

Research Article



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중량식 라이시미터에서 콩 재배시 물관리 방법에 의한 양분의 용탈과 작물 흡수

이예진*, 한경화, 이슬비, 성좌경, 송요성, 이덕배

Nutrient Leaching and Crop Uptake in Weighing Lysimeter Planted with Soybean as Affected by Water Management

Ye-Jin Lee*, Kyung-Hwa Han, Seul-Bi Lee, Jwa-Kyung Sung, Yo-Sung Song and Deog-Bae Lee (Soil & Fertilizer Management Division, Department of Agricultural Environment, National Institute of Agricultural Science, Rural Development Administration, Wanju 55365, Korea)

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ORCID

Ye-Jin Lee

<http://orcid.org/0000-0003-4415-846X>

Kyung-Hwa Han

<http://orcid.org/0000-0003-2840-0893>

Seul-Bi Lee

<http://orcid.org/0000-0001-5216-6908>

Abstract

BACKGROUND: Soil water content strongly depends on weather condition and irrigation, and it could influence on crop nutrient use efficiency. This study was performed to assess nutrient uptake of soybean by soil water condition.

METHODS AND RESULTS: In this study, nutrient leaching and crop uptake as affected by water management practice was investigated using weighing lysimeter which is located in National institute of agricultural science, Wanju, Jeonbuk province from June 2015 to October 2016. Water supply for soybean (cv. Daewon) was managed with irrigation and rainfall. Nitrate leaching was greatest in the rainfall treatment at early July 2016. Yield of soybean in the rainfall treatment was only 25% compared to the irrigation due to the drought at flowering and podding period. The uptake of nitrogen was considerably reduced by drought whereas the uptake of phosphorus and potassium was less affected by drought.

CONCLUSION: It was proven that nitrogen loss and uptake were dependent on soil water condition. Therefore, irrigation water management to maintain available soil moisture capacity is critical to nitrogen uptake and yield of soybean.

Key words: Irrigation, Nitrogen uptake, Soybean, Weighing lysimeter

서론

(Baligar *et al.*, 2001).

가 . 가 (Pinkerton and Simpson, 1986). (*Glycine max* L.)

(Ashley, 1983). 6 10 가

*Corresponding author: Ye-Jin Lee

Phone: +82-63-238-2446; Fax: +82-63-238-3822;

E-mail: leeyj418@korea.kr

Table 1. Soil physico-chemical properties before experiment

Soil series	Horizon	Soil depth (cm)	Bulk density (Mg m ⁻³)	Soil texture	pH (1:5)	EC (dS m ⁻¹)	OM (g kg ⁻¹)	Av.P ₂ O ₅ (mg kg ⁻¹)	Exch. cations (cmol _c kg ⁻¹)		
									K	Ca	Mg
Songjeong	Ap	0~12	1.18	Silty Clay Loam	5.2	0.6	22.5	463	0.17	1.3	2.0
	BAt	12~36	1.26	Silty Clay Loam	5.4	ND	2.6	ND	0.09	0.1	1.4
	Bt	36~61	1.34	Silty Clay Loam	5.8	ND	2.0	ND	0.09	0.1	1.9
	Bw	61~98	1.32	Silt Loam	5.9	ND	1.5	ND	0.09	0.3	2.5
	C	98~150	1.43	Silt Loam	5.9	ND	1.8	ND	0.13	0.6	3.0

Table 2. Chemical properties of top soil in 2016

pH (1:5)	EC (dS m ⁻¹)	OM (g kg ⁻¹)	T-N (g kg ⁻¹)	Av.P ₂ O ₅ (mg kg ⁻¹)	Exch. cations (cmol _c kg ⁻¹)		
					K	Ca	Mg
7.0	0.5	38	1.6	288	0.45	7.8	5.0

(Holzman *et al.*, 2014).

65%가

50~100 cm

Table 1

(Karam *et al.*, 2005).

가

처리내용

1 7

2015 6

30×30 cm, 2015 6 8

가 10 30, 2016 6 10

10 24, 2015 2016

2015

300 kg 10a⁻¹, 1000 kg 10a⁻¹

N-P-K=3.40-1.31-7.73 kg 10a⁻¹

2016 Table 2

N-P-K=0.0-0.74-3.16 kg 10a⁻¹

(NIAST, 2006).

