A SPECTRAL CHARACTERISTIC ANALYSIS OF DAMAGED PINE WILT DISEASE AREA IN IKONOS IMAGE

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ABSTRACT

 In this study, various analysis methods of remote sensing are applied to select the most effective method for detecting damaged area by pine wilt disease from IKONOS image on February 13. 2000. The study area was Yuncho-myen, Koje-si, Kyungnam, which is located in the southern part of Korea.

Damaged area by pine wilt disease were extracted by analysis of DN value Red and NIR bands that was histogram analysis after image correction to topographical conditions (direction, slope, elevation etc.), also ground truth datum were helpful in terms of GPS field survey. These bands of IKONOS image have been used for lost of studies in the field of forest and vegetation.

The result of analysis per topographical conditions, eight aspects (north, northeast, east, southeast, south, southwest, west, northwest) appeared striking difference of DN value. However, slope did not appeared difference of DN value. And elevation did not appeared difference of DN value, too.

The result of extraction using satellite images was compared with real damaged tree, which was extracted from GPS field survey. It might estimate that the 78 percent of it were damaged tre e by Pine Wilt Disease.

In this study, IKONOS 1m and 4m images were significant and available for detecting and identifying damaged area by pine wilt disease.

I. INTRODUTION

Recently the development of spatial information technology has supplied prompt and forest environment. Through this spatial information technology, forest damages, forest fire and landslide have been predicted and prevented.

The forest-damaged area in Korea has appeared about 370,000ha, especially, most of them were observed because of pine wilt disease. This pine wilt disease has currently spread over Jinju, Geoje, Tongyoung, Masan, Mokpo, Gumi around Busan region.

However, since it is difficult to figure out the damaged areas and to predict it's spreading, the control of it has currently partially exterminated. Thus the application of spatial information technology such as GIS(Geographic Information System) and GPS(Global Positionin g System) and RS(Remote Sensing) is deadly needed. It is very effective to examine and present the spatial distribution map that helps to establish domestic proper strategies against pine wilt disease. In addition, it is used to figure out the damaged situations as soon as possible and predict damage spreading.

In Korea, Jo, M. H(2001) studied to extract the damaged area by pine wilt disease using Landsat TM image in Chubong-do and Kim, J. B(2001) analyzed temporal and spatial correlation between pine wilt disease damaged area and metrological factors using GIS and satellite images. Yang, K. L(1999) extracted the damaged areas by Pine Gall Midge in Youngyang-gun Kyungbuk in terms of Ratio and Spatial filtering method using Landsat TM image and Oh, D. H(1998) classified the damaged areas by Pine Gall Midge and analyzed its spatial changes around Hongcheon Kangwon using Landsat TM image and digital map data. In foreign countries, Itten, K. I and P. Meyer(1993) studied geometric and radiometric correction of Landsat TM images in mountainous forest area and Wloter P. T and others (1995) improved forest classification in the northern Lake States using multi -temporal Landsat images. Hoffer, R. M and others (1995) integrated of GIS, GPS and remote sensing for inexpensive assessment of forest insect damage and Ekstrand, S(1996) estimated forest damage area through correction for topographic effects.

This study has analyzed the spectral characteristic depending on each topographical condition using IKONOS image and GIS, GPS. As the result of it, it is shown the possibility to extract damaged area by pine wilt disease using those above spatial technologies.

II. MATERIALS AND METHODS USED

In this study the various spatial data such as IKONOS images (February. 13. 2000) in Yuncho-myen Geoje-si and IKONOS images (February. 20. 2001) in Jeongchon-myeon Jinju-si and Chukdong-myeon Sacheon-si as shown in Figure 1. In addition, not only 1:5,000 and 1:25,000 digital maps and 1:25,000

digital forest type map have been used for topography analysis and preparation of thematic maps but also the the GPS field data has obtained to survey. The study area was Yeoncho-myen Geose-si and Jeongchon-myen Jinju-si and Chukdong-myen Sacheon-si, Gyeongsangnam-do.

