

Research Article



CrossMark

Open Access

## 새만금간척지에서 뚱딴지(*Helianthus tuberosus* L.) 재배시 염류 특성 변화 및 적정 자원 선발

오양열<sup>1\*</sup>, 이정태<sup>1</sup>, 홍하철<sup>2</sup>, 김재현<sup>3</sup>, 서우덕<sup>1</sup>, 김선<sup>1</sup>, 류진희<sup>1</sup>, 이수환<sup>1</sup>, 김영주<sup>4</sup>

<sup>1</sup>

<sup>3</sup>

<sup>2</sup>

<sup>4</sup>

### The Selection of Proper Resource and Change of Salinity in *Helianthus tuberosus* L. Cultivated in Saemangeum Reclaimed Tidal Land

Yang-Yeol Oh<sup>1</sup>, Jung-Tae Lee<sup>1</sup>, Ha-Cheol Hong<sup>2</sup>, Jae-Hyun Kim<sup>3</sup>, Woo-Duck Seo<sup>1</sup>, Sun Kim<sup>1</sup>, Jin-Hee Ryu<sup>1</sup>, Su-Hwan Lee<sup>1</sup> and Young-Joo Kim<sup>2</sup> (<sup>1</sup>Division of Crop Foundation, National Institute of Crop Science, Rural Development Administration, Wanju 55365, Korea, <sup>2</sup>Division of Crop Post-harvest Technology Research, Department of Central Area Crop Science, National Institute of Crop Science, Rural Development Administration, Wanju 55365, Korea, <sup>3</sup>Division of Technology Transfer, National Institute of Crop Science, Rural Development Administration, Wanju 55365, Korea, <sup>4</sup>Department of cadastre & Civil engineering, Vision College of Jeonju, Jeonju 55069, Korea)

Received: 21 March 2018/ Revised: 11 April 2018/ Accepted: 23 April 2018

Copyright © 2018 The Korean Society of Environmental Agriculture

This is an Open-Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ORCID

Yang-Yeol Oh

<http://orcid.org/0000-0002-7471-0406>

### Abstract

**BACKGROUND:** Soil salinity of reclaimed tidal land in Korea is highly important factor. High salinity is harmful to crop productivity. Jerusalem artichoke (*Helianthus tuberosus* L.) is known to be salt-tolerant and has high adaptability to diverse pedo-climatic conditions. The objective of this study was to assess the changes of soil properties and crop productivity according to salt concentration in the reclaimed tidal lands.

**METHODS AND RESULTS:** Experimental sites were selected at Saemangeum (35°46'N, 126°37'E) reclaimed tidal land, and their dominant soil series were Munpo (coarse loamy, mixed, non-acid, mesic, typic Fluvaquents). *H. tuberosus* L were collected from 12 locations across Korea. Tubers were planted at 75×25 cm with EC 2 to 7 dS m<sup>-1</sup>. Soil samples were periodically collected from both 0~20 cm and 20~40 cm depths of each site. Soil salinity and

soil moisture contents were varied depending on weather conditions. Soil electrical conductivity varied from 1.0 to 5.9 dS m<sup>-1</sup>, and soil moisture contents varied from 9.2 to 28.7%. The white-colored tubers of *H. tuberosus* L. collected from 'Yeongwol-gun' exhibited the highest height (207 cm), followed by the white-colored tubers of *H. tuberosus* L. collected from 'Iksan-si' (202 cm). The white-colored tubers of *H. tuberosus* L. collected from 'Gyeongju-si' showed the highest yield (549 kg/10a). The purple-colored tubers of *H. tuberosus* L. collected from 'Yeongwol-gun' showed the highest yield (615 kg/10a).

**CONCLUSION:** Our results indicate that the plant height and tuber yield did not appear to be correlated. Considering yield and inulin content, the Gyeongju-si seemed to be suitable as the white-colored tubers of *H. tuberosus* L. and the Yeongwol-gun seemed to be suitable as the purple-colored tubers of *H. tuberosus* L. in the reclaimed tidal lands. However, it is necessary to consider the relationship between the inulin content and the yield.

