areas that behave differently than the rest of the field.

But your agronomist knowledge is still needed to make sense of those maps! Are the less vigorous areas showing a nutrient deficiency? Is there a pest or disease problem? A watering issue?
Or an equipment defect?

Based on your experience, you will most likely be able to easily answer these questions once our algorithms have identified the problem areas for you. No computer can replace your expert eyes and your knowledge. But those maps will help you save time by assessing the extent of the damages and by giving you the necessary tools for a response plan.

Management zones

Drone technology and remote sensing can help understand the variability within a territory, a farm or a field by creating maps that illustrate the spatial distribution of certain characteristics. Combined with quantitative, qualitative, intuitive and historical factors, these maps can then be used to delimit areas of a field that behave relatively homogeneously called "management zones". Combined with modern farming equipment, our products allow growers to leverage the full potential of Precision Farming by facilitating the creation of variable rate prescription plans that maximize the efficient use of inputs (fertilizers, pesticides, water, etc.)



Corn

General plant vigor

In early stages, bare soil will be quite apparent on the aerial images. Therefore, we recommend using the SAVI (Soil Adjusted Vegetation Index) or GSAVI (Green SAVI) algorithm which takes into account the soil pixels and focuses on vegetation pixels. Once rows start closing, OSAVI (Optimized SAVI) is more appropriate. When the rows fully close, you can use NDVI (Normalized Difference Vegetation Index) and ENDVI (Enhanced NDVI) as general plant vigor analysis tools. Note that ENDVI was more specifically developed for BGNIR (Blue/Green NIR) sensors and drone usage. CANOPY COVER, is also beneficial, we will give more details below.

Yield estimation for grain

Germination rate and stand count

To estimate your germination rate, you can apply PLANT COUNT after emergence and before V3. The plants have to be big enough in order to appear clearly on the images. Once they start overlapping, the PLANT COUNT algorithms can no longer differentiate the individual plants properly. However, after V3-V4, CANOPY COVER can give you a visual estimate of the germination rate by looking at the surface of the field covered in green vegetation and can also be an indicator of crop growth stage, which affects important crop factors such as rate of water uptake.

GDVI values calculated on images taken at midgrain filling were shown to be highly correlated to grain yields at maturity.

Yield estimation for silage

To predict silage yield, run the algorithm PLANT HEIGHT. This algorithm is essentially your CANOPY COVER multiplied by a height. This output will be strongly correlated to the biomass for silage.

Fertilization

Sidedress or delayed nitrogen application

In case of a late N application, you can run the GDVI (Green Difference Vegetation Index) prior to your sidedressing. GDVI is known to correlate with corn nitrogen content, which means it can be used to infer plant N requirements. This tool will help you visualize the vigor of the corn plants and assess if you need a spatial custom application plan.

Getting feedback on your fertilization plan

After your last fertilization application and before senescence of the bottom leaves start, NDVI, ENDVI and GDVI can be used to assess plant vigor and draw some conclusions on your fertilization plan.

Pests and diseases

Any pest or disease that affects the state of the leave's health (less live green surface) will affect the variability of vegetative indices across the field. To assess possible damages, run the general plant vigor algorithms listed above (SAVI, GSAVI, OSAVI, NDVI, ENDVI).

Maturity variability and harvest

For grain corn harvest, it is important to know if your field has any maturity variability in case you need to come up with a custom drying/storing plan. To asses this, you can fly your drone when plants are close to complete senescence but still have some green live vegetative tissue (around R4 - dough). GNDVI is a good indicator of senescence, and by using this algorithm, you can get a representation of any potential spatial variability in your field before it reaches physiological maturity.

Soy

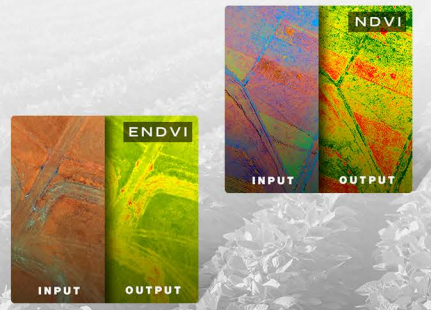
Germination

PLANT COUNT will not be able to distinguish each particular soy plant because they are much smaller than corn. However, with an algorithm such as CANOPY COVER, you can draw conclusions about your emergence rate.

