GreenSeeker projekt

Formål:

Delprojektet har til formål at vurdere om GreenSeeker sensor, som måler planters refleksion, kan anvendes til at estimere ukrudtsdækningskort i korn og andre afgrøder sået på rækker via metoder indenfor signalbehandling.

Forudsætninger:

GreenSeeker sensoren fra GeoTeam anvendes i korn sået på 25 cm rækkeafstand for måling af vegetationsindeks ved første radrensning. Vegetationsindekset signalbehandles for at opnå et estimat for ukrudtsdækning mellem rækkerne. Ukrudtskortet har stor betydning for <u>stedspecifik bekæmpelse af ukrudt med radrenser</u> eller anden fysisk ukrudtsbekæmpelse ved 2. og 3. behandling.
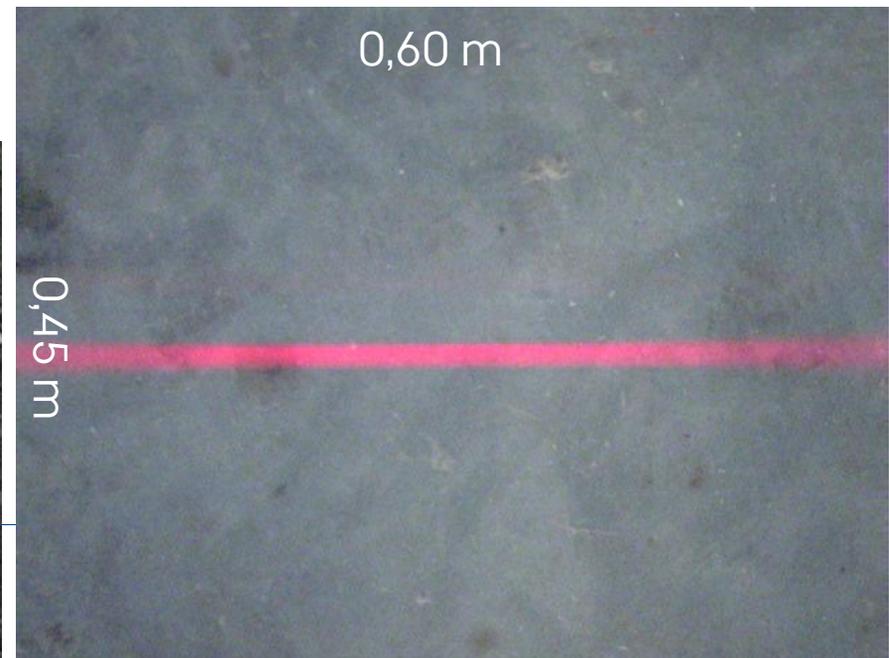
Kravspecifikationer:

