EARLY IDENTIFICATION OF BASAL STEM ROT DISEASE SYMPTOM ON OIL PALM USING MULTISPECTRAL SMALL FORMAT AERIAL PHOTOGRAPH

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Abstract. Basal stem rot disease that caused by *Ganoderma boninense* is the most destructive disease in oil palm plantation in Indonesia. Early detection of *Ganoderma* disease incidence will inform the pattern of disease spread quickly and determine the best disease management strategies. Identifiying the oil palm that attacked *Ganoderma* have been studied by using Multispectral Small Format Aerial Photograph (MSFAP). The study was carried out to determine the MSFAP vegetation index and correlate with level of *Ganoderma* attacked. The methods that used on this study were using simple ratio (SR) and atmospherically resistance vegetation index (ARVI). The results showed that vegetation index analyzing by using SR and ARVI have strong correlation with level of *Ganoderma* attacked (r^2=0.764 for SR and r^2=0.865 for ARVI).

Keywords: remote sensing, uav, Ganoderma, multispectral, oil palm

1. Introduction

Basal stem rot disease is the most destructive disease on oil palm (*Elaeis guinensis* Jacq.). This disease causes by fungus *Ganoderma boninense* that is most damaging disease on oil palm. It can cause up to 50% loss of oil palm population (Darmono 2000; Corley& Tinker 2004; Santoso et al. 2010).Various action have been proposed to control this disease (Susanto et al. 2005), has control practices by fungiside injection into the stem combined eith mounding soil at the base of disease palm (Santoso et al. 2010).The other practices by biomoleculer mapping and remote sensing technology. Remote sensing on vegetation studies have been used extensively in the oil palm plantation by using satellite imagery and small aerial photograph with various resolutions. Analyzing pattern of attacked basal stem rot disease on oil palm have been done by Santoso et al(2010) and Izzuddin et al (2015). Santoso et al (2010) has been used spectral vegetation index of Quickbird sattelite imagery for mapping and identifying basal stem rot disease on oil palm. Izzuddin et al (2015) has been used airborne hyperspectral remote sensing image for detection of *Ganoderma* disease in oil palm. The aim of this study was carried out to determine the multispectral small format aerial photograph (MSFAP) vegetation index and correlate with level of *Ganoderma* attacked.

2. Material and Methods

2.1. Small Format Aerial Photograph

The MSFAP data which used in this study were captured by Unmanned Aerial Vehicle (UAV) that Tetracam ADC-Lite attached. Tetracam ADC-Lite have Blue, Red and Near Infra Red (equivalen with Landsat TM bands). Photos capturing was done on partially block of oil palm plantation in Batubara District, North Sumatera Province. The geographic position was 99˚ 27’ 42,985” to 99˚ 27’ 53,652” E and 3˚ 09’ 55,373” to 3˚ 10’ 7,864” N. Photos capturing was done on 3 Pebruary 2015. Camera correction, geometric correction and radiometric correction have done to these photos.

2.2. Vegetation Index

Simple Ratio (SR) and Atmospherically Resistant Vegetation Index (ARVI) were used in this study. Vegetation index function that used in this study are present on Table 1.

Table 1. Vegetation Index were used in this study

Vegetation Index	Function
Simple Ratio (SR)	$SR = \frac{\lambda NIR}{\lambda R}$
Atmospherically Resistant Vegetation Index (ARVI)	$\text{ARVI} = \frac{[\lambda\text{NIR} - (2\lambda R - \lambda B]}{[\lambda\text{NIR} + (2\lambda R - \lambda B]}$

Description :

λNIR : Near Infrared Wavelenght (760-900 nm);

λB : Near Infrared Wavelenght (450-515 nm);

λR : Red Wavelenght (630-690 nm)

2.3. Basal Stem Rot Ground Census

The ground data consisted of basal stem rot disease level was done by visual ispection on attacked categories. The attacked categories based on description as presented in Table 2.

Table 2. Basal Stem Rot Ground Census Based on Attacked Categories on Oil Palm.

