Evaluation of the Quality of Filtering Spectral Data and the Prospects for its Functioning

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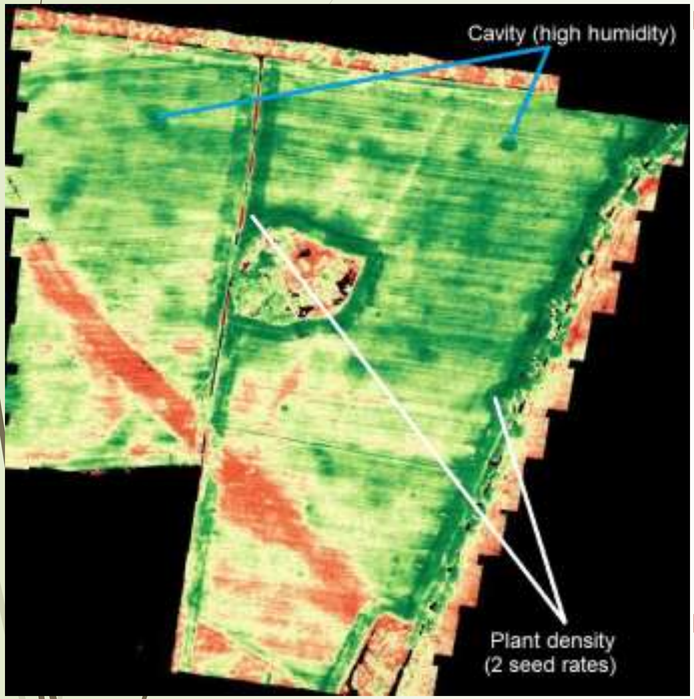
Introduction

- UAVs are innovative equipment for monitoring fields, which are deprived of a number of fundamental shortcomings of satellites in terms of availability, cost, image resolution. However, the issues of quality, reproducibility, and suitability for crop management processes remain relevant.
- However, the state of plant development is determined by many factors, including the state of mineral nutrition, water supply, etc., so within one field there may be a situation when the plants are at different stages of the growing season. Accordingly, in such situations, the calculation of the mean value over the site, which is inherent in satellite solutions, is erroneous. At present, the issue of assessing the suitability of the results of spectral monitoring of plantations in relation to the condition of plants has not been resolved. **Since spectral monitoring is a necessary component in the concept of crop management, the development of a methodology for assessing the suitability of remote monitoring spectral data for the calculation of agrochemical practices was the purpose of our work**

Problem Formulation

Since spectral monitoring is a necessary component in the concept of crop management, the development of a methodology for assessing the suitability of remote monitoring spectral data for the calculation of agrochemical practices was the purpose of the work. According to the publications, the dependence of the number of pixels on the values of the intensity of color components for plants and soil is described by the Gaussian distribution. Deviation from such distribution is caused by the imposing of distributions from various objects fixed on a photo. The experimental test was carried out on the basis of wheat, using the results obtained during 2017-2020 when considering the stresses of nutrient deficiency and technological nature.

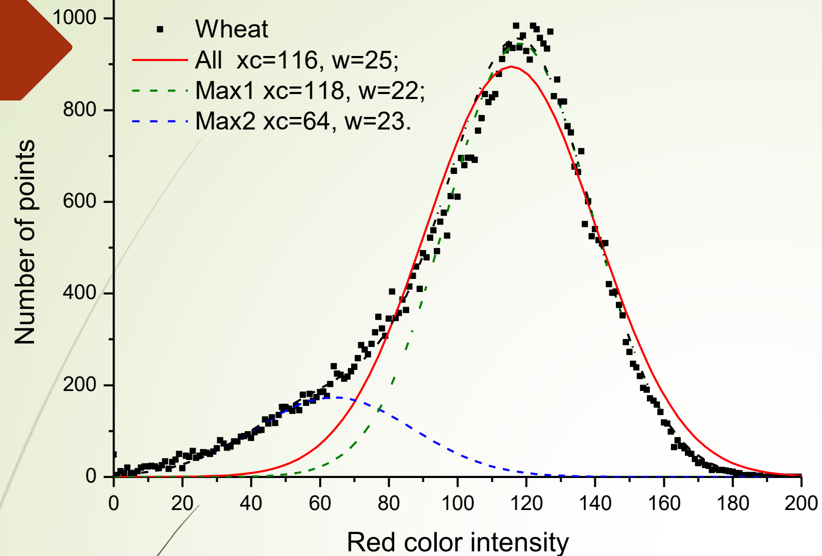
Materials and research software and hardware