Signalbehandlingen skal vha. et minimum af brugerindtastning kunne
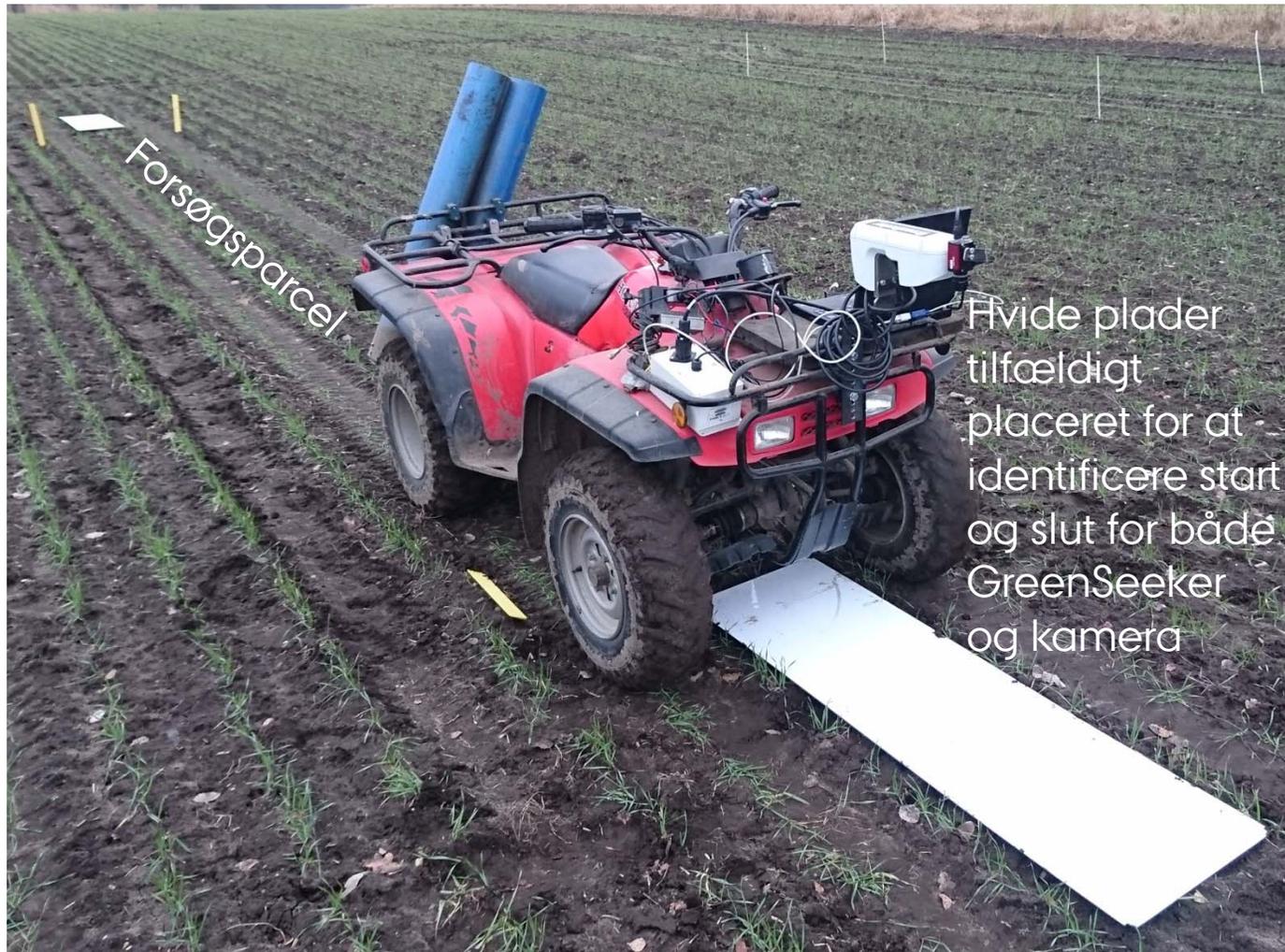identificere fire kategorier:

      1) Lav afgrødetæthed, ingen ukrudt mellem rækker

      2) Lav afgrødetæthed, ukrudt mellem rækker

      3) Høj afgrødetæthed, ingen ukrudt mellem rækker

      4) Høj afgrødetæthed, ukrudt mellem rækker

Ukrudt   Afgrøderække

Forsøgsopstilling

› Marlin digitalt videokamera monteret således GreenSeeker måling indenfor billedfelt, position i billedfelt kalibreret (illustreret herunder)

› GreenSeeker anvendt som beskrevet i bilag, dog med bærbar PC som datalogger af seriel data fra GreenSeeker

› Billedoptagelser fra Marlin kamera via 'SmartView' software fra AVT, 15 billeder per sekund, manuel instilling af kamera parametre (lukketid, billedfrekvens, type, m.m.)

Forsøgsparcel

Hvide plader tilfældigt placeret for at identificere start og slut for både GreenSeeker og kamera

Bilag: GreenSeeker manual modtaget fra GeoTeam

GreenSeeker® RT100
Data Collection and Mapping System

� Trimble.

Legal Notices

Copyright and Trademarks

Release Notice

This is the May 2010 release (Revision F) of the *GreenSeeker RT100 Data Collection and Mapping System User Guide*. It applies to version 1.00 of the GreenSeeker RT100 system.

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- an explanation of the problem

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Registration

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1 A copy of the Trimble Navigation Limited Limited Warranty Terms and Conditions is provided with the distributed Product and is available from your local Trimble authorized dealer and upon request at trimble_support@trimble.com.