(a)

가

(b)

가

재료 및 방법

가

중량식 라이시미터 및 토양 특성

재배기간 중 기상 조건

1 m, 1.5 m

, 10, 30, 55, 85, 125 cm

(UMP-1, UGT, Germany)

(Suction probe system, UGT, Germany)가 가

(Weighing lysimeter, UGT, Germany)

Seo (2016)

2013 10

2015

15.2°C 25.8°C

2016 15.9 27.5°C, 2015

400 mm 50%

, 2016 630 mm 7 9

10 가 가 8

가 27mm 가 (Fig. 1).

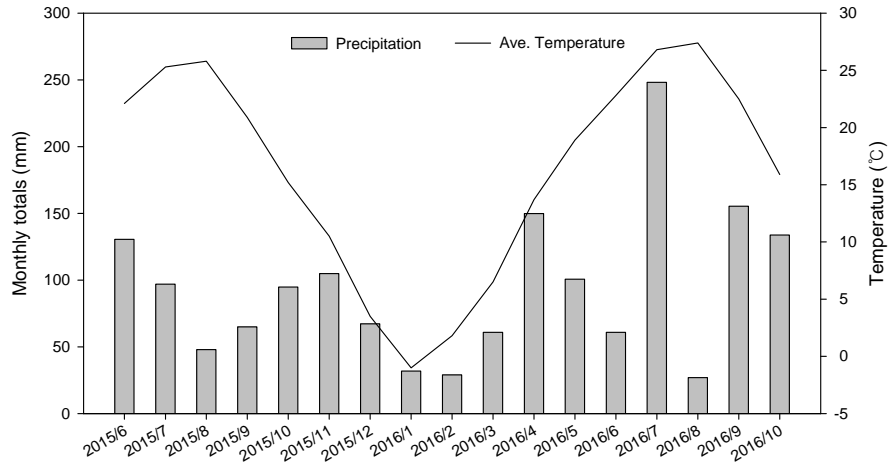


Fig. 1. Monthly precipitation and average temperature during soybean cultivation from June 2015 to October 2016.

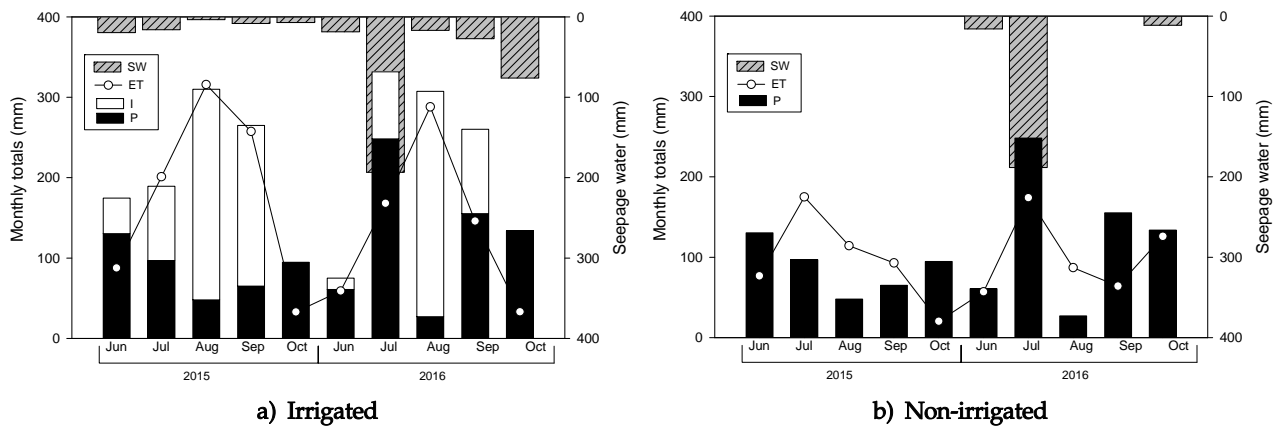


Fig. 2. Precipitation (P), Irrigation (I), evapotranspiration (ET) and seepage water (SW) by water managements during soybean cultivation using weighing lysimeter.

작물 증발산량 산정

(Klammler and Fank, 2014).

$$(ET) = P + I - S - R$$

Integra XL Dual, Australia) (NIAST, 2000).

0.5 g (H₂SO₄) 1 mL 50% (HClO₄) 10 mL 가

가 , , , Lee (2017)

(MOE, 2017)

(QuAAtro, Seal analytical,

USA)

토양 이화학적, 식물체 흡수량 및 침투수 분석

USDA Soil taxonomy (Soil survey staff, 1999).