\*Corresponding author: Yang yeol Oh

Phone: +82-63-238-5317; Fax: +82-63-238-5305;

E-mail: nubira7777@korea.kr

**Key words:** *Helianthus tuberosus* L, Inulin content, Soil EC, Soil moisture, Plant height

**Table 1. List of *H. tuberosus* L. collected from 12 regions in Korea**

Assess number	Collecting place	Tuber color	Systemic name
1	Haenam-gun	White	WH1
2	SangJu-si	Purple	PS1
3	GyeongJu-si	White	WG1
4	GyeongJu-si	Purple	PG2
5	Daegu	Purple	PD1
6	Daegu	White	WD2
7	Yeongwol-gun	Purple	PY1
8	Yeongwol-gun	White	WY2
9	Yeongwol-gun	White	WY3
10	Yeongwol-gun	Purple	PY4
11	Yeongwol-gun	White	WY5
12	Iksan-si	White	WI1

**서론**

가  
가  
가

13 5 ha  
8,570 ha가  
(Shim *et al.*, 2011).

가  
가  
가

**재료 및 방법**

**동만지(*H. tuberosus* L.) 수집 지역 목록**

2016 3  
가 12  
(Table 1).  
7  
3 가  
1  
가 1.5~3 m  
75% 가  
(Liu *et al.*, 2012).

2  
5  
가

(Kalyani *et al.*, 2010).

**시험장소 및 토양 조건**

가  
가  
가  
(Kosaric *et al.*, 1985),  
가  
(Geng-Mao *et al.*, 2008).

12  
가  
(35°46'N, 126°  
37'E) 2016 4 11  
2006 가  
가 2014 ( ) ( )  
(Fluvio-  
marine deposit)  
pH 가 6.7  
Conductivity (EC) 0.7 dS m<sup>-1</sup>, 2.2 dS m<sup>-1</sup>, Electrical

Table 2. Soil properties before the study began in 2016

Soil depth (cm)	pH 1:5	EC dS m <sup>-1</sup>	OM* g kg <sup>-1</sup>	T-N* g kg <sup>-1</sup>	Av. P <sub>2</sub> O <sub>5</sub> mg/kg	cmolc kg <sup>-1</sup>			
						K	Ca	Mg	Na
0~20	6.7	0.7	3.45	0.05	46	0.63	1.5	2.2	1.4
20~40	7.2	2.2	1.37	0.03	27	0.67	1.2	2.5	2.4

\* OM : Organic matter, T-N: Total Nitrogen

3.45 g kg<sup>-1</sup> (Table 2).

재배 및 조사방법

12 2016 4 12 1  
 75×25 cm ( × ),  
 N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O- 10 a 5-5-5-1500 kg  
 가  
 (auger)  
 (0~20 cm) (20~40 cm)  
 3 5 23 , 6  
 7 , 7 14 , 8 19 4 EC  
 2 mm  
 EC 1:5 ( : =1:5, w/w) pH-EC  
 105°C (%)  
 [( - )/ ]×100  
 Lancaster (Shimadzu, JP/UV-2501)  
 720 nm  
 1N-NH<sub>4</sub>OAc (pH7.0)  
 ICP-OES (Varian, Vista MPX-ICP)  
 ( , 2014). 9  
 15 50%  
 11 3 10  
 가 , Fructose  
 가 50 mL tube 1 g  
 50% ACN 20 mL 24  
 shaking 0.2 um  
 가 1 g 20 mL 0.2 M HCl 9  
 7°C 45 50% ACN  
 10 0.2 um LC  
 ultra-high performance liquid chromatography  
 (Dionex Ultimate 3000, Thermo Scientific)

통계분석

10 3  
 R (Ver. 3.1.1)  
 0.05 , Duncan test

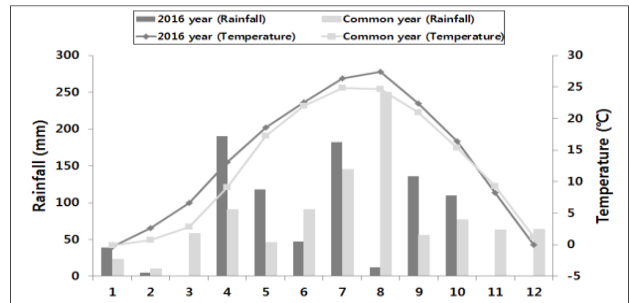


Fig. 1 The monthly average temperature ( ) and accumulative rainfall (mm) in the experiment field during common and 2016 year.