2 "Firmware" means software used in the hardware device to enable the different hardware systems to communicate and function together. These functions are essential to the performance of the hardware device.

Australia and New Zealand

This product conforms with the regulatory requirements of the Australian Communications Authority (ACA) EMC framework, thus satisfying the requirements for C-Tick Marking and sale within Australia and New Zealand.

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Recycling in Europe: To recycle Trimble WEEE (Waste Electrical and Electronic Equipment, products that run on electrical power.), Call +31 497 53 24 30, and ask for the "WEEE Associate". Or, mail a request for recycling instructions to:

Trimble Europe BV
c/o Menlo Worldwide Logistics
Meerheide 45
5521 DZ Eersel, NL

Safety information

Before you start the installation, you must read and understand the information contained in this section.

Always follow the instructions that accompany a Warning or Caution. The information they provide is intended to minimize the risk of personal injury and/or damage to property. In particular, observe safety instructions that are presented in the following format:

⚠ **WARNING –** This alert warns of a potential hazard, which, if not avoided, can cause severe injury.

⚠ **CAUTION –** This alert warns of a hazard or unsafe practice which, if not avoided, can cause injury or damage.

Note – An absence of specific alerts does not mean that there are no safety risks involved.

Cautions

⚠ **CAUTION –** Failure to charge the PDA for several days may result in lost data. Trimble recommends that you regularly copy data from the PDA and then save it to your computer or to a Secure Digital card.

Contents

Introduction

This manual describes the GreenSeeker® RT100 data collection and mapping system, and how to use it to capture data.

The system is a tool for crop research and consulting that provides precision measurement and data logging of the Normalized Difference Vegetative Index (NDVI) and RED/NIR of plant material. These data points can be used in conjunction with other agronomic references to index basic nutrient response, crop condition, yield potential, stress, pest and disease impact in a quantitative manner. The system can be used to monitor changing field (plant or crop) conditions during the growing season, and the effects of different levels of an input compared to a local standard.

The system uses second-generation optical sensor technology. It generates light at two specific wavelengths and measures the light reflected off the target (typically, plants in soil). The microprocessor within the sensor analyzes the reflected light and calculates the results.

The supplied GreenSeeker Capture software runs on a ruggedized PDA (Personal Digital Assistant), which may be a Trimble Recon® or Nomad® handheld computer, or an HP iPaq PDA. The software shows the output in real-time and also logs the output data to a file. The data from the sensor is transmitted serially to the PDA and can later be exported to a desktop computer for analysis. Additional features are available if you use other tools to log data.

In this document, "PDA" refers to any ruggedized Personal Digital Assistant that has a built-in serial port: If anything refers to only one model, this is clearly indicated.

Accessories

Included items:

- GreenSeeker Capture software for the Windows Mobile® 2003 and Windows Mobile version 5.0 software ("Windows Mobile-based software").

- Auto adaptor (for the powered cradle only).

Additional items:

- Farm Works Farm Site Mate VRA Data logging Pocket PC software or other PDA/Pocket PC software that has a feature to log GreenSeeker data.

- GPS Receiver: This can be a WAAS CF Card type receiver or higher resolution receiver. If you use a non-CF card slot receiver, you must use a CF-to-serial adapter for connecting to the PDA.

Primary components

Control box

Contains a battery and a circuit board to interface the power and switches to the sensor and external connectors.

Power connector

Connects power from the vehicle battery (12 V DC in).

Power switch/indicator

Supplies power to the sensor and powered cradle. The built-in indicator in the switch lights up when power is on.

External data port

Enables data collection through an RS232 connection using the serial cable provided (Com Port: 38,400 baud, 8, 1, N; Flow: None)

Sensor port

Sends power and commands to the sensor through the controller cable provided.

Personal Digital Assistant (PDA)

The sensor requires a PDA running Windows Mobile-based software to show and store the data from the sensor. For more information, refer to the manual for your device. The GreenSeeker Capture software is pre-loaded on the PDA.

Powered PDA cradle

Acts only as a mechanical mount for the PDA. The cradle draws power from the control box. To charge or extend the PDA battery life, turn on the power switch.

