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# RESEARCH ON VEGETATION INDEX OF CROP PLANTS IN AN EXPERIMENTAL GARDEN

**George MOISE**

"Lucian Blaga" University of Sibiu, Faculty of Agricultural Sciences, Food Industry and Environmental Protection, Sibiu, Romania, Phone: 0040269234111, Fax: 0040269234111,
E-mail: georgemoise@yahoo.com

***Corresponding author*:** georgemoise1@yahoo.com

***Abstract***

*Precision agriculture is a new agricultural concept relying on the existence of new variables in the field. Modern technologies are used, such as global positioning (GPS and DGPS), sensors, satellites or aerial images, and information management tools (GIS) to assess and understand some variation of an agricultural crop. The information collected for this type of agriculture can be used to more accurately assess the optimal density of seed, fertilizer use is estimated to culture and more specifically during the harvest. This type of agriculture is trying to avoid the application of inefficient practices to a crop, regardless of soil, climatic conditions, and can help to better assess the phytosanitary status of crops and changes in different stages of vegetation. Crop Circle is an equipment of last generation and can be used successfully in this direction, for this type of agricultural practice.*

***Key words*:** *measurements, Sibiu, Romania, Crop Circle, vegetation*

## INTRODUCTION

This study was conducted on the surface of 4,800 $m^2$ vegetable garden inside the Evangelical Church in Gusterița neighborhood in the city of Sibiu. GPS location coordinates are 45 ° 44 '13.74' north latitude and 24 ° 06 '22.26' 'East longitude. (Photo 1).


Photo 1. Environmental Education Center Evangelical Church Guşteriţa- Sibiu (orig.)

Evangelical-Lutheran parish in Sibiu has proposed a new project: to achieve overall fortified church Sibiu Gusterita an Educational Center for Environment and youth. Sibiu Parish certification in the Community's management and Audit Scheme EMAS as a second institution in the country underlines the importance that we attach to protecting Creation. Analysis and evaluation of the effects they have actions on the environment. The focus is on reducing the consumption of electricity and fuel, renewable energy [5], waste recycling, biodiversity [1,2,10-12], urban mobility and appropriate food produced organically. The application is carried transparently and communicate experiences and stated desire to continue to make contributions to protecting the environment [6,8,14]. An important part of the activity is to sow love and respect for the environment into the consciousness of the young generation. Based on these principles was the idea of reuse of an entire Saxon fortified church on the outskirts of Sibiu: by turning it into an educational center on themes of environmental protection.

## MATERIALS AND METHODS

Crop Circle ACS-430 appliance was purchased CEMPER Research Centre of the Faculty of ŞAIAPM in 2010 through a project PNCDI - 2 and was first used in collecting field data to determine "the degree of green" a

default location.

The data measured by Crop Circle ACS-430 allowed us to calculate the classic index of grassland vegetation of the plants analyzed, such as NDVI and SRI indexes. These data were collected in the field from October 2015 to experience being continued and in March 2015 until June 2016 (Photo 2). The study was aimed at acquiring and mastering skills in handling the device, field data collection and processing in order to perform statistical interpretations. The device Crop Circle ACS-430 allowed us to use dozens of indices of vegetation detected measurements overhead and transmitted via satellite using GPS applications by remote sensing plot analyzed in a certain time when vegetation from grassland was in various stages of evolution.

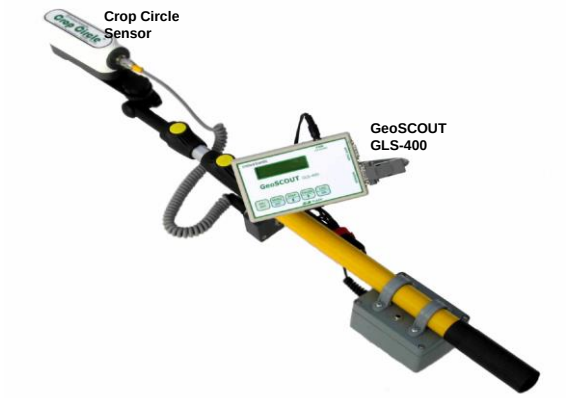



Photo 2. Crop Circle ACS-430

Field visits and data collection were performed over 24 field trips, we try to capture the state of green meadow since the autumn months when vegetation is approaching dormant, in spring when the explosion of vegetation it was at its peak and then make measurements during all summer months.

For measurements during each trip to collect field data we mounted sensor on the camera body and the data measured in the field come from a certain position of the appliance by a desired spacing (at an angle of 30° C), surface analysis or target plants (Photo 3).

The sensor device Crop Circle ACS-430 incorporates a proprietary technology[4] polychrome consisting of a light source and principle of operation is to illuminate and detect green part of the leaf carpet which we have reviewed [3].