(Gee and Boudier, 1986)

(Blake

and Hartge, 1986). pH EC 1:5

Tyurin ,

Lancaster , 1 M NH₄OAC (pH 7.0)

(ICP-OES, GBC,

결과 및 고찰

강우 및 관개여부에 따른 수분 이동과 양분 유출

2015 2016

, , Fig. 2

2015 7 9

, 2016 7 5 가

, 2016 7 5 가

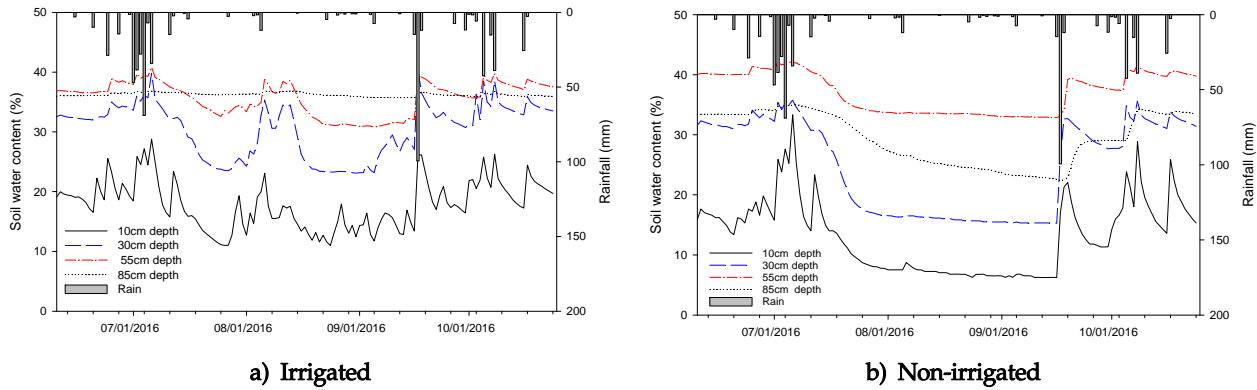


Fig. 3. Variation of soil water content by water managements during soybean cultivation in 2016.

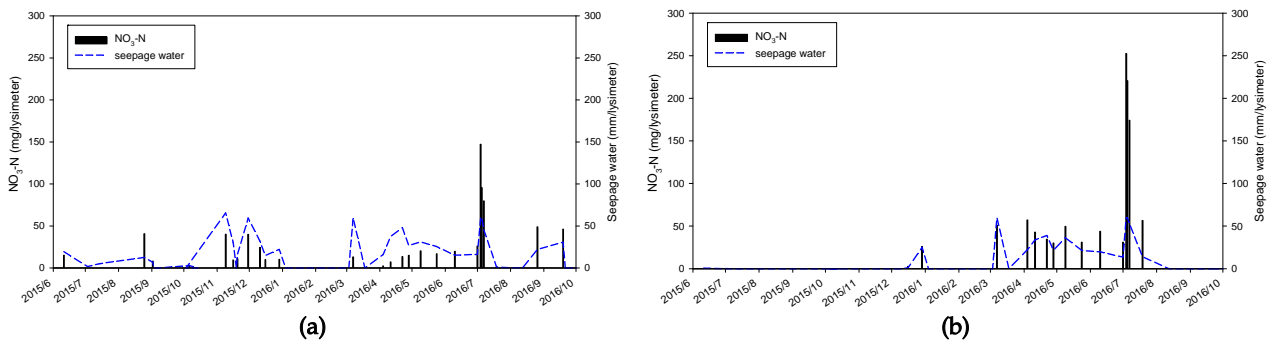


Fig. 4. NO₃-N leaching in a) irrigated and b) non-irrigated weighing lysimeter from June 2015 to October 2016.

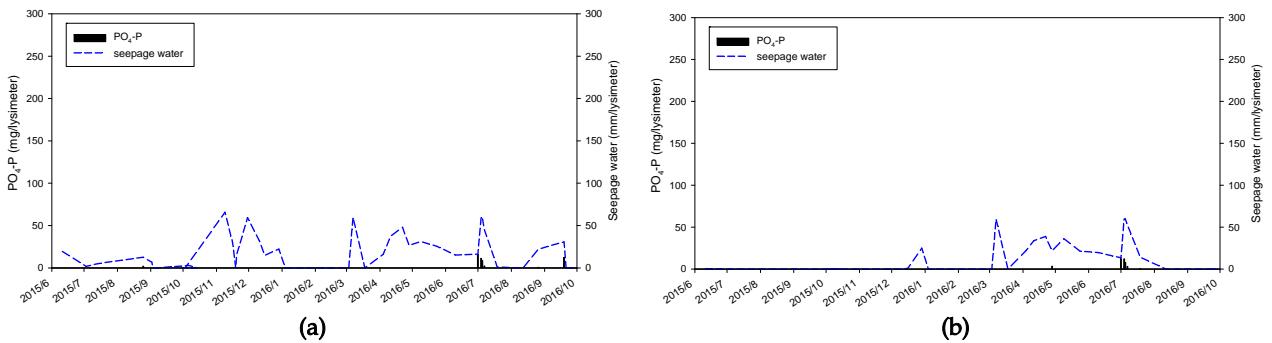


Fig. 5. PO₄-P leaching in a) irrigated and b) non-irrigated weighing lysimeter from June 2015 to October 2016.