Sample switch

Controls the data flow and the count of the data collected. If required you can disable the buzzer that sounds while the trigger is pressed. See General information, page 9.

Sensor

Takes the reflectance readings. This sensor uses internal illumination for use in any lighting condition, day or night. When the sensor is on, you can see a red band of light immediately below the rectangular sensor window. Hold the sensor 32"-48" (approximately 81 cm-122 cm) over the plant or crop canopy to be sensed. The width of the sensor measurement is approximately 24" (61 cm): This width remains almost constant in the height range given above.

Sensor mount

You can attach the sensor to a bracket, tubing, or other suitable surface using 5/16" hardware. Adjust the sensor so that it is parallel to the target.
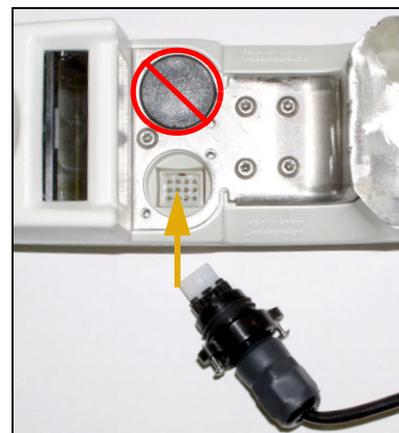
Connections

Verify the connections between the sensor, the control box, and the PDA according to the following figures.

Sensor

Attach the 12-pin connector to the sensor with two captive screws. Make sure it is inserted into the *lower* port

Do not connect to the adjacent connector port.

Control box to PDA

Connects to the powered cradle/PDA with a DB9 (RS232) serial cable.

1. Plug in the small black power cable so that the cradle can draw power from the control box.

2. Cut the gray battery cable to an appropriate length and then attach it to the vehicle battery using the supplied ring terminals.

3. Mount the sample switch so that the vehicle driver can start and stop data collection.
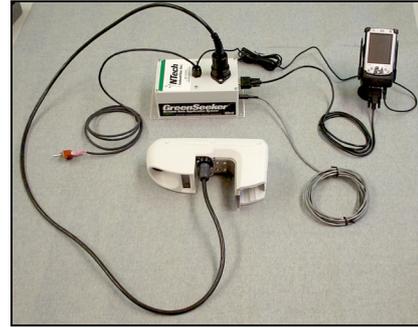
Note – The Sensor and control cable are weatherproof, but the control box, cradle, and cables are intended for mounting in a dry location.

General information

⚠ **CAUTION –** Failure to charge the PDA for several days may result in lost data. Trimble recommends that you regularly copy data from the PDA and save it to your computer or to a Secure Digital card.

Before going out into the field:

- Fully charge the PDA battery. Check the indicator on the PDA to confirm that it is fully charged.

- Make sure that there is enough available memory on the PDA.

- Hold the sensor approximately parallel to the ground, and at the recommended height, while operating.

To disable the buzzer:

a. Open the control box: Use a Phillips head screwdriver to remove the four corner screws.

b. Carefully separate the two halves of the box: Make sure that the cables remain plugged in.

c. Remove the black jumper from J5 on the PCB (ASSY 400-1-014).

d. Close the control box and reinstall the four screws.

The RT100 system: Getting started

1. Connect one end of the provided serial cable to the powered cradle connector (or directly to the PDA serial port).
Connect the other end to the control box.

2. Use the switch on the control box to turn on the sensor.

3. Turn on the PDA. Tap *Start* / *Programs* and then tap the GreenSeeker Capture icon.

Note – Your PDA may not be the same as the one shown here.

4. Tap *Sensor* / *Start GreenSeeker*.

5. Position the sensor at the start of the target region. Keep the sensor approximately parallel to, and 32"- 48" (approximately 81 cm-122 cm) above the canopy.

*Note – To avoid incorrect data, position the sensor over the target **before** you turn on the sample switch.*

6. Toggle the sample switch on and then traverse the region. At the region boundary, toggle the sample switch off.

Once you turn off the sample switch, the number shown in the white box is the average of all readings to that point. Each time you toggle the switch, the system logs a new value.

