Weed-dispersal monitoring in the maize stand by the remote sensing

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Abstract

Precise-agriculture is one of the new and fast-developing areas of present agriculture based on the modern technologies. Generally speaking, some manufacturing operations in agricultural technology are made on the basis of more precise understanding and description of each elemental step. Another possibility of this technology is monitoring of undesired plants in the arable crop-stands. The remote sensing of Earth is used exactly for this purpose.

For the green-plants monitoring are used mainly two spectral bands: 630–690 nm (red band, devised for the detection of the irradiation absorbed by chlorophyll) and 760–900 nm (near infrared band, used for the determination of stand-type, vitality and biomass).

Stand of each herb-specie has its own specific spectral image in different growth-period. On the other hand, these spectral images differ due to neighborhood conditions. The final spectral characteristics depend on the reflectance and emissions properties of plants and theirs background.

The hugest impact on the spectral characteristic of specific plant has generally, due to theirs surface, leaves. This allows us to follow the growing up process of the plants, because the leave-surface is changing during the different development stages of the plants.

For the precise distinguishing between different types of plants, it is a great advantage if their growth-periods are time-shifted. Exactly this situation occurs during the monitoring of the late-seeded maize. Consequently, the development of the maize-stand is delayed compare to other plants. It means that in the moment when all the undesired plants have large leaves and therefore the reflectance is high, the spectral characteristic of the maize stand is rather low.

In this period of the maize development, the combination of remote sensing of Earth (aerial photo coverage) and ground monitoring permit the precise dispersion of weeds in monitored areas. Aerial photos are later on processed in geographical information system (GIS) and observed data can be used for further work, e.g. resulting data can be used as a base for the application of the chemical spraying.

The agriculture farming systems are under never-ending process of development and improvement. The advance is generally achieved by applying new technologies, often developed for other purposes out of the agriculture area. The rise of a new discipline, so-called Precise Agriculture, is exactly the case. Precise agriculture, more precisely Precise Farming, is a new holistic approach to agriculture based on the development of IT technologies.

Based on the literature, the term precise agriculture is possible to determine as manufacturing operations in agricultural technology that are made on the basis of more precise understanding and description of each elemental step of the process and take it in account in its development. As a benefit, more optimal technological processes, due to a fulfilling of more precisely formulated requirements as well as better exploitation of working items (fertilizer, machines, etc.) leading to the final-prize decreasing, are obtained.

The main goal of precise farming is to improve the stand grown efficiency and to reduce the wrong impact of agriculture chemicals on the nature *via* directed inputs (seeding rate, fertilize doses, pesticide applications…), which are based on the specific requirements of each specific field zone. Relatively homogenous treatment of the fields require theirs dividing into zones that can be later on independently treated.

To define and divide the specific field into the zones is done generally according to the two mechanisms. The first one is based on the yield maps. These maps can be obtained from yield sensors or *via* stand remote sensing. The second method is based on the probes made directly on the field.

To increase the efficiency of the data acquisition, multispectral aerial photo coverage is used. In this method, the reflection of the irradiation from the stand is taken in context with its shape (content of water, chlorophyll…), volume (biomass) and surface (leave-surface covering). All these informations are good predictors of the yield and good indicators of local yield potential.

Remote sensing is potentially very well utilizable in the precise agriculture. The picture analysis allows visual interpretation as well as its digital processing *via* the software for the image analysis. This software allows us additional data processing including statistical treatment and identification of the zones with homogeneous spectral reflection.

For the green-plants monitoring are used mainly two spectral bands: 630–690 nm (red band, devised for the detection of the irradiation absorbed by chlorophyll) and 760–900 nm (near infrared band, used for the determination of stand-type, vitality and biomass). The comparison of the green-plants reflection and the land without vegetation is shown in Picture 1.

Stand of each herb-specie has its own specific spectral image in different growth-period, however, these spectral images differ due to theirs neighborhood conditions. The final spectral characteristics depend on the reflectance and emissions properties of plants and theirs background. The main impact on the spectral characteristic of specific plant has generally, due to theirs surface, leaves. This allows us to follow the growing up process of the plants, because the leave-surface is changing during the different development stages of the plants.

For the precise distinguishing between different types of plants, it is a great advantage if their growth-periods are time-shifted. Exactly this situation occurs during the monitoring of the late-seeded maize. Consequently, the development of the maize-stand is delayed compare to other plants. It means that in the moment when all the undesired plants have large leaves and therefore the reflectance is high, the spectral characteristic of the maize stand is rather low.

In this period of the maize development, the combination of remote sensing and ground monitoring permit the precise dispersion of weeds in monitored areas. The reflectance of the places containing weeds is higher compare to the places without them. Subsequent treatment of obtained aerial pictures in geographic informational system, gives precise positions of the weeds in monitored area.

This method was applied on locality Knížecí les, which belongs to Školní zemědělský podnik Žabčice. Treated aerial picture is shown in Picture 2.

Obtained results could be used in the future for the directed chemical spraying with herbicides, which could be applied only on the locality containing weeds. Alternatively, the higher doses of herbicides could be applied on those places. However, that requires being equipped with modern machines, which allow directed application of chemical materials.

