GROUND SPECTROMETRY DATA - A BASIS OF REMOTE SENSING DATA VERIFICATION

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ABSTRACT:

In the paper the optical reflection spectra of native hemp and contiguous plants are presented. The spectra were obtained by ground spectrometry methods in field condition. The analysis of spectra shapes has been carried out, and the ground spectrometry data have been compared with remote sensing results.

1. INTRODUCTION

Now world community faces the challenge bound up with permanent growth of production, traffic and usage of narcotic. In Kazakhstan and other Central Asia countries the situation is aggravated with the availability of large territories occupied by native narcotic plants like hemp and ephedra.
For management of action on reduction and it is necessary the precise information about their location, spread dynamics and resource potential. It should be noted that such an information demands continuous renewal, i.e. the persistent monitoring of spreading of narcotic plant kinds is required. All above conditions can be satisfied with help of modern technologies of remote sensing and geoinformation mapping. However, for reliable verification of the remote sensing results information about spectral characteristics of supervised subject is needed.
In literature the works containing information about so-called spectral signatures of narcotic vegetation was not found by us. Therefore in this work we set a problem to obtain and systematize the spectral characteristics of native hemp and contiguous plants by methods of ground spectrometry on specially selected subsatellite test sites in Shu valley of Kazakhstan, and to compare the acquired results with the remote sensing data of specific test site.

2. PROCEDURE AND SUBJECT OF SUPERVISION

Field investigations were conducted in Shu valley of Kazakhstan on which territory the native hemp occupied areas no less than thousand hectares. The spectrometric measurements have been performed on about thirty various sites with native hemp. On surveyed sites both pure and mixed hemp thickets were observed. Among contiguous kinds the most similar to hemp by "greenness" (chlorophyll content in leaves) are turned out Glycyrrhiza uralensis, Artemisia scoparia, Onopordon acanthum and Cynodon dactylon. So, we recorded and analyzed the solar radiation reflection spectra both for hemp and basic contiguous plants.

The field spectrometric investigation were performed in wave length diapason 375-1025 nm by portable spectroradiometer of FieldSpec®HandHeld (HH), UV/VNIR model of Analytical Spectral Devises company (Colorado, USA) possessing 512 channels and spectral resolution approximately 3nm over the entire range of 700 nm.
The solar radiation reflection spectra from vegetation canopy were recorded. For this the spectroradiometer, with help of special adjustment, was placed above the canopy and standard target was on the level of vegetation canopy. As a standard target we use polyvinylchloride plate with the size of 1x1 m.
The comparative analysis was conduct with the remote sensing results obtained with use of IKONOS satellite system. This satellite has four spectral channels in wavelength interval of visible and near infrared spectrum range: first multi-spectral channel MS-1(blue)-480,3 nm, the second – MS–2 (Green)-550,7 nm, the third - MS-3 (red) - 664, 8 nm, the fourth - MS-4 (NIR=Near Intra Red) - 805 nm.

3. RESULTS AND DISCUSSION

In Figures 1-2 there are the solar radiation reflection spectra from both hemp and contiguous plants canopies and takyr (dense clay soil without vegetation) obtained by ground spectrometry method. One can see from the Figures that all plant spectra have analogous shape typical for green vegetation, and glycyrrhiza and hemp spectra are quite similar. And so for identification criteria definition of considered plant kinds by their spectral characteristics it was performed an analysis of relative intensities of the reflection peaks for fair spectra quantities obtained at different recording conditions. As a result of such detailed analysis it was provided the data given in Table 1 where NDVI is conventional normalized index of vegetation difference which value is defined as:

$$NDVI=\frac{NIR-RED}{NIR+RED} \qquad (1)$$

Here NIR and Red - the subject reflectance values at mean wavelength quantities of near infrared and red spectrum range, i.e. 805 and 665 nm, correspondingly.
A coefficient θ has been introduced by us, it is equal to follow ratio:

$$\theta=\frac{I_1(\lambda_{760})}{I_2(\lambda_{551})} \qquad (2)$$

where $I_1(\lambda_{760})$ and $I_2(\lambda_{551})$ - subject reflectance quantities for wavelength 760 and 551nm, correspondingly.

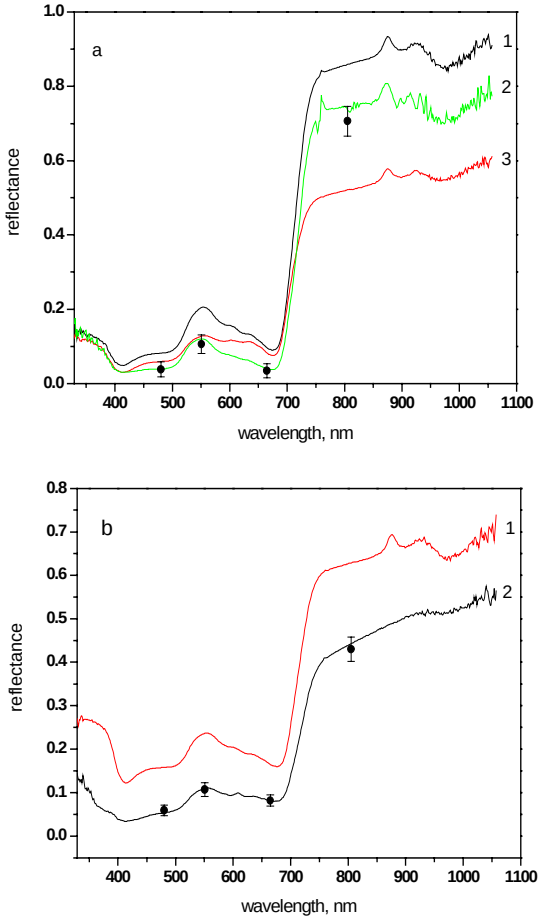

Figure 1. Solar radiation reflectance spectra from different objects, gained by ground spectroscopy method (solid curve) and satellite date IKONOS (dots):
a) 1 – glycyrrhiza uralensis, 2 – cannabis, 3 – Artemisia scoparia; b) 1 - artemicia terrae albae, 2 – cynodon dactylon.

