International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-8 Issue-3, September 2019

Soil Spectral Signature Analysis for Influence of Fertilizers on Two Different Crops in Raver Tahshil

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Abstract*: Soils as a significant ingredient of terrestrial ecosystems are extremely important in agriculture field. Soil having different physical, biological, chemical properties. Physicochemical soil properties are the basic indicator of soil efficiency, it is strongly related to agronomic output. Soil parameters are very important in soil fertility that helps for plant growth as well as production. The soil quality is uniformly important as crop invention. The primary goal of this research is to use remote sensing techniques to evaluate soil properties. This goal is satisfied by emerging soil analysis on the basis of spectral data collected by FieldSpec4 spectroradiometer. The spectral analysis technique includes soil samples preparation, acquisition of spectral signatures and selection suitable statistical method. In this regard, soil properties and their consequent soil spectral signature measure. Statistical mean and series of processes are performed using View Spec pro Software. In the collected soil samples, surface soil parameters are more reflected than subsurface soil parameters. The spectral reflectance data can be alternative to the traditional methods for determining soil properties.

Keywords: Soil, Fertilizer, Spectroradiometer

I. INTRODUCTION

Soils is a substantial constituent of global ecosystems are tremendously important. Physicochemical soil properties are basic indicators of soil efficiency, it is powerfully linked with agronomic output [1]. In the agriculture field various fertilizers treatments are apply for more crop yield. Organic and inorganic fertilizers are most important in agriculture field. Inorganic fertilizers gives instant nutrients to plants as well as support for produce earlier. Organic fertilizers require long time to relief in soil, but it helpful to create healthier soil long time [2]. The heavy use of fertilizers can be influence soil quality and contents. High inorganic carbon concentrations related to uncertainly developing or degrading soil, whereas low content often indicate more developed soil [3]. Organic carbon is another consistent indicator associated to soil quality and dependent on water availability. Aggregate soil organic carbon applications improve soil conditions because of well accumulation, greater penetration rates and water holding which are conducive to their resistance to erosion [4],[5]. Beside that soil salinity, pH, macro and micronutrient content of the soil has also tremendous influence on soil productivity. So, therefore, the spatial detection of soil properties, particularly inorganic and organic is great importance in the perspective of land degradation [6],[7]. The determination of soil properties is difficult task in the large area. There is a need to develop remote sensing based approach for spectral determination such as soil organic and inorganic content concentrations. There are various remote sensing techniques are used in soil study. In the spectroscopy techniques visible (VIS, 400–700 nm), near-infrared (NIR, 700–1100 nm), shortwave infrared (SWIR, 1100–2500 nm) spectral varieties are used for observing and learning various aspects of soil properties in surface and subsurface layer [8]-[12]. The spectral curve plotted reflectance with respect to wavelength. Reflectance spectroscopy provides a large range of soil properties. Spectral information gives a better understanding of the influence of fertilizers on soil spectral reflectance. Chemical fertilizers influence detection can be difficult due to the different elements on the surface. The surface features creating spectral confusion with different elements of reflectance properties [13],[14].

II. STUDY AREA

The study was conducted at Jalgaon District, Raver tahsil, Wadgaon Shivar which is located between Lat: 21°12’30’’N, Lon:75°56’36’’E and Lat: 21°11’42’’N, Lon:75°58’08’’ E in, Maharastra, India with GPS information. Raver tahshil is famous for agricultural activities where different crops Jowar, banana, cotton, yellow gram and, soybean, wheat, corn taking farmers. Mostly Banana is the main cash crop in the study area. Banana from this area is very famous in the national and international market. Banana and cotton crops are associated with the formation of soils, nature of surface, availability of groundwater. Fig. 1 shows the study area map.