Level		Description
Level 0	Healty Palm	Uninfected Palm
Level 1	Slighty Infected	Infected palm with Ganoderma fungus without any foliar symptoms
Level 2	Moderate Infected	Infected palm with Ganoderma fungus with foliar symptoms
Level 3	Heavily Infected	Infected palm with Ganoderma fungus with foliar symptoms and have fruiting body at stem base
Level 4	Unhealty/Dead Palm	Dead Palm

3. Result and Discussion

The MSFAP images that have geometric and radiometric corection processed into an orthoimage mosaic is highlighted in Figure 1. The figure 1 was a partially block of oil palm plantation in Batubara District, North Sumatera Province.

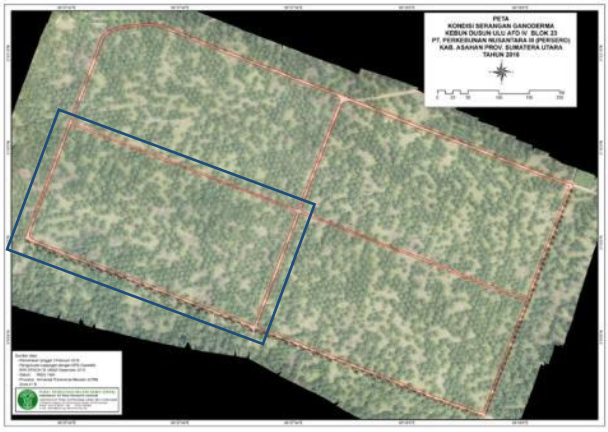

Figure 1. The MSFAP images that have orthoimage mosaic processed

3.1. Vegetation Index

The results showed that simple ratio (SR) value of MSFAP data between 0,15-0,81; while atmospheric resistant vegetation index (ARVI) value 0,05-0,79. The SR and ARVI vegetation index

with high value was contained on healty oil palm, otherwise the SR and ARVI vegetation index with low value was contained on poor performance or unhealty plant (Figure 2). The SR and ARVI were conducted to five range that represented of disease levels (Table 3).

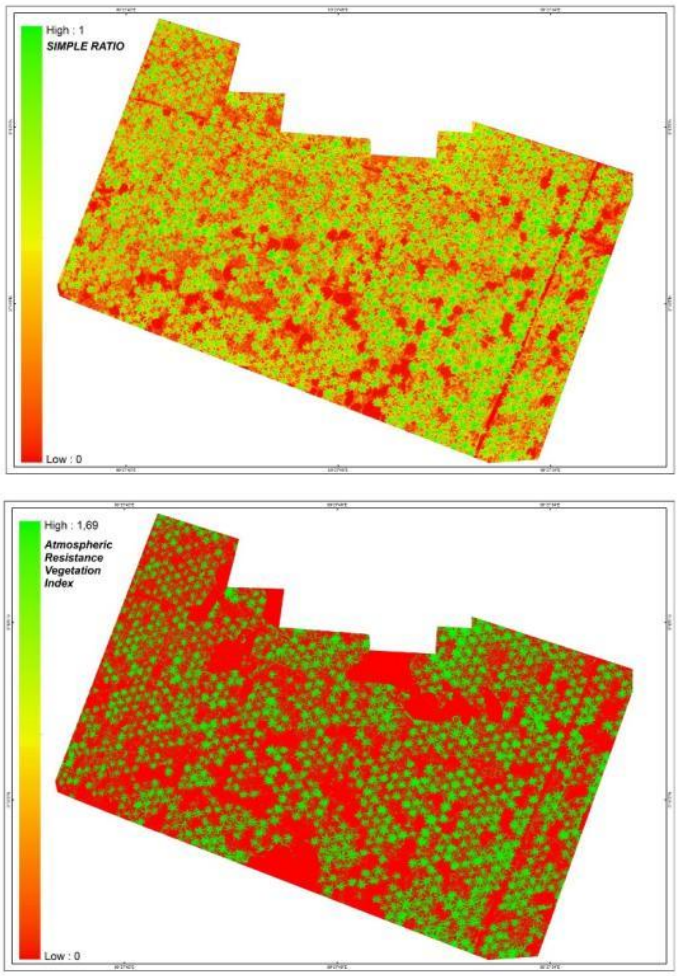

Figure 2. Distribution of SR and ARVI values

Table 3. The Average Value of SR and ARVI

Category	Vegetation Index (the Average Value)	
	SR	ARVI
Level 0	0,81	0,79
Level 1	0,75	0,70
Level 2	0,64	0,58
Level 3	0,63	0,50
Level 4	0,16	0,06