결과 및 고찰

재배기간의 기상 특성

2016  
 5 (Fig. 1).  
 (4 ~11 ) 19.3°C  
 17.9°C 1.4°C  
 2016 795 mm 817 mm 22 mm  
 4 10 2016  
 8 238 mm 가

동판지 재배기간 동안 토양 EC 및 수분함량

2016 EC  
 (Fig. 2). 5  
 EC가 1 dS m<sup>-1</sup> 1.5 dS m<sup>-1</sup>  
 22%  
 . 6  
 EC가 가  
 . 7  
 가  
 6  
 EC가 2.1 dS m<sup>-1</sup> 3.5 dS m<sup>-1</sup>  
 8  
 11.1% 13.0% EC 3.2 dS m<sup>-1</sup>  
 5.0 dS m<sup>-1</sup> 가

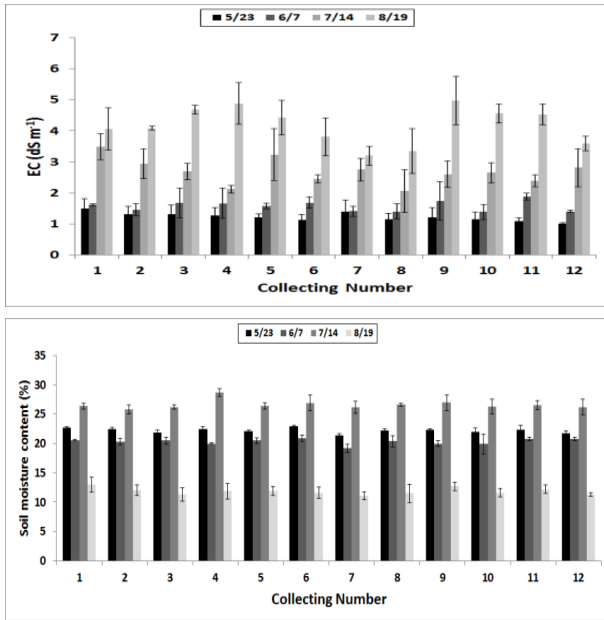


Fig. 2. Comparison of different *H. tuberosus* L. on the field soil electrical conductivity and soil moisture content during 2016.

(Conde, 1991). EC (Kwun and Yoon, 1994). 수집 별 동단지 초장 및 수량 (Table 3). (Stauffer *et al.*, 1981). 4 8 0.1% 0.3% (WY3) PY1

(WI1)가 207 cm, 202 cm (WG1), (WH1), (PS1)가 144 cm, 139 cm, 131 cm 가 . WG1 549 kg/10a, WH1 477 kg/10a 가 (Table 3), PY4 PY1 10a 615 kg, 584 kg 가 . WY3 WI1 가 . 10 a 1,000 kg , 2,000 kg 2.5 dS m<sup>-1</sup> , 6.0 dS m<sup>-1</sup> (Gengmao *et al.*, 2010). (Gao *et al.*, 2011). 가 가 (Denoroy, 1996).

가 수집 별 동단지 이늘린 함량 및 간척지 적응 동단지 선발 50% (Danilcenko *et al.*, 2008). 12 PY1 33.9 g/100 g 가 WD2가 33.7 g/100 g (Fig. 3). WD2 PY1

Table 3. Comparison on plant height and yield on the basis of color of *H. tuberosus* L. collected from 12 regions in 2016

Tuber Color	Collecting place	Plant height (cm)	Yield (kg/10 <sup>3</sup> )	
White	Haenam-gun	139 <sup>cd</sup>	477 <sup>a</sup>	±122.1
	GyeongJu-si	144 <sup>cd</sup>	549 <sup>a</sup>	±149.3
	Daegu	168 <sup>abcd</sup>	153 <sup>b</sup>	±30.2
	Yeongwol-gun	192 <sup>abc</sup>	136 <sup>b</sup>	±72.9
	Yeongwol-gun	207 <sup>a</sup>	29 <sup>c</sup>	± 9.3
	Yeongwol-gun	200 <sup>ab</sup>	58 <sup>c</sup>	±12.6
	Iksan-si	202 <sup>a</sup>	66 <sup>c</sup>	±14.5
Purple	SangJu-si	131 <sup>d</sup>	507 <sup>c</sup>	±60.1
	GyeongJu-si	149 <sup>bcd</sup>	543 <sup>bc</sup>	±81.3
	Daegu	147 <sup>bcd</sup>	444 <sup>d</sup>	±24.8
	Yeongwol-gun	165 <sup>abcd</sup>	584 <sup>ab</sup>	±114.4
	Yeongwol-gun	172 <sup>abcd</sup>	615 <sup>a</sup>	±120.5

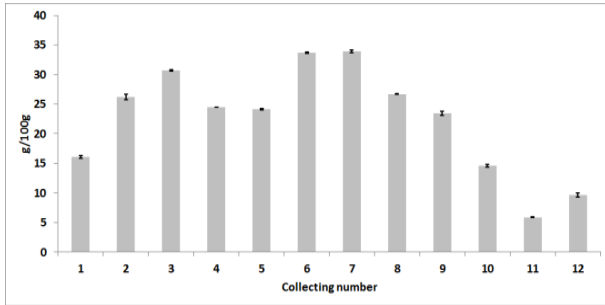


Fig. 3. Comparison on inulin content *H. tuberosus* L. collected from 12 regions in 2016.