Manuscript published on 30 September 2019
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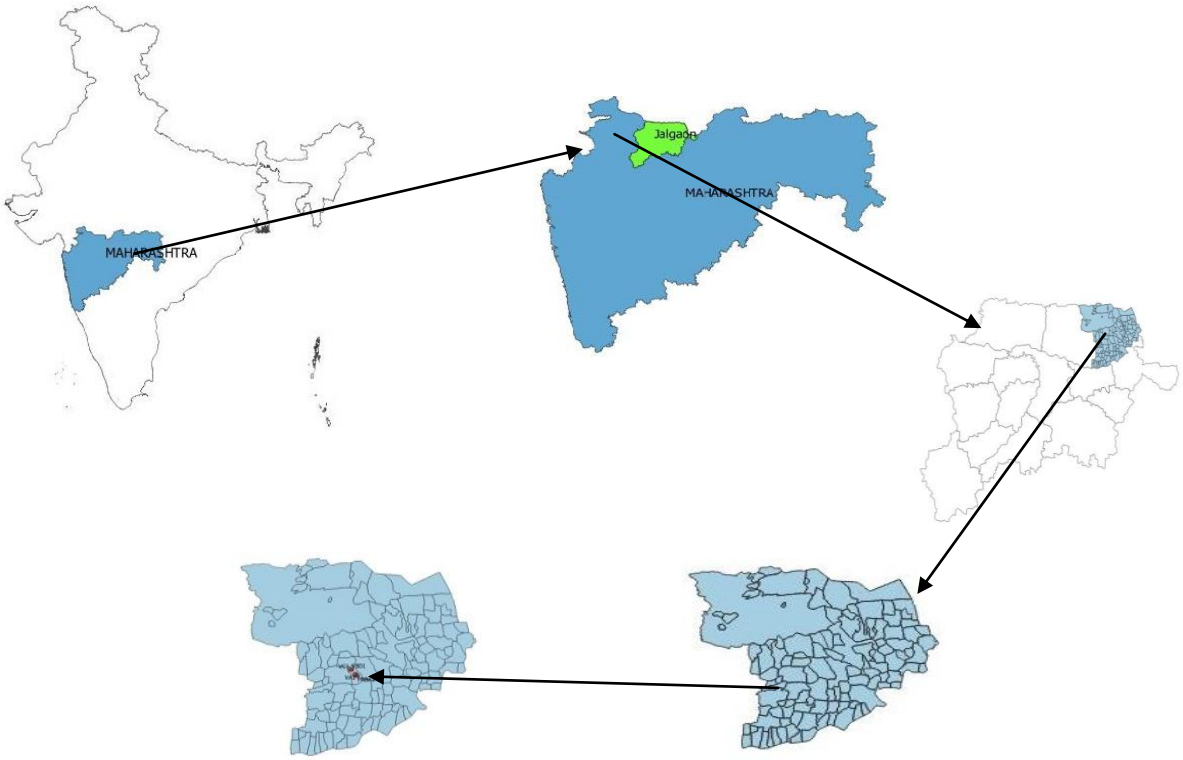

Study area Wadgaon

Raver Tahshil

Figure 1 Study area location map

III. DATA COLLECTION

Total 60 quantities of soil samples were collected from banana and cotton fields in two different classes, one is surface and another is subsurface. Surface soil is collected from (20 cm) depth from top and subsurface soil (30cm) depth from top during the end of kharip season. Soil sample collection done where different fertilizers treatment were used by farmers like organic fertilizer, Inorganic (chemical) fertilizers, and organic & inorganic (mixed) fertilizers. Total five locations are choose in each field four corner and one centre of the field respectively. There are two soil sample collected from each location. Like this, total ten soil samples are collected from each field in the air tight bags with the geographic location (latitude, longitude). All soil samples collection information arranged in different five categories and it shown in table no.1.

Table- II: Category wise soil sample collection

Crop	*Fertilizers Treatment*	*Surface [20 CM]*	*Subsurface [30 CM]*
Banana	Inorganic	Yes	Yes
Banana	Organic	Yes	Yes
Banana	Mixed	Yes	Yes
Cotton	Organic	Yes	Yes
Cotton	Mixed	Yes	Yes

A. FieldSpec4 Spectroradiometer

Field spec Spectroradiometer device has a spectral range of 350 to 2500 nm and a resolution from 3 nm (at 700 nm) to 10 nm (at 1400 and 2100 nm) as a result of its three pointers. Data experiment interval is 1.4 nm @ 350-1000 nm and 2 nm @ 1000- 2500 nm. Spectroradiometer provides total 2151 data values per spectrum [10]-[13].