7. Once you finish collecting data, tap *File* / *Save* to save and name the job.

Capturing data

If you are geo-referencing data with Farm Works Farm Site Mate VRA or other PDA software, refer to specific information provided with that software.

GreenSeeker Capture software captures the readings from the RT100 system, shows the current reading, and stores the readings for you to analyze later or to make fertilizer recommendations. The software is pre-loaded on the PDA at the factory: If necessary, you can download it from http://www.greenseeker.com/software/.

Note – You may have to reload the software if the PDA battery discharges completely, depending on whether or not your PDA has non-volatile memory.

The software operates like most Windows programs: Open and save files as with a normal word processing program. Make sure that you note where you save the files on the PDA.

The following modes are available for logging data:

- Log Strips: See .
- Log Plots: See .

If you switch between modes, and you do not save the data file, you are prompted to do so.

Note – Once you switch modes or close the program you cannot open an existing file and save more measurements to it. After you save a data file, you can tap File / New to create a new file. This clears the data cells and enables you to collect readings for a new field.

Log Strips mode

Use this mode to collect sensor readings from large strips with different fertilizer levels. More specifically, use it to compare nitrogen rich strips (NRS_NDVI) with lower rate, farmer practice strips (FP_NDVI) to determine recommendations.

1. Turn on the power switch on the control box.

2. Turn on the PDA: From the *Start* menu, tap *Programs / GreenSeeker Capture*.

3. Tap *Non - Ref (Farmer Practice)* or *NDVI Reference (N Rich Strip)*. The button changes to *Collecting*.

4. Tap *Sensor / Start GreenSeeker*.

5. Position the sensor at the start of the target region.

6. Toggle the sample switch on and then traverse the region.
   As long as the switch is toggled on, data is recorded to the file.

7. At the end, toggle the sample switch off.
   Once you turn off the sample switch, the number shown in the white box is the average of all readings to that point. Each time you toggle the switch, the system logs a new value.

8. Once you finish collecting data, tap *File / Save* to save and name the job.

Data: Log Strips mode

Once you save the data, you can view it. Tap *Field* and then tap the name of the file from the *File Name* list.

The filename.txt file contains the following information:

- Average FP_NDVI value
- Average RS_NDVI value
- Maximum NDVI from the rich strip (RS).

You can use this data displayed to generate a nitrogen recommendation in conjunction with the Oklahoma State University web page:
http://www.soiltesting.okstate.edu/SBNRC/SBNRC.php

The following example is for your reference:

filename.txt

```
FP_NDVI:
--------------------
AVG = 0.67112, STDEV = 0.11562
RS_NDVI:
--------------------
AVG = 0.77964, STDEV = 0.01023
MAX_NDVI:
--------------------
Max_NDVI = 0.77740
```

Log Plots mode

Use this mode to collect readings from multiple plots. It is better suited for data analysis.

1. Turn on the power switch on the control box.

2. Turn on the PDA: From the *Start* menu, tap *Programs / GreenSeeker Capture*.

3. Tap *Sensor / Start GreenSeeker*.

4. Select the *Log Plots* tab.

5. Position the sensor at the start of the target region.

6. Toggle the sample switch on and then traverse the region.
    As long as the switch is toggled on, data is recorded to the file.

7. At the end, toggle the sample switch off.

    Once you release the trigger, the following information appears:

    –   Sample No.

    –   NDVI

    –   Avg NDVI

    Each time that you toggle the sample switch, the plot increases by one.

8. Once you finish collecting data, tap *File / Save* to save and name the job.

Data: Log Plots mode

Once you save the data, three files are created and automatically saved to the folder: *My Device\My Documents\Capture*.

*   filename.txt: Contains all of the data collected

*   filenameAvg.txt: Contains only an average NDVI for each sample (plot)

*   filenameDiag.txt: Contains all the diagnostic information for the sensor (typically, this is empty)

Data management: Log Plots mode

You can write the collected data to the PDA internal memory or to a removable SD (Secure Digital) memory card.

To export the data to your computer, synchronize the PDA with the computer.

The system writes *Filename.txt* and *filenameAvg.txt* to a comma-delimited ASCII text file suitable for direct import to Microsoft Excel® spreadsheet software.