NDVI distribution maps are created by Slantrange software

- The research was carried out on the basis of wheat, using the results obtained during 2017-2020. Stresses due to lack of nutrients were studied in the fields of the long-term stationary experiment of the Department of Agrochemistry and Plant Quality of NULES of Ukraine, where fertilizer application systems are studied. Technological stresses were studied on and in the production fields of farms in the Kyiv region.
- Multispectral studies using the infrared range were performed using the Slantrange 3p system and Slantview software.
- Laboratory studies accompanied all stages of plantation monitoring. A sampling of plants and soil was performed on the day of monitoring or within two days thereafter

The results

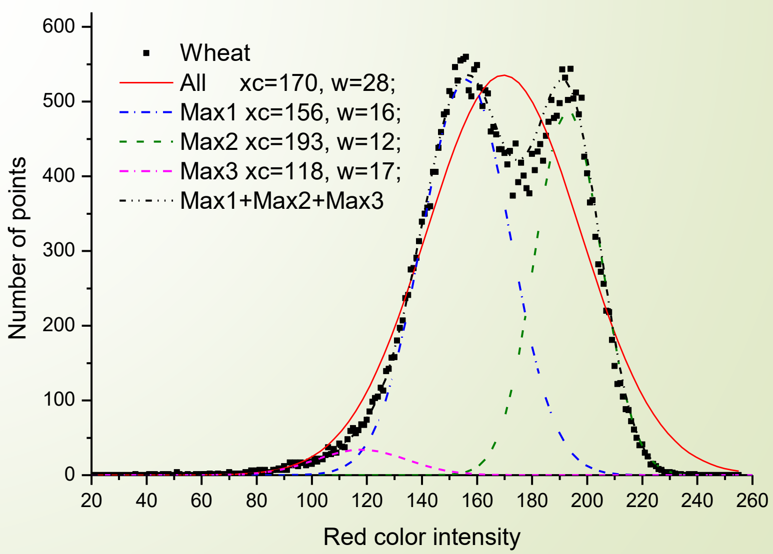


The results of the approximation of the dependence of the number of pixels on the intensity of the red component of color

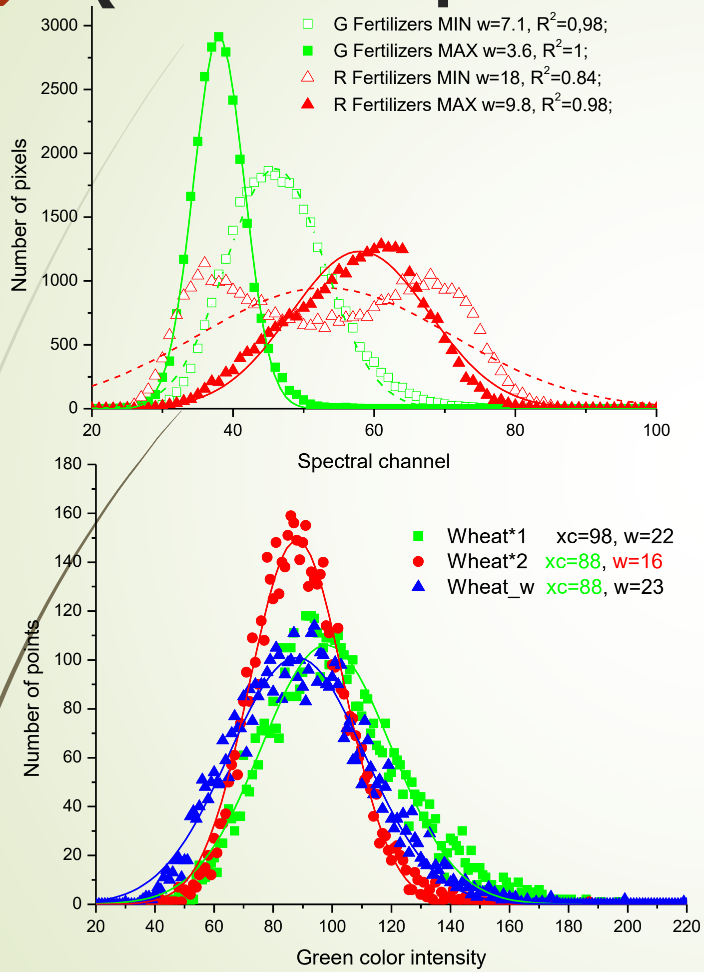
As can be seen from the above data when using the proposed method, it was found that the value of the maximum distribution shifted by 2 units, while reducing the width w by 3 units. The presence of the Max2 distribution can be explained both by the presence of shadow on the lower and upper leaves and by the fixation of the soil.

In practice, a situation is possible when plants of the same crop are in the field at the same time, but at different stages of the growing season or in a fundamentally different physiological state, such as the appearance of a flag leaf, which was recorded on 06.08.2018.

That is, monitoring was performed when the plants were in a transitional state and monitoring should be repeated after a few days when the vast majority of plants in the field are in a single stage of vegetation.



