Soil Physical and Chemical Properties on Mars Global Simulant

AG-13-21

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Keywords: Food Production, Mars, Soil Physical Properties, Soil Chemical Properties

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INTRODUCTION and OBJECTIVES

- Recently, people are about to reach Mars. To survive sustainably on Mars, there is need to find a way to produce food under Mars conditions such as climate, soil, water, etc.
- Mars Global Simulant (MGS-1) was developed based on quantitative mineralogy from the Mars Curiosity Rover NASA data, at Exolith Laboratory, University of Central Florida.
- MGS-1 is a simulated soil and we compared MGS-1 and Andisol which is a typical soil in Japan for possibility of food production on Mars.

The objective of this study
MGS-1 is a simulated soil and we compared MGS-1 and Andisol and Standard-sand (Toyoura) which is a typical soil in Japan for possibility of food production on Mars.

MATERIALS and METHODS

Mars Global Simulant (MGS-1)
Mars Global Simulant (MGS-1) is a mineralogical standard for basaltic soils on Mars, developed based on quantitative mineralogy from the MSL Curiosity rover (Cannon et al., 2019).

Soil Physical Properties Analysis
Texture analysis, Saturated hydraulic conductivity test, Max and Min bulk density test, water retention

Soil Chemical Properties Analysis
pH and Electrical conductivity test, Loss of ignition test, N and P test, Trace element test

Fig. Photo of Mars ground surface
Source (NASA/JPLCaltech/ASU/MSSS)

RESULTS and DISCUSSION

Tabel1. Soil physical properties of MGS-1, Andisol, and Standard Sand (Toyoura)

	Texture	Sand	Silt	Clay	Ks	Maximum BD	Minimum BD
	-	%	%	%	cm s-1	Mg m-3	Mg m-3
MGS-1	Sandy Loam	84.6	14.5	0.9	3.90×10^{-4}	1.84	1.24
Andisol	Loamy Sand	88.8	8.6	2.6	1.21×10^{-2}	-	-
Standard Sand (Toyoura)	Sand	100	0	0	-	1.65	1.35

Tabel1. Soil chemical properties of MGS-1, Andisol, and Standard Sand (Toyoura)

	pH	EC	Loss of Ignition	NO_3-N	P_2O_5	K_2O	Na_2O	CaO
	-	mS cm^{-1}	%	mg $100g^{-1}$	mg $100g^{-1}$	mg $100g^{-1}$	mg $100g^{-1}$	mg $100g^{-1}$
MGS-1	6.60	3.47	1.87	10.6	0.882	278	644	61.6
Andisol	5.30	0.07	29.6	14.8	0.641	259	484	-

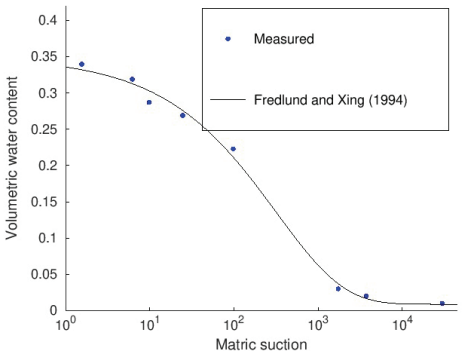

Fig. Water Retention Curve of MGS-1 with Nonlinear regression program (webmasters.gr.jp)

- MGS-1 contains less organic matter than Andisol, therefore it is considered that the soil structure may be fragile.
- The saturated hydraulic conductivity of MGS-1 was relativity lower than its Andisol, therefore it will be a challenge for food production.
- According to Table2 (Soil chemical properties of MGS-1), P_2O_5 and CaO are deficient in significant amounts, on the other hand, and K_2O is more likely to cause problems, because of high concentration.

CONCLUSIONS

The results showed that the saturated hydraulic conductivity of MGS-1 was relativity lower than its Andisol. The water holding ability of MGS-1 was as same as its Andisol. The micronutrient was observed under MGS-1 compared to the same level of Andisol.
We concluded that MGS-1 needs to be improved physical and chemical properties for food production, such as applying organic materials.

Reference

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