To download the data file(s) to your computer:

1. Synchronize the PDA with your computer.

2. Open the Excel software and then select *File / Open*.

3. Change *File Types* to *All Files* and then select your .txt data file.

4. Select *Delimited Text, delimited by commas and spaces*. This imports data into separate columns in the spreadsheet file.

The following examples are for your reference:

filename.txt

Time (ms)	Plot	Count	NDVI	VI_2
11000,	0,	17,	0.700,	0.171
11100,	0,	18,	0.730,	0.156
11200,	0,	19,	0.720,	0.157
11300,	0,	20,	0.740,	0.148
11400,	1,	1,	0.740,	0.149
11500,	1,	2,	0.730,	0.156
11600,	1,	3,	0.730,	0.153
11750,	1,	4,	0.720,	0.156
11800,	1,	4,	0.720,	0.161

filenameAvg.txt

Time (ms)	Plot	Count	NDVI	VI_2
18570,	1,	12,	0.78517,	0.78517
21570,	2,	13,	0.78031,	0.78031
24570,	3,	9,	0.77944,	0.77944

filenameDiag.txt

Model	500 Series
Software version	.9.4 Mar 03 2008
Serial Num	H4920 (Red)
Module Addr	20

```
Sensor Mode                                HH
Time, Plot#, Pix#, NDVI, IRVI
$pnti,woi100,wv11.000
$pnti,woi100,wv11.000
```

Appendices

Data output options

For special applications, you can change the sensor output, such as the data output interval. For more information, contact Trimble Support.

Reinstalling or updating the GreenSeeker Capture software

1. If necessary, install the latest version of Microsoft ActiveSync® technology:

    a. Go to http://www.microsoft.com/downloads/.

    b. From the *Product/Technology* menu, select *ActiveSync*.

    c. Follow the instructions to download and install the software.

2. Use ActiveSync technology to connect the PDA to the computer.

3. Once ActiveSync indicates that the PDA is connected, do one of the following:

    –   Insert the *GreenSeeker Capture CD* into the computer. From the Windows taskbar, select *Start / Run*. Once the *Run* window opens, enter **D:\GreenSeeker Capture\2003\Install1.exe** (where D: is the CD drive).

    –   Download the version you want to install from www.greenseeker.com. Double-click the downloaded file and then follow the on-screen instructions.

4. When the *Microsoft VB Runtimes Installer* window opens, click **Next** and then follow the on-screen instructions.

5. If prompted to overwrite a file on the PDA, click **Yes To All**.

6. Press the soft-reset button on the bottom or rear of the PDA.

Vegetation indices available in the GreenSeeker sensor

There are several vegetation indices defined, evolving from more than thirty years of research in remote sensing and aerial imaging. In precision agriculture applications, two of the most commonly used indices are the Ratio and the Normalized Difference (NDVI), each comparing the relative reflectance of plant material and soils at two wavelengths. Additional modifications of the indices have been developed to compensate for various conditions of the plant canopy and background soil.

Several indices are available from GreenSeeker sensors. The sensor always outputs NDVI, plus an additional index (the default is IRVI), which makes it possible to compare indices on the same data at the same time. You can change this by connecting the sensor directly to a computer. Once selected, the output options are stored in the sensor, and remain in effect until you change them again.

- NDVI: Normalized Difference Vegetation Index
- SA-NDVI: Soil Adjusted
- RVI: Ratio
- IRVI: Inverse Ratio

Index equations

The wavelength bands are in the visible (red, 660 nm) and infra-red (NIR, 770 nm) regions of the spectrum. Half-power bandwidths are approximately 25 nm.

$ndvi = \frac{\rho_{NIR} - \rho_{VIS}}{\rho_{NIR} + \rho_{VIS}}$	$rvi = \frac{\rho_{NIR}}{\rho_{VIS}}$
$sa\,ndvi = \left(\frac{\rho_{NIR} - \rho_{VIS}}{\rho_{NIR} + \rho_{VIS} + L}\right)(1 + L)$	$irvi = \frac{\rho_{VIS}}{\rho_{NIR}}$

References

For more information on how to use the indices, go to http://www.greenseeker.com/.