This instrument uses a 75-W tungsten quartz halogen lamp as energy source for lighting the samples. The lamp was set as 60° angle at a 45 cm distance from the soil sample. The reflected rays are collected in 1-nm bandwidth among 350 to 2500 nm with 8° field-of-view. High intensity fibre optic cable probe of spectroradiometer that kept at a distance of 15 cm above the soil sample. Air-dried soil samples placed at the bottom of a 4-cm diameter Petridis. Before recording soil samples, the instrument is optimize and calibrated using white reference for obtaining absolute reflectance for controlled laboratory readings [14],[15]. Reflectance of soil is recorded 10 subsequent spectral signature. The average of 10 spectra was recorded for each sample to minimize noise produced by the device. The RS3 (version 6.3) inbuilt software is used to record the reflected rays (spectral signature) [15]-[17]. FieldSpec4 Spectroradiometer setup shown in figure 2.

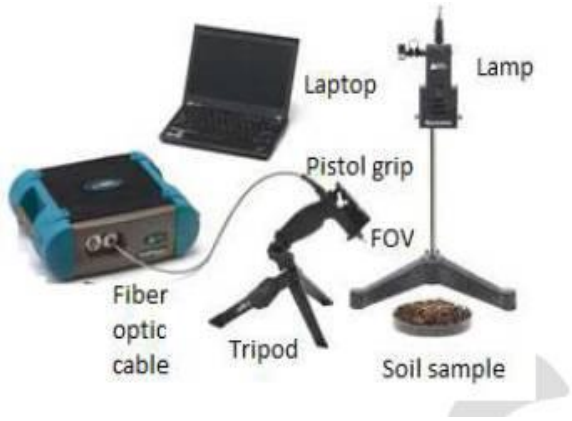

Figure 2: FieldSpec4 Spectroradiometer Setup

B. Spectral Data Acquisition

Spectroradiometer giving least sample preparation, fast analysis, cost-effective to analyse a soil samples. Several constituents can be determined, no destruction of samples, no hazardous chemicals are required, and results can be accurate [18]. The spectral signatures of surface and subsurface soil sample reflection of each samples is recorded. Approximate ten spectral signatures are acquired for every sample. Then calculate the mean for each of ten spectral signature using View Spec Pro version 6.2 software [14].

After calculating the mean of ten spectral signatures which are collected for each sample then calculate the average of five samples which are collected from each category field. The average is categorized in different categories like organic cotton, mixed cotton, organic banana, inorganic banana, and mixed