In this study thematic maps and various GIS DB such as on digital map and digital forest type map were constructed by using GeoMania EasyMAO 2.5.
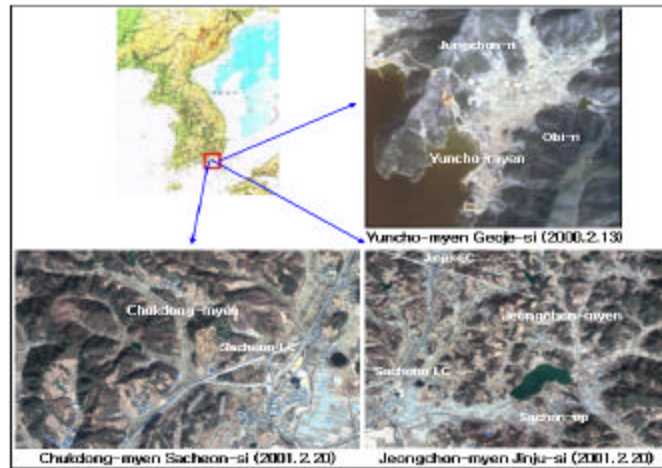

Figure 1. The study area

IKONOS image used here was composed with 1m panchromatic image and 4m multi spectral image. The GCP (Ground Control Point) in this study was obtained from 1:5000 digital maps and performed geometric correction on it using iCube 2.0. The result of spectral characteristic analysis has observed 230 damage points in Yeoncho-myen Geoje-si. The Red and NIR band were used for histogram analysis and extraction of NDVI. For this, DN distribution range of per pixel was used to extract damaged area from each image. Figure 1 shows the verification of it in Jeongchon-myen Jinju-si and Chukdong-myen Sacheon-si. This study was carried out in the following process as shown in Figure 2.
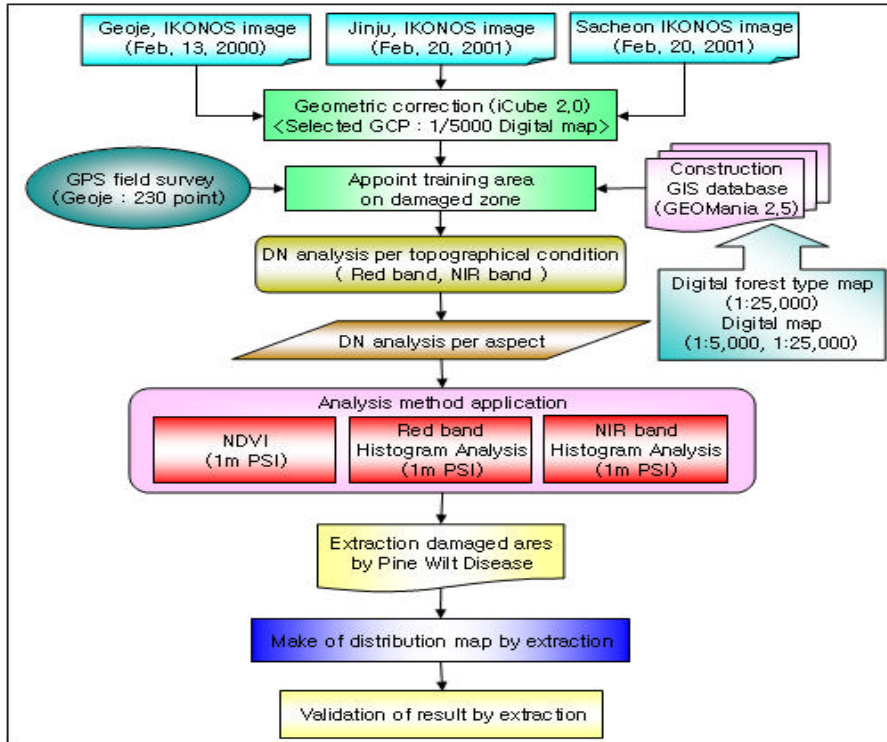
Figure 2 The Study flow chart

III. RESULT AND CONSIDERATION

1. SPECTRAL CHARACTERISTIC ANALYSIS OF DAMAGED PINE WILT DISEASE AREA IN IKONOS IMAGE

Spectral characteristic analysis of each image is performed on each topographical condition. For example, the analysis of DN value of Red and NIR bands was examined depending on each aspect, slope, elevation in desired pine wilt disease area and healthy pine area. (Table 1.2.3) This result can prove that there is no relation between the spectral characteristic and topography data such as slope and elevation. However, aspect has been very related to DN value. In this case, to extract damaged area by pine wilt disease, sub-study area was defined as only pine tree. So, there was masking area where was pine tree.