The results
(use of separate spectral channels)

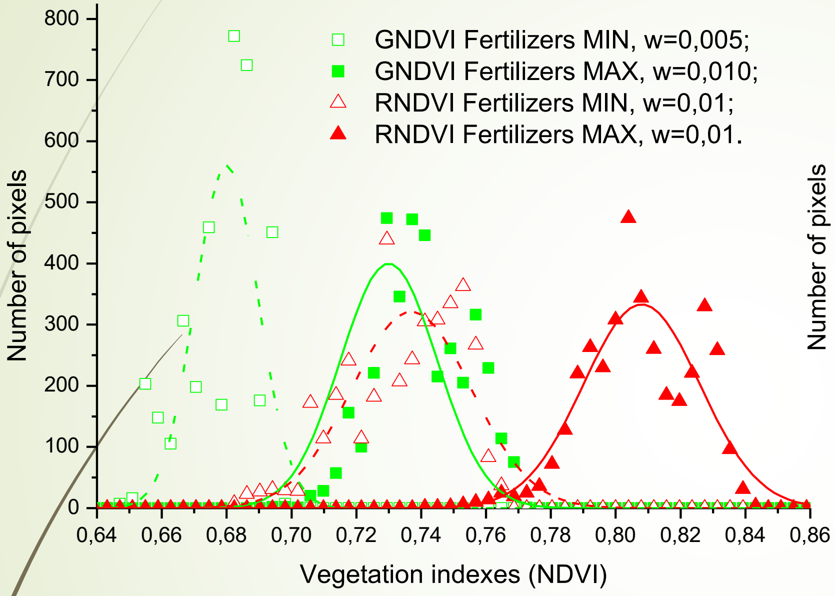


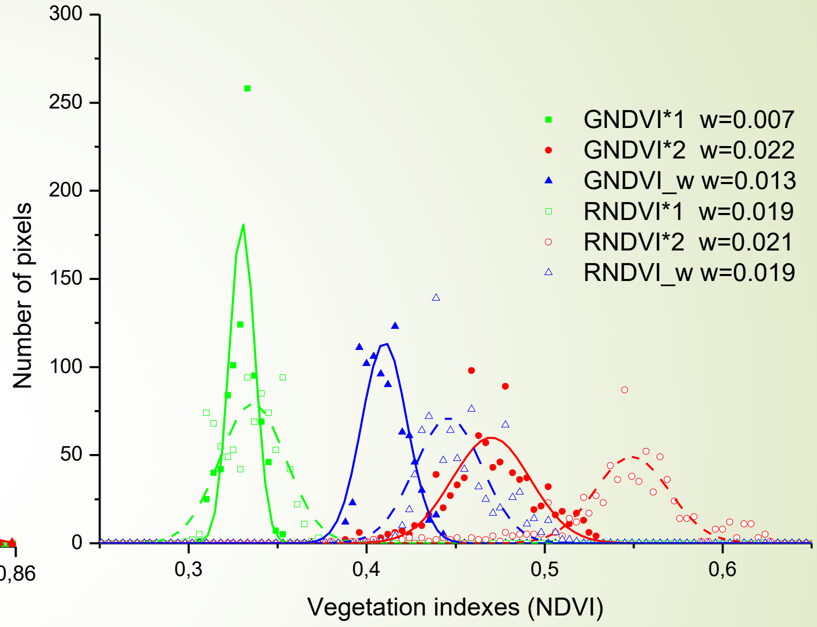
Dependence of the number of pixels on the intensity of the G and R components of color and the presence of technological stresses (The.str) and a dose of mineral fertilizers .

According to the results obtained under stress conditions, the width of distribution on both the green and red channels is 1.5≤ times greater than in healthy plants.

On the red channel, regardless of the presence of technological stresses, 2 pronounced maxima of distribution were not observed. According to the authors, the difference in plant development is explained by the difference in climatic factors due to the location of the plots.

Wheat (distribution maps of vegetation indices)





Based on the data obtained for the distribution of the NDVI index, there is a difference in the distribution of spectral channels. Thus, the width of the distribution regardless of the nature of stress in stress plants was similar or even smaller than in healthy plants.

Conclusions

- For the first time, it is proposed to evaluate the quality of filtering of foreign objects by identifying plantings, based on the assessment of the intensity distribution of the pixel color components in the experimental area. It is established that the distribution for plants is described by the GaussAmp function, and therefore the presence of "foreign" pixels (soil, organic residues) is determined by comparing the existing distribution with the approximate Gaussian dependence. In addition to assessing the quality of filtration, this approach will increase the accuracy and reproducibility of the obtained data for agronomic needs.
- For the first time, a method of identifying areas affected by technological stress, namely crop compaction is acceptable for industrial fields on the basis of spectral monitoring data obtained using UAVs. Identification can be performed both on individual spectral channels and on the distribution maps of standard vegetation indices NDVI. Thus, the technique can be implemented both on specialized systems such as Slantrange and using universal cameras.


Thank you attention !
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