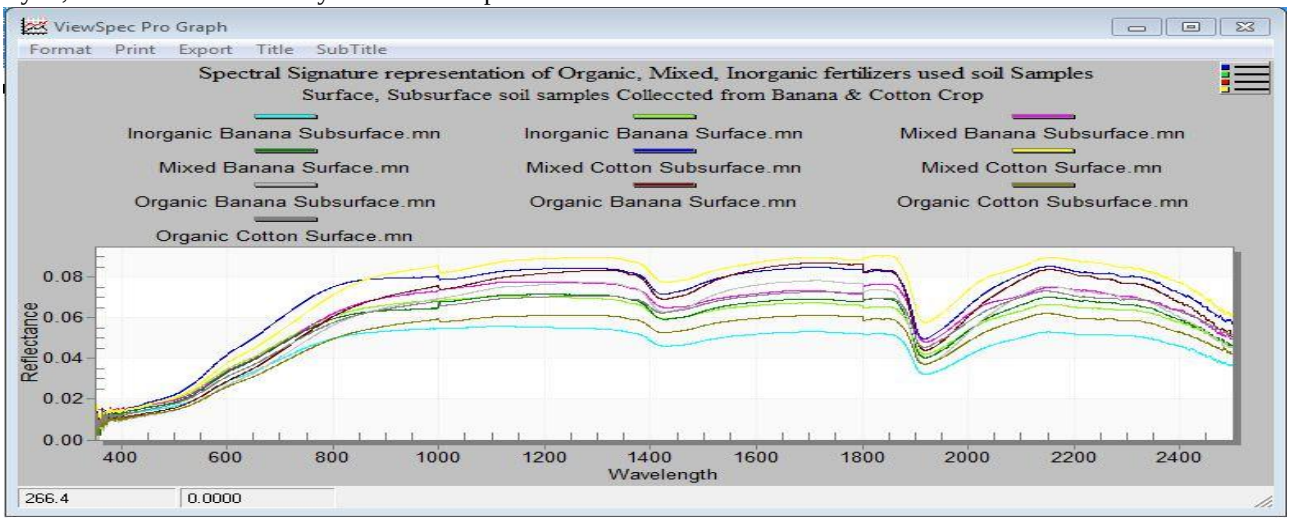

Figure 3. Spectral Signature representation using View Spec Pro

banana. Spectral signature representation of all category in surface and subsurface class shown in figure 3.

IV. RESULT AND DISCUSSION

All soil samples divide in different five category organic cotton, organic banana, mixed cotton, inorganic banana, mixed banana and these category is applied for surface and subsurface class. Each category and class of soil sample analysis done.

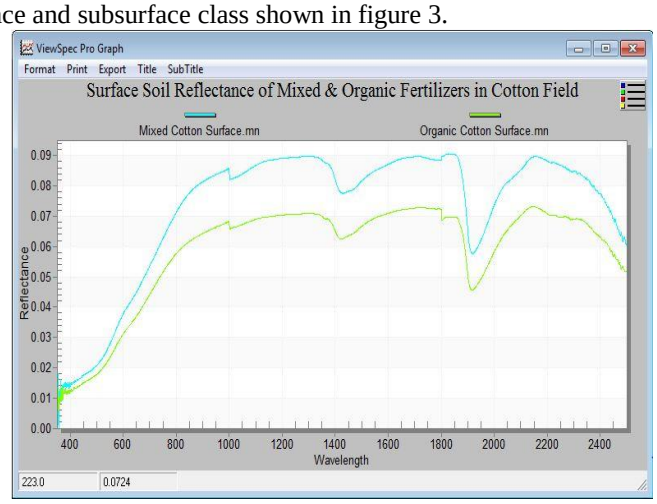

Figure 4.(a) Mean Spectral Signature for surface Soil sample of cotton field where Mixed, Organic fertilizers used

In cotton crop field where organic and mixed fertilizers treatment were used, the soil spectral signature reflection shown in figure 4.a and 4.b.

for surface and subsurface respectively. In surface and subsurface class mixed fertilizers soil reflection is more than organic fertilizers for cotton crop. Subsurface soil spectral signature reflection transformation is more than surface soil reflection for mixed fertilizers. The upper (sky blue) spectral signature represents the reflection of soil where mixed fertilizers were used. The lower (green) spectral signature represents the reflection of soil where organic fertilizers were used.

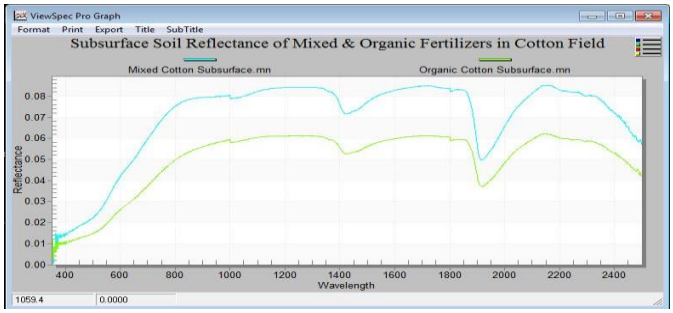

Figure 4.(b) Mean Spectral Signature for Subsurface soil sample of cotton field where Mixed, Organic fertilizers used