WD2가 , WG1 ,  
(Sawicka and Michałek, 2005).

**요 약**

2016 12  
1. 가 , 8 가 0.3%  
가 0.3%

2. 50%  
WY3 W11가 207 cm, 202 cm 가  
WG1, WH1, PS1 144 cm, 139 cm, 131 cm 가

3. 11  
WG1 549 kg/10 a, WH1 477 kg/10 a 가  
PY4 PY1  
10 a 615 kg, 584 kg

4. 12  
PY1 33.9 g/100 g 가  
D2가 33.7 g/100 g 가

G1  
Y1 ,  
2 가  
가

**Note**

The authors declare no conflict of interest.

**Acknowledgement**

This study was supported financially by a grant from the research project (No. PJ011796022017) of National Institute of Crop Sciences, Rural Development Administration, Republic of Korea.

**References**

Conde, J. R., Tenorio, J. L., Rodriguez-Maribona, B., & Ayerbet, L. (1991). Tuber yield of Jerusalem artichoke (*Helianthus tuberosus* L.) in relation to water stress. *Biomass and Bioenergy*, 1(3), 137-142.

Danilcenko, H., Jariene, E., & Aleknaviciene, P. (2008). Quality of Jerusalem artichoke (*Helianthus tuberosus* L.) tubers in relation to storage conditions. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca*, 36(2), 23-27.

Denoroy, P. (1996). The crop physiology of *Helianthus tuberosus* L.: a model oriented view. *Biomass and bioenergy*, 11(1), 11-32.

Gao, K., Zhu, T., & Han, G. (2011). Water and nitrogen interactively increased the biomass production of Jerusalem artichoke (*Helianthus tuberosus* L.) in semi-arid area. *African Journal of Biotechnology*, 10(34), 6466-6472.

Gengmao, Z., Mehta, S. K., & Zhaopu, L. (2010). Use of saline aquaculture wastewater to irrigate salt-tolerant Jerusalem artichoke and sunflower in semiarid coastal zones of China. *Agricultural Water Management*, 97(12), 1987-1993.

Geng-Mao, Z., Zhao-Pu, L., Ming-Da, C., & Shi-Wei, G. (2008). soil properties and yield of jerusalem artichoke (*Helianthus tuberosus* L.) with seawater irrigation in north china plain. *Pedosphere*, 18(2), 195-202.

Kalyani Nair, K., Kharb, S., & Thompkinson, D. K. (2010). Inulin dietary fiber with functional and health attributes-a review. *Food Reviews International*, 26(2), 189-203.

Kosaric, N., Wiczorek, A., Cosentino, G. P., & Duvnjak, Z. (1985). Industrial processing and products from the Jerusalem artichoke. In *Agricultural Feedstock and Waste Treatment and Engineering*, pp. 1-24, Springer, Berlin, Heidelberg.

Kwon, S. K., & Yoon, K. S. (1994). Variational characteristics of water-table and soil moisture in paddy-upland rotational fields. *Journal of the Korean Society of Agricultural Engineers*, 36(2), 123-131.

Liu, Z. X., Spiertz, J. H. J., Sha, J., Xue, S., & Xie, G. H. (2012). Growth and yield performance of Jerusalem

- artichoke clones in a semiarid region of China. *Agronomy Journal*, 104(6), 1538-1546.
- Sawicka, B., & Michałek, W. (2005). Evaluation and productivity of *Helianthus tuberosus* L. in the conditions of the central-east Poland, *Electronic Journal of Polish Agricultural Universities*, 8(3), #42.
- Shim, H. H., Choi, S. M., & Cho, J. H. (2011). A Study on new vililage planning in the farming zone of Saemangeum reclaimed area. *Journal of Korean Society of Rural Planning*, 17(4), 61-74.
- Stauffer, M. D., Chubey, B. B., & Dorrell, D. G. (1981). Growth, yield and compositional characteristics of Jerusalem artichoke as they relate to biomass production. In: Klass, D. L., Emert, G. H(eds), *Fuels from Biomass and Wastes*. pp. 79-97, Ann Arbor Science Publishers, Inc Ann Arbor, Michigan, USA.