General Plant Vigor

In early stages of development, bare soil will be quite apparent on the aerial images. Therefore, we recommend to use the SAVI or GSAVI algorithm which takes into account the soil pixels and focuses on vegetation pixels. Once the rows start to close, OSAVI is more appropriate. The pace of canopy coverage (30'' or 15')' will depend on the row spacing and seed rate that you chose.

When the rows fully close, you can use NDVI and ENDVI as general plant vigor analysis tools. Note that ENDVI was more specifically developed for BGNIR sensors and drone usage.



Stunted growth

Stunted soybeans may be detected by the algorithms listed above (SAVI, GSAVI, OSAVI), but if you fly your drone later in the season, you can also use the PLANT HEIGHT or CANOPY COVER tools to assess damage.

Pest, diseases and nutrient deficiencies

Any pest, disease or nutrient deficiency that affects the state of the leave's health (less live green surface) will affect the variability of vegetative indices across the field. To assess possible damages, run the general plant vigor algorithms listed above (SAVI, GSAVI, OSAVI, NDVI, ENDVI).

Weed detection

Harvest

Some recommend to harvest your weediest fields last because it gives more time for the weed biomass to deteriorate and allows easier threshing. To assess the weed situation close to harvest, use GNDVI when the soybeans have already reached maturity. It will spot the live green vegetation of weeds in between the soybeans that have already senesced.

Wheat

General plant vigor

In early stages of development, bare soil will be quite apparent on the aerial images. Therefore, we recommend to use the OSAVI algorithm which takes into account the soil pixels and focuses on vegetation pixels. When the rows fully close, you can use NDVI and ENDVI as general plant vigor analysis tools. Note that ENDVI was more specifically developed for BGNIR sensors and drone usage.

Germination and tillering rate

PLANT COUNT will not be able to distinguish each particular wheat plant because they are much smaller than corn. However, with an algorithm such as CANOPY COVER, you can draw conclusions about your emergence and even your tillering rate in some cases.

Fertilization

Early growth and tillering

As mentioned above, CANOPY COVER can help you assess the tillering variability across your field. After validating the aerial maps with field data, you can decide whether an early application of N is needed to induce tillering

Split applications and grain quality

If you're working with a split fertilizer application plan, drone images can help you spatially customize the last application depending on the vigor of your field. For that, use GDVI prior to the last application.

Pest and diseases

Any pest or disease that affects the state of the leave's health (less live green surface) will affect the variability of vegetative indices across the field. To assess possible damages, run the general plant vigor algorithms listed above (OSAVI, NDVI, ENDVI).

Harvest

For wheat harvest, it is important to know if your field has any maturity variability in case you need to come up with a custom drying/storing plan. To asses this, you can fly your drone when plants are close to complete maturity but still have some green live vegetative tissue. GNDVI is a good indicator of senescence and by using this algorithm; you can get a representation of any potential spatial variability in your field before reaching physiological maturity

Cover crops

Cover crops were widely used in the typical American farmer's crop rotation until the 1950's, but cover cropping was largely abandoned when synthetic fertilizers became available. However, we're observing a renewed interest in cover crops. Benefits of cover crops include the promotion of pest-suppression, soil and water quality, carbon sequestration, nutrient cycling efficiency, prevention of soil erosion, conservation of soil moisture and in the end, cash crop productivity.

But integrating cover crops requires the farmers to experiment with their systems. Drones can be a useful tool to monitor the effects of the new rotations.

Germination and tillering rate

Plant count will not be able to distinguish each particular wheat plant because they are much smaller than corn. However, with an algorithm such as CANOPY COVER, you can draw conclusions about your emergence and even your tillering rate in some cases.

General plant vigor

Because the rows will close rapidly, use NDVI and ENDVI as general plant vigor analysis tools (no need to use algorithms that take into account the soil pixels such as SAVI, GSAVI and OSAVI). Note that ENDVI was more specifically developed for BGNIR sensors and drone usage.

If your have a complex mix of species in your cover, using RDVI (Red Difference Vegetation Index) might be an option since it was developed for vegetative covers with multiple phyllotaxis.

Effects on the following crop

Drones can help monitor the effects of cover crops on subsequent crops in the rotation. Cover crop biomass at termination will be the most important variable to monitor especially when comparing different farming practices (cover crop planting date, termination date, species etc.).

Biomass estimation

To assess that biomass, run the algorithm PLANT HEIGHT. This algorithm is essentially your CANOPY COVER multiplied by a height and the output will be strongly correlated to cover crop biomass.