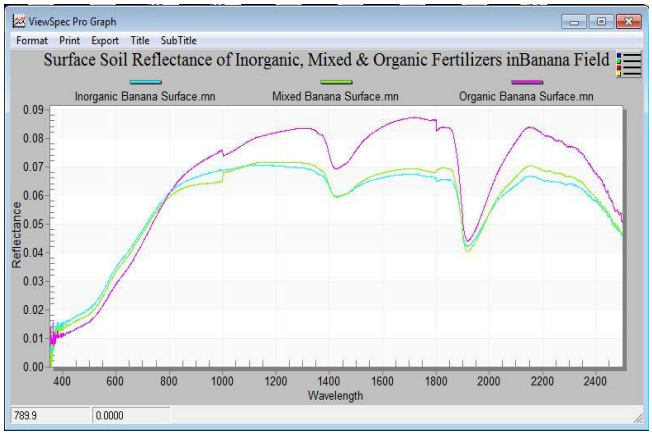

Figure 5.(a) Mean Spectral Signature for surface sample of Banana field where Mixed, Organic fertilizers used

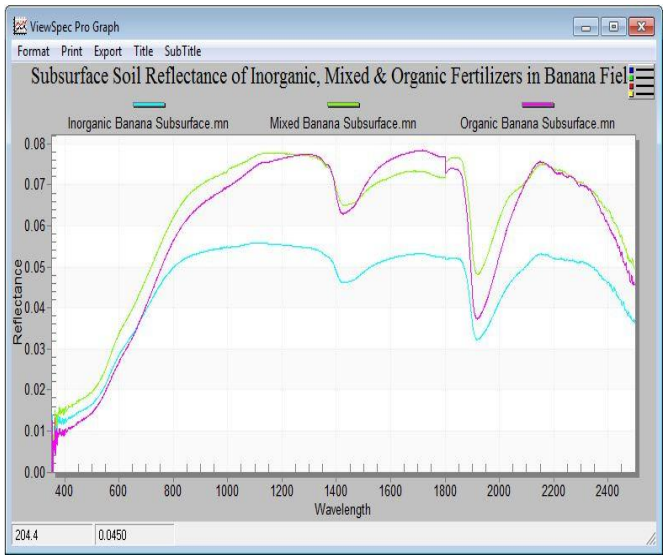

Figure 5.(b) Mean Spectral Signature for soil subsurface sample of Banana field where Mixed, Organic fertilizers used

In banana crop field where organic, inorganic and mixed fertilizers treatment were used, the soil spectral signature reflection shown in figure 5.a and 5.b. for surface and subsurface respectively. The pink colour spectral signature denotes the reflection of soil where organic fertilizers were used. The green colour spectral signature denotes the reflection of soil where mixed fertilizers were used. The sky blue colour spectral signature denotes the reflection of soil where inorganic fertilizers were used. In surface soil sample class, organic fertilizers used soil reflection is more than inorganic, mixed fertilizers used for banana crop. Mixed and inorganic fertilizers used soil spectral signature reflection is same on number of points. In subsurface soil sample class, inorganic fertilizers used soil reflection is less than organic, mixed fertilizers used for banana crop. Mixed and organic fertilizers used soil spectral signature reflection is same on number of points. The difference between two classes is the organic fertilizers used soil signature is more reflected than in subsurface inorganic fertilizers used soil signature is less reflected.

V. CONCLUSION

Remote sensing is the best techniques for soil analysis and use of remote sensing technology to measure soil spectra provides alternative technique. It correlate spectral response with soil properties. In the collected soil samples, surface soil reflectance is greater than subsurface soil parameters. The different soil content, parameters can influence the spectral signature of surface soil samples. Mixed fertilizers used soil signature is more reflected than organic fertilizers soil signature in cotton crop field. Organic fertilizers used soil signature is more reflected than mixed and inorganic fertilizers used soil signature in banana crop field. The spectral reflectance data can be alternative to the traditional methods for determining soil properties

ACKNOWLEDGMENT

The authors would like acknowledge to DIST-FIST program to Department of Computer Science & I.T, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, and M.S.India for providing lab facilities and infrastructure.

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