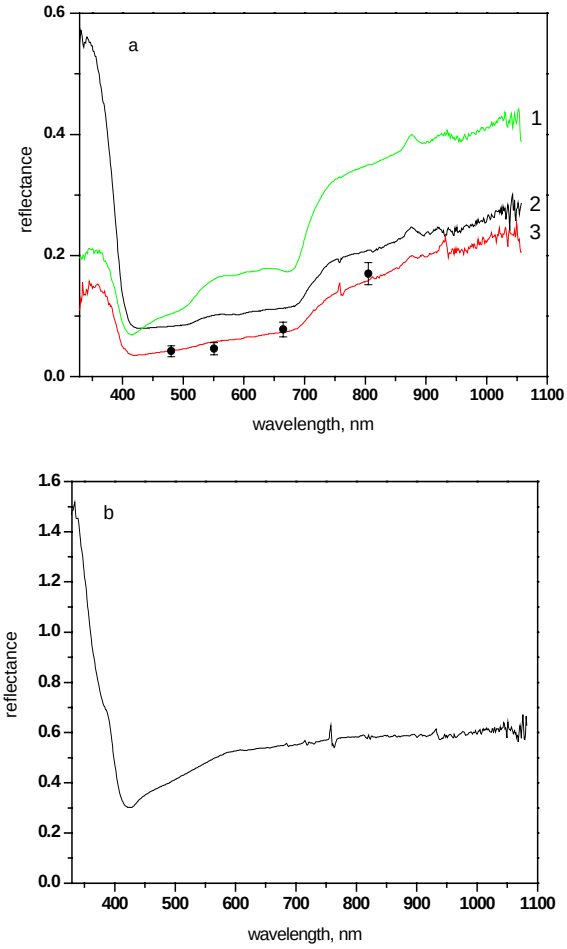

Figure 2. Solar radiation reflectance spectra from contiguous plants from the sites of wild hemp vegetation of Shu valley (solid curve- ground spectroscopy, dots- satellite date IKONOS)
a) 1 - cynodon daktylon (died), 2 - artemicia scoparia, 3 - onoporden acanthum (died); b) takyr.

Object	**θ**	**NVDI**
Cannabis	6,5	0,91
Glyzyrniza uralensis	4,1	0,80
Artemicia sckoparia	3,9	0,73
Artemicia leycodes	2,2	0,44
Artemicia terrae albae	2,6	0,58
Zynodon daktylon	3,7	0,69
Artemicia scoparia (died)	1,9	0,30
Onoporden acanthum (died)	2,3	0,36
Cannabis (died)	1,8	0,14
Cynodon daktylon (died)	2,1	0,33
Takyr	1,1	0,04

Table 1. Values of coefficient θ and NVDI index for hemp, contiguous plants and soils.

It should be noted that both the coefficient θ and the index NDVI have absolutely definite quantities for each of plants above considered. Hence, hemp and contiguous plants can be recognized by their spectral characteristics.

In Figure 3 there is a space photo fragment of one of Shu valley regions involved the local test site “Tatty” with center coordinates $43^0 15' 12'' N$ and $73^0 21' 13'' E$.

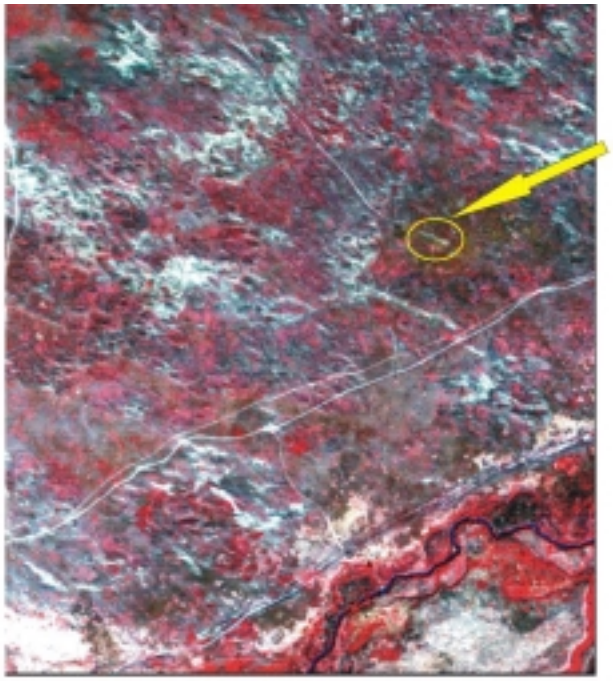

Figure 3. Test site with coordinates N $43^0 15' 12''$, E $73^0 21' 13''$ has been shown with the arrow.

Here, in accordance to field observation there are hemp thickets interchanged with Cynodon dactylon and Onopordon acanthum. The solar radiation reflection spectra for this site obtained from the remote sensing data were compared with above spectra of hemp, Cynodon dactylon and Onopordon acanthum. The comparison results are presented in Figures 1 and 2. One can see that spectral data of remote sensing, as a whole, correlate with the ground spectrometry results.

4. CONCLUSION

Thus, the solar radiation reflection spectra of native hemp and contiguous plants presented in given work are suitable for use when processing of remote sensing data with the aim of recognition of narcotic hemp vegetation sites.