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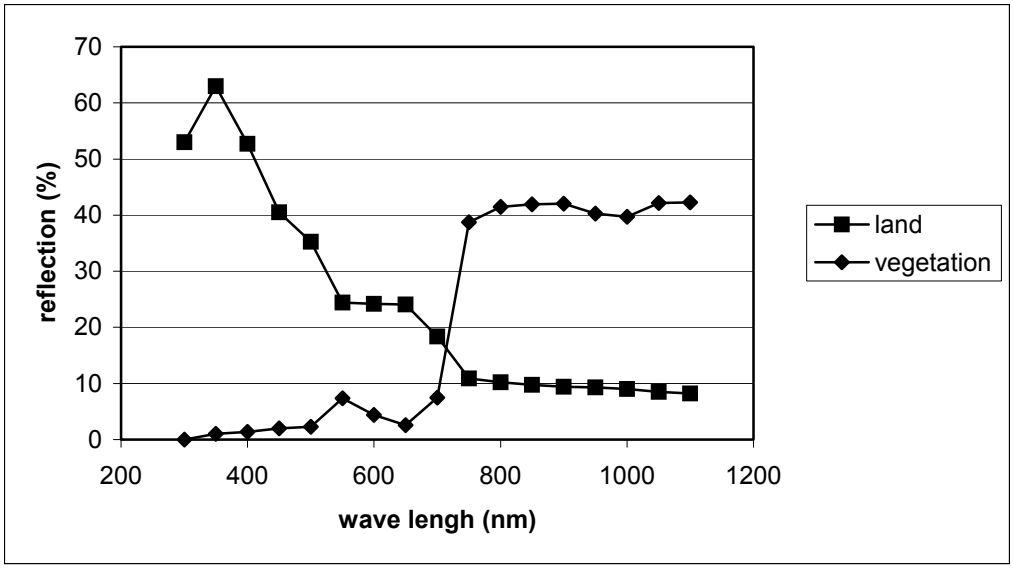
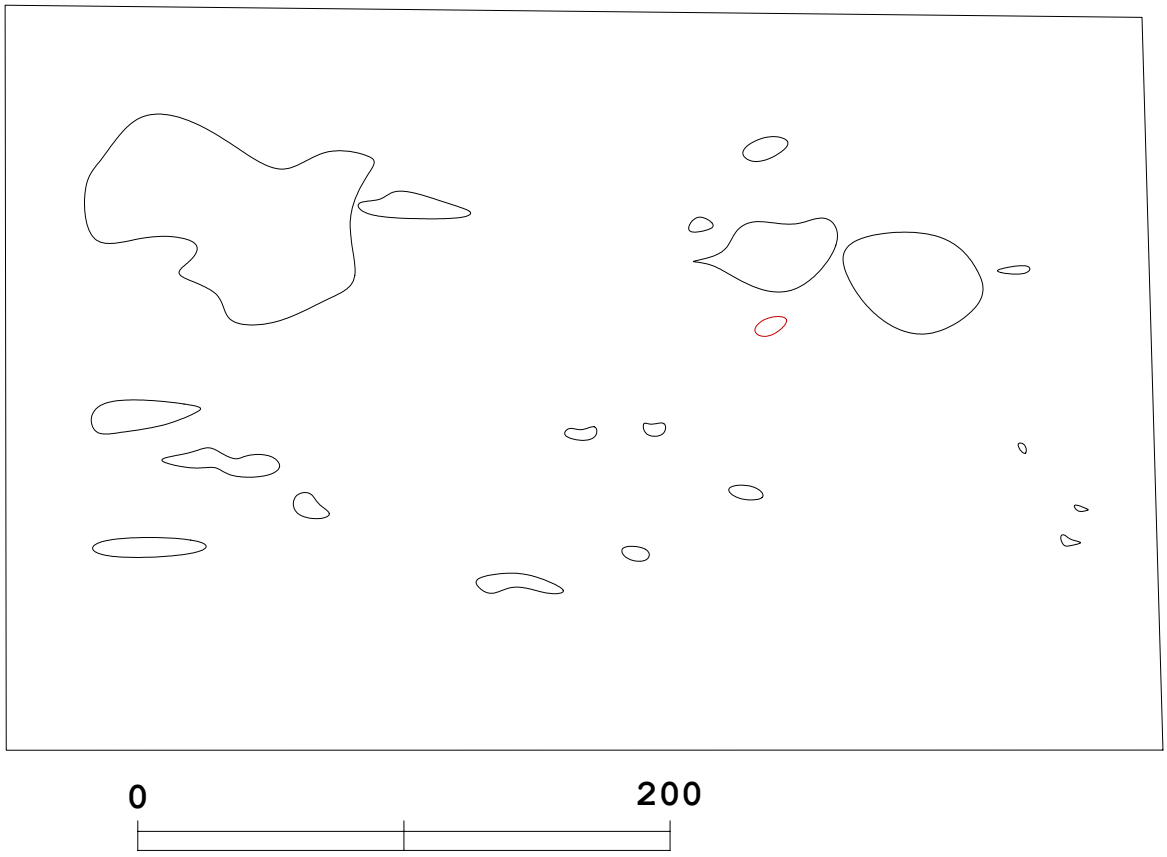


Picture1: The comparison of the land reflection with and without vegetation coverage.



Picture 2: Weeds distribution in monitored area.