

Estimation Model for Simplification and Validation of Soil Water Characteristics Curve on Volcanic Ash Soil in Subtropical Area in Korea

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Most of volcanic ash soils in South Korea are distributed in Jeju province which is an island placed on southern part of Korea and has steep slope mountain area. There are many soils containing high contents of organic matter (OM) derived from volcanic ash in Jejudo, also. Therefore, irrigation and drainage in volcanic ash soil different with general soil which has low OM content have to be applied with another management way, but studies searching appropriate methods for them are set on insufficient situation because the area of volcanic ash soil in South Korea is only 1.3% (130,000ha). This study was conducted for analysis of soil water content and irrigation quantity appropriate for crops cultivated in volcanic ash soil with high OM content. Although soils with different soil color have the same soil texture, soil water characteristics curve by soil color showed the difference of water retention capability by OM content. But, this characteristics classified with soil color could be unified by scaling technique with similitude analysis method which get dimensionless water content using a present water content, a residual water content and saturated water content (or water content at 10kPa). A relation of gravimetric soil water content (GSWC) and dimensionless water content by the results showed a form of power function. The dimensionless water content (DWC) express a relative saturation degree of present water content. This was also expressed by van Genuchten model which describe the relation between relative saturation degrees and matric potentials. These results on soil water characteristics curve (SWCC) of volcanic ash soil will be the basic of irrigation plan in area having high organic contents into soil

Key words : Volcanic ash soil, Soil water characteristics, Soil color, Scaling technique

41%, 17%

가

40%

2-3%

(wind erosion) 가

(Kang, 2006).

가 CEC(

allophane ,) 가

21% , 3%

(Eom et al.,

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* : Phone: +82312900273, 1977).

E-mail: sohur@rda.go.kr , 40%

(Yoo., 2000).

Stokes

1.724

plate

가

plate

가

plate

Eom et al.(1995) 10

가

scaling factor

10, 20,

33, 50, 100, 200, 300, 500, 1000, 1500 kPa

% (GSWC, gravimetric soil water content)

(SWCC, soil water characteristic curve)

가

가

가

58,500 ha

3,500 ha

가

13,000 ha

가

가

800

가

(hue), (value), (chroma)

HV/C

(NIAST, 2000)

Tyurin

Table 1. Soil characteristics of volcanic ash soil in subtropical area.

Soil color	Soil series	OM	Sand	Silt	Clay	Soil texture	
		g kg ⁻¹	----- % -----				
Black	(10YR 4/1)	Songdang	248	16.7	64.8	18.5	SiL
	(10YR 4/1)	Namweon	209	14.4	58.6	27	SiCL
Very dark brown	(10YR 3/4)	Ora	153	16.2	52.3	31.5	SiCL
	(10YR 2/2)	Euigui	70	10.9	69.4	19.7	SiL
Dark brown	(7.5YR 2.5/2)	Gangjeong	35	9.9	51.8	38.3	SiL

가

(Yoo, 2000)

(24.8, 20.9%) (15.3, 7.0%)가
(3.5%)가 (Table 1).

10YR(), 가 4, 가 1 ,
10YR(), 가 3
2, 가 4 2
7.5YR(), 가 2.5, 가 2 (Table 1).

(Soil Water Characteristics Curve)
Darcy

(Eom et al.,

1995).

가

, Fig. 1

al.(1995)

Table 1

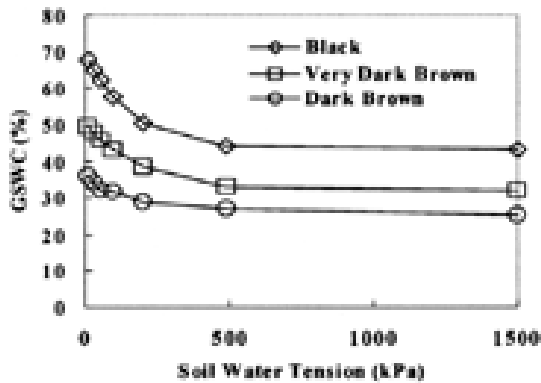


Fig. 1. Soil water characteristics curve by volcanic ash soil color.

, Fig. 1

가

가 scale factor scaling
(Brooks & Corey, 1964; van Genuchten, 1980; Eom et al., 1995). Scaling scale factor
dimensional , inspectional ,
similitude

가

similitude Fig. 1

(Fig. 2).