Source of light emitted by the machine during the measurements in the field simultaneously emits visible light spectrum and in the near infrared (NIR) from a single LED light source.

The major benefit of this technology Recent already farmers practice in European countries has a principle of operation of the light source can be detected on the surface of the plant to be examined is identified for both light spectra both visible and bands of infrared light [18].

During the research by we managed to highlight and measure using the apparatus Crop Circle ACS-430 simultaneous measurements in three bands: 670 nm, 730 nm and NIR bands.

The data measured by Crop Circle ACS-430 allowed us to calculate the index vegetation classic of the plants that formed analyzed grassland habitat, such as NDVI and SRI indexes.

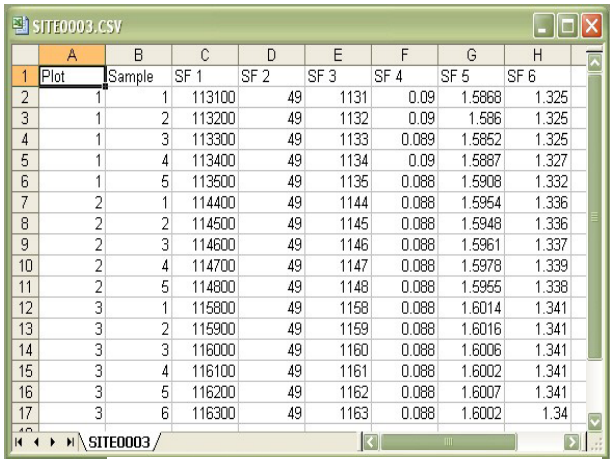
Serial data were generated by sensor processing by computer and are shown in the tables in Appendix, where NDVI is the Normalized Differential Vegetative Index) value reflctanţei NIR near infrared reflectance and VIS is value in the visible.

Photo 3. Experimental field where measurements were made (orig.)

Crop Circle can be used in two ways data acquisition in the field. These modes are the type MAP (map) and how PLOT (data collection).

One of these two modes is selected by the user when the device is turned on.

If MAP mode is selected, it is necessary for the proper operation and installation of the GPS device (Photo 4).


SITE0003.CSV

| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 1 | Plot | Sample | SF 1 | SF 2 | SF 3 | SF 4 | SF 5 | SF 6 |
| 2 | 1 | 1 | 113100 | 49 | 1131 | 0.09 | 1.5868 | 1.325 |
| 3 | 1 | 2 | 113200 | 49 | 1132 | 0.09 | 1.586 | 1.325 |
| 4 | 1 | 3 | 113300 | 49 | 1133 | 0.089 | 1.5852 | 1.325 |
| 5 | 1 | 4 | 113400 | 49 | 1134 | 0.09 | 1.5887 | 1.327 |
| 6 | 1 | 5 | 113500 | 49 | 1135 | 0.088 | 1.5908 | 1.332 |
| 7 | 2 | 1 | 114400 | 49 | 1144 | 0.088 | 1.5954 | 1.336 |
| 8 | 2 | 2 | 114500 | 49 | 1145 | 0.088 | 1.5948 | 1.336 |
| 9 | 2 | 3 | 114600 | 49 | 1146 | 0.088 | 1.5961 | 1.337 |
| 10 | 2 | 4 | 114700 | 49 | 1147 | 0.088 | 1.5978 | 1.339 |
| 11 | 2 | 5 | 114800 | 49 | 1148 | 0.088 | 1.5955 | 1.338 |
| 12 | 3 | 1 | 115800 | 49 | 1158 | 0.088 | 1.6014 | 1.341 |
| 13 | 3 | 2 | 115900 | 49 | 1159 | 0.088 | 1.6016 | 1.341 |
| 14 | 3 | 3 | 116000 | 49 | 1160 | 0.088 | 1.6006 | 1.341 |
| 15 | 3 | 4 | 116100 | 49 | 1161 | 0.088 | 1.6002 | 1.341 |
| 16 | 3 | 5 | 116200 | 49 | 1162 | 0.088 | 1.6007 | 1.341 |
| 17 | 3 | 6 | 116300 | 49 | 1163 | 0.088 | 1.6002 | 1.34 |

SITE0003

Photo 4. Program data processing from measurements taken from ground (orig.)

## RESULTS AND DISCUSSIONS

With the help of new generic device called Green detector we were able to analyze remote sensing measurements in the time period in the range October 2015 and June 2016 4,800 m2 plot, located in the Evangelical Church in Guşteriţa (Photo 5). We noticed measurements carried out and the degree of green vegetation evolution represented by the (NDVI) in the area with grass and vegetable crops inside the parish garden.

Photo 5. Crops under review (orig.)