Table 1. The mean DN value of GPS survey point per slope

Slope ( )	The mean DN value of pine wilt disease area		The mean DN value of healthy pine area	
	Red band	NIR band	Red band	NIR band
1 30	229.38	255.18	209.34	272.89
31 60	228.61	253.61	208.57	271.32
61 90	227.87	254.17	207.83	271.88
91 140	232.74	252.37	212.70	270.08
141 200	226.94	253.16	206.90	270.87

Table 2. The mean DN value of GPS survey point per elevation

Elevation (m)	The mean DN value of pine wilt disease area		The mean DN value of healthy pine area	
	Red band	NIR band	Red band	NIR band
1 30	230.27	253.12	210.23	269.99
31 60	229.26	252.28	208.65	273.73
61 90	231.06	256.02	209.16	270.83
91 120	228.69	255.12	211.02	272.83
121 150	229.27	253.39	209.23	271.10
151 180	226.05	251.65	208.00	269.36
181 230	228.04	253.56	206.01	272.18
230 300	230.29	254.47	210.25	281.27

Table 3. The mean DN value of GPS survey point per aspect

Aspect	The mean DN value of pine wilt disease area		The mean DN value of healthy pine area	
	Red band	NIR band	Red band	NIR band
North	155.30	197.06	135.26	214.77
Northeast	184.95	212.06	163.36	229.88
East	191.48	220.27	171.94	234.47
Southeast	303.65	315.38	287.37	332.82
South	295.06	308.14	279.20	326.51
Southwest	277.40	289.69	257.98	310.79
West	263.83	281.11	248.67	303.16
Northwest	161.17	205.90	143.22	222.39

The same range of DN values per aspect is showed in Table 3 and the number of GPS survey points was 230 in Yeoncho-myen Geoje-si. And range of NDVI values is 143.80 - 140.95 (Figure 3)
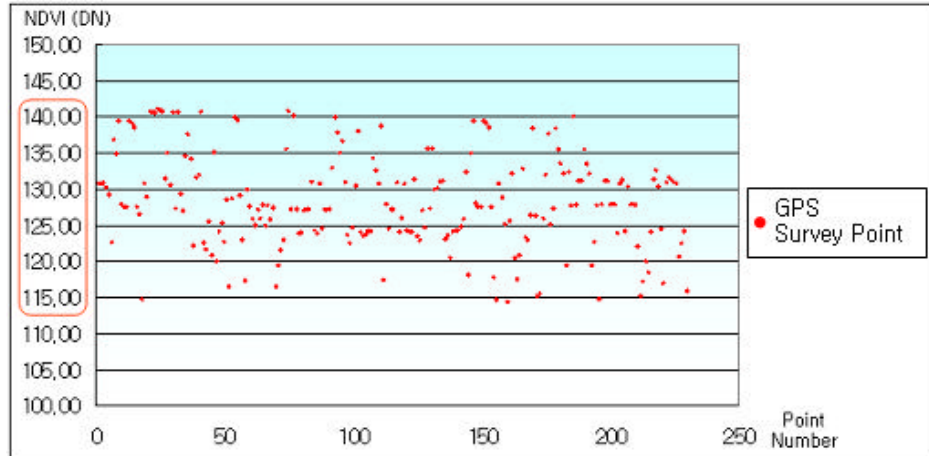

Figure 3. The distribution of NDVI

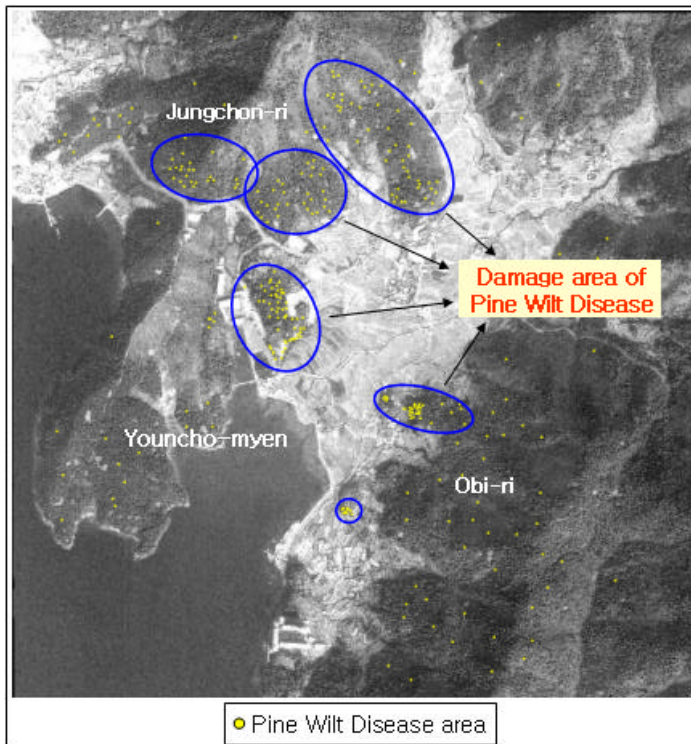The result of extraction of pine wilt disease area in Youncho-myen Geoje-si is same as in Figure 4.