Fig. 2 Fig. 1

(1) scale

$$= \frac{i - r}{s - r} \quad (1)$$

scale dimensionless water
content (DWC) , i
, r 1500kPa , s 10kPa
scale

Brooks and Corey(1964)가 DWC
van Genuchten(1980)

. Fig. 2

Gardner et al.(1970)

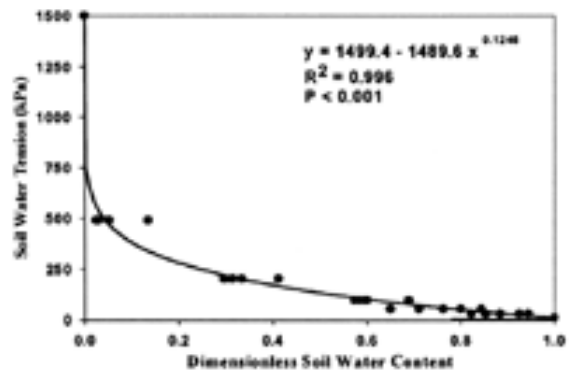


Fig. 2. Soil water characteristics curve unified by dimensionless water content.

DWC Eom et al.(1995)
 scale DWC
 van Genuchten (2)
 (SWAT, BASIN)

(logistic)

Table 2

가

$$= \frac{i - r}{s - r} = \left[\frac{1}{1 + (\cdot m)^n} \right]^m \quad (2)$$

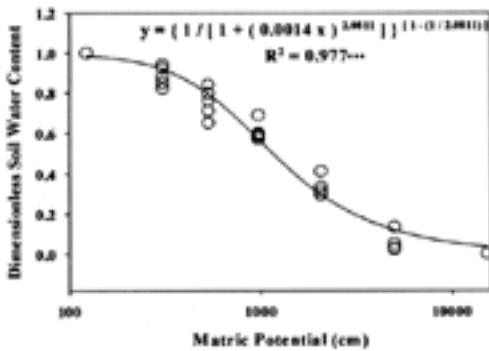
, m matric potential , , n, m
 , m 1-(1/n)
 van Genuchten
 Mualem (1976)

가
 scaling

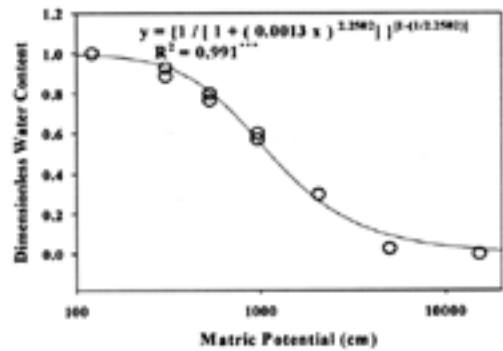
Table 2. Parameters of van Genuchten model for volcanic ash soil with different colors.

Soil classification	a	n	m
Total	0.0014	2.0811	0.5195
Black	0.0013	2.2502	0.5556
Very dark brown	0.0013	2.1084	0.5257
Dark brown	0.0020	1.8053	0.4461

(Warrick et al., 2002) 가
 가 가 . Fig. 3 scale



(a) Total



(b) Black Soil

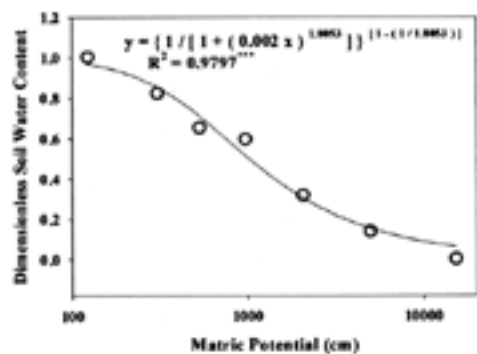
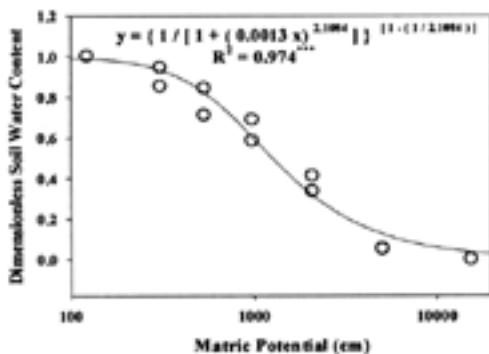


Fig. 3. Relation between matric potential and dimensionless water content by van Genuchten model.

(logistic)

van Genuchten
SWAT

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가

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scaling

가

scaling

dimensionless water content

, scale

van Genuchten