Table 3 showed the average value of vegetation index (SR and ARVI) for each level that verified sampling with the point from ground census. The higher value means the healty oil palm and the lowest value means dead oil palm or unhelty oil palm. This results was similar by Izzuddinet al (2015) study that the higher value of spectral indices value indicate the healty plant and the lowest value indicate the non-vegetation area. Level 0 have SR value 0,81 and ARVI value 0,79. This level of SR and ARVI value represent healty oil palm or have uninfected *Ganoderma*. SR value 0,75 and ARVI value 0,70 represent slighty infected (Level 1) or the infected palm with Ganoderma fungus without any foliar symptoms. SR value 0,64 and ARVI value 0,58 represent moderate infected (Level 2) that infected by Ganoderma fungus with foliar symptoms. The higher level infected have by Ganoderma

fungus with foliar symptoms and have fruiting body at stem base have SR value 0,63 and ARVI value 0,50.

3.2. Vegetation Index and Ganoderma Level Attacked

Based on statistical analysis between vegetation index (SR and ARVI) and Ganoderma level attacked have a strong correlation according Sugiyono (2014). The coeffisient (r) value of the relationship was 0,76 for simple ratio (SR), and 0,86 for atmospherically resistant vegetation index (ARVI) (Figure 3 and 4).

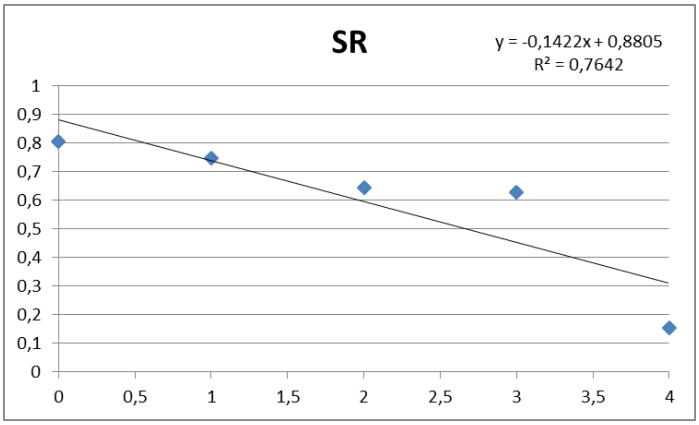

Figure 3. SR and Ganoderma level attacked

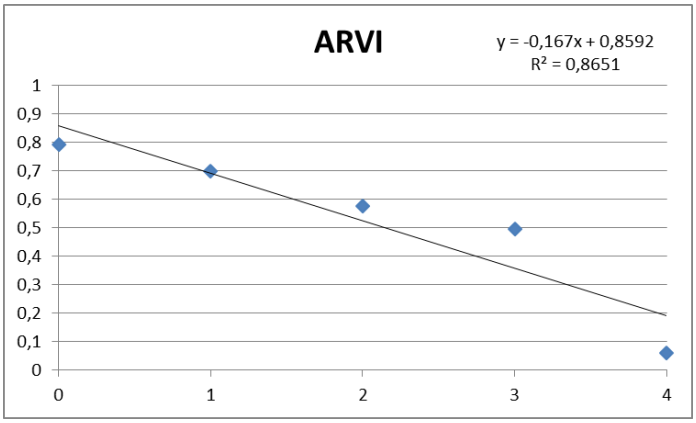

Figure 4. ARVI and Ganoderma level attacked

ARVI has higher coeffisient (r) value of the relationship than SR. ARVI provided higher coeffient to identifying infected plant. This results has a similar with Santosoet al (2010) that ARVI have good results for identifying with highest accuracy.

4. Summary

Multispectral SFAP could be used for identifying oil palm that attacked by Ganoderma fungus by analizing vegetation index. For more detil identifying needed futher study by MSFAP or Hyperspectral SFAP data.

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