200 mm 가 .
 가 (Yang *et al.*, 2000), 7 6
 2015 , 2016 가 7 23 9
 가 가 8 10~30 cm 7 50%
 가 , 10 (Fig. 3). 10 cm
 7 8 10% , 30 cm 20% ,
 가 가
 , 2016 9 . 9 100 mm
 10 가

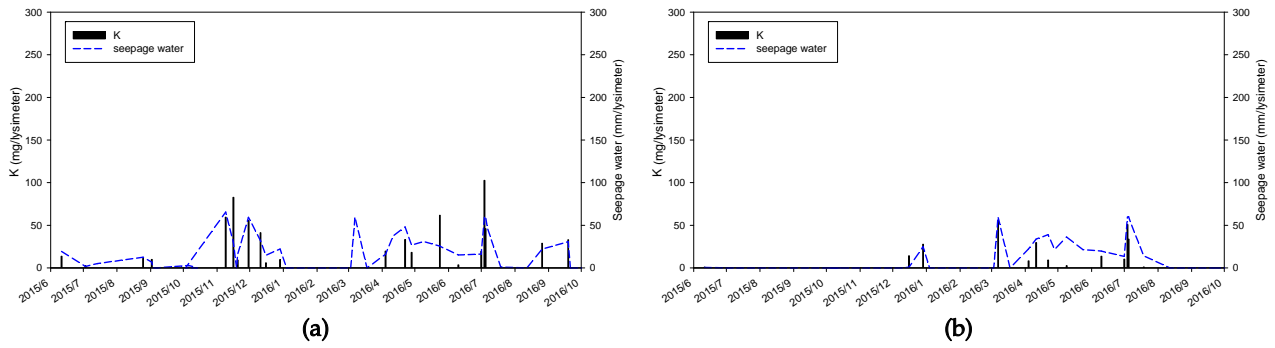


Fig. 6. Potassium leaching in a) irrigated and b) non-irrigated weighing lysimeter from June 2015 to October 2016.

Table 3. Yield of soybean by water managements

Treatments	Year	Pod weight (g m ⁻²)	Grain weight (g m ⁻²)	Percentage of immature pod (%)
Irrigated	2015	128.1	330.1	14.0
	2016	73.5	163.3	19.4
Non-irrigated	2015	35.7	81.1	31.5
	2016	31.4	45.1	28.2

Table 4. Nutrient leaching and crop uptake by water management

Treatments	Year	Fertilization (g m ⁻²)			Leaching* (g m ⁻²)			Crop uptake (g m ⁻²)		
		N	P	K	N	P	K	N	P	K
Irrigated	2015	3.40	1.31	7.73	0.05	0.002	0.02	22.7	1.6	6.8
	2016	0.00	0.74	3.16	1.29	0.16	0.52	18.5	1.8	4.3
Non-irrigated	2015	3.40	1.31	7.73	-	-	-	15.7	1.0	6.1
	2016	0.00	0.74	3.16	0.82	0.07	0.13	15.1	1.6	3.9

*N : NO₃-N+NH₄-N, P : PO₄-P, K : Inorganic K

가 . 적습관개 및 무관개구의 콩 수량과 양분수지
25% ,
10 mg L⁻¹ , 2016 3 10~15%
7 (Table 3). Park (2014)
가 . 37% , Shin
가 , 2016 7 (2015) 15
5 가 39%
가 (Fig. 4). 가 가
2015 가 2016 가
3 가 가 (Sale and Campbell, 1980),
가 가 7 8
2016 7
(Fig. 5), 0.5~2 mg L⁻¹ , ,
(Fig. 6). 가 가 ,
(Table 4).

20~50% 가
 .
 ,
 (Albrecht *et al.*, 1994; Zahran, 1999).

요약

가
 가
 2015 2016
 6 10
 , 2016 7
 8
 가 9
 가
 2016 7 5 가 가
 , 가
 7 8
 7 50%
 , 25%
 ,
 20~50% , ,

Notes

The author declare no conflict of interest.

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