Vegetation in plot has analyzed the property of absorbing solar radiation in the region of the electromagnetic spectrum called for photosynthetic active radiation (RAF) which is used as an energy source for the specific processes of photosynthesis [9,13,16]. The cells analyzed were leaf of the habitat ability to reflect solar energy in the near infrared spectral region, as the energy per photon in this area (wavelengths greater than 700 nanometers) is not sufficient to be useful to synthesize organic molecules. A strong absorption at this wavelength (if the leaves would not reflect) plant would result in overheating which could lead to tissue destruction. As a result, the analyzes carried out in the six months I noticed that green plants appear relatively dark in the RAF spectral column FS6 (VIS) [18].

The vegetation consists of vegetable crops in experimental fields analyzed absorb this radiation light in the near infrared spectral specific radiation SF 5 column (NIR) NIR reflectance due. Plants with chlorophyll, absorb visible radiation very strong (between 0,4şi 0.7 μm) and use it in photosynthesis.

Within the 33 charts that are processed field data was used formula for calculating the vegetation index NDVI (SF4 column):

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

NIR reflectance and VIS are obtained device (SF 5) for respectively visible and near infrared (SF4).

Positioning sensor during measurement of biomass is as shown below (Fig.1.)

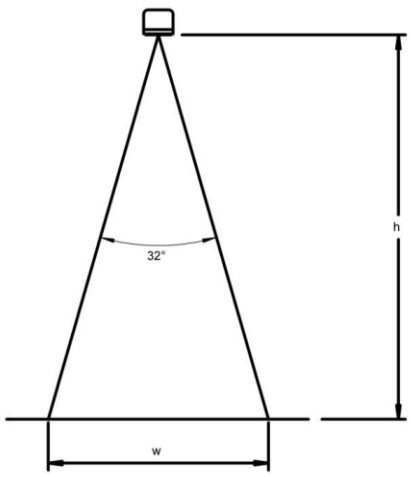



Fig.1. Positioning sensor (FOV)

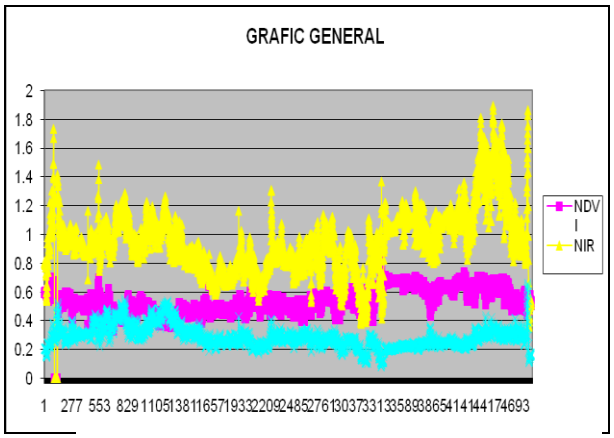



Fig.2. Centralization of data obtained from the survey (orig.)

## CONCLUSIONS

The analysis of data collected during six months of monitoring of the parcel described herein can draw the following conclusions:

- Green plants in our case the layer of grass and vegetable [17] crops monitored due to the content of chlorophyll and the phenomenon of photosynthesis have the ability to reflect and transmit the visible (VIS) per wavelength blue and red reflecting the green, so the level of green,
- Using the apparatus Crop Circle ACS-430 which performs measurements reflecting these wavelengths have given us during tests index green herbaceous straw and vegetable crops analyzed. Thus we can conclude that during the spring months of March respectively in April and then in the summer months from May to June index was green meadow highest measured values ranged from 0.2 to 0.489 in the ranges found in graphs and tables at number 9 to number 33.
- Also during autumn and early spring when the infrared light (NIR) was stronger it is absorbed by soil carpet coverage because vegetation [15] was lower readings were between intervals 0.94 -1.2705, found in graphs and tables from number 1 to number 10.
- The measurements we observed the evolution of green vegetation and the degree represented by the (NDVI) values ranging from 0.38 to 0.733.
- Also over research using the apparatus Crop Circle ACS-430 have obtained information on the amount of green reflected from vegetation cover, these values are influenced certain days of atmospheric moisture, coverage of clouds and air temperature,
-Measurements representing different combinations of wavelengths represented biophysical characteristics of grassland vegetation under review [1,2,7], this index was influenced chlorophyll content of leaves and vegetation stage. Using these measurements carried out in agricultural crops, we could identify certain plant diseases which may lead to the timely application of phytosanitary treatments. But this was not possible because the crops were analyzed in an organic garden.
-The device Crop Circle ACS-430, operating on the principle of remote sensing, can be used in natural resource management for estimating vegetation cover land, in our case herbaceous layer DAFR and vegetable crops analyzed, estimating biomass which can lead to change use of certain parcels of Gușterița Ecological Garden.

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