Figure 4 The extraction of damaged area by pine wilt disease in Youncho-myen Geoje-si
(IKONOS image, Febury 13. 2000)

The result of study was applied to Jeongchon Jinju and Chukdong Sacheon. 190 checkpoints and 110

checkpoints, which were coordinates in terms of the result of GPS field survey, were used in Jeongchon Jinju and Chukdong Sacheon, respectively.

Finally, 147 points in Jeongchon Jinju were verified as real damaged trees of 190 points extracted from GPS field survey, it might estimate that the 77 percent of the them were damaged tree by pine wilt disease as shown in Figure 5. And 87 Points in Chukdong Sacheon were verified as real damaged trees of 110 points extracted from GPS field survey, it might estimate that the 79 percent of the them were damaged tree by pine wilt disease as shown in Figure 6.
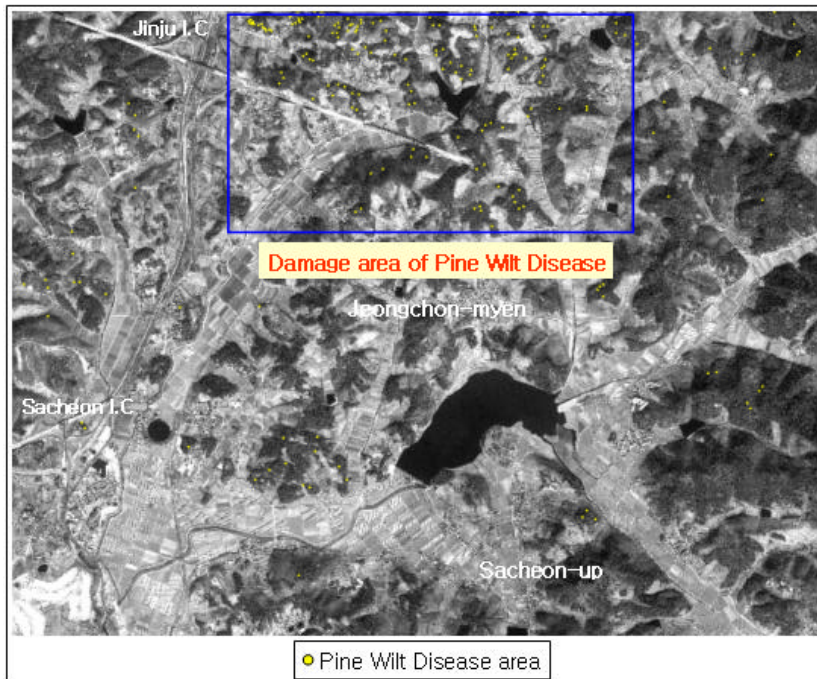

Figure 5. The extraction of damaged area by pine wilt disease in Jeongchon-myen Jinju-si
(IKONOS image Febury 20. 2001)

Figure 5. The extraction of damaged area by pine wilt disease in Chukdong-myen Sacheon-si
((IKONOS image Febury 20. 2001)

In this study, damaged area by pine wilt disease was extracted through the analysis of DN value Red and NIR bands, which was histogram analysis after image correction to topographical conditions. As the result of this, it is proved that there is no relation between aspect and DN value. Then, the spectral characteristic per aspect and the range of DN values are analyzed and extracted. In addition, the possibility to extract damaged area by pine wilt disease is showed by using the range of DN value in high-resolution image.

Also the result of NDVI and histogram analysis was applied to other damaged area in Jeongchon-myen Jinju-si and Chukdong-myen Sacheon-si. It is verified as the high accuracy to extract spectral characteristic per topographical conditions. Finally, the result of this study is proved very useful to extract pine wilt disease area and prevent disease in plants.

In future, it is expected to have more accurate extraction of damaged areas by using advanced spatial information technology such as various satellite image, GIS, and GPS.

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