

# 遮光條件과 有機物 施用量이 더덕의 生育 및 香氣成分에 미치는 影響

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## Effects of Shading Condition and Organic Matter Application Rates on Aromatic Constituents of *Codonopsis lanceolata* Beth. et Hook. fil.

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### 實驗目的

本 實驗은 遮光條件과 有機物 施用量에 따른 더덕의 生育特性和 一般成分, 無機成分, 粗사포닌, 아미노酸 및 香氣成分의 組成을 比較分析하여 香氣높은 더덕의 栽培方法을 確立코자 함.

### 材料 및 方法

本 實驗은 慶北農村振興院 北部試驗場 圃場에서 1993年 4月부터 1996年 4月까지 3年間에 걸쳐 遮光條件을 無遮光과 遮光 (55%)으로 나누어 各各 有機物 施用量을 10 M/T과 30 M/T으로 處理한 다음 더덕의 生育特性, 一般成分, 無機成分, 粗사포닌, 아미노酸 및 香氣成分 등을 調査하였다.

### 結果 및 考察

- 가. 遮光條件에 따른 氣象環境의 差異는 無遮光區에 비해 遮光(55%)에서 最高氣溫 6.1 °C, 最低氣溫 0.6 °C, 平均氣溫 3.4 °C로 낮았고 地溫도 3.4 °C 낮았으며 照度量은 44% 적었다.
- 나. 試驗土壤의 理化學의 特性에서 pH는 遮光條件과는 無關하게 有機物 施用量이 많을수록 낮았고 有機物 含量은 有機物 施用量이 많을수록 높았으나 遮光區(55%)에 비해 無遮光區에서 顯著하게 높았다.
- 다. 地上部 및 地下部 生育은 有機物 施用量이 많을수록 良好하였으나 그 結果는 遮光區(55%)에 비하여 無遮光區에서 顯著하였다.
- 라. 一般成分의 組成에서 粗蛋白質은 遮光區에서 높았고 有機物 施用量이 많을수록 顯著하게 높았으나 無遮光區에서는 이와 反對로 有機物 施用量이 많을수록 顯著하게 減少하였으며 粗脂肪은 無遮光區에서 높았고 有機物 施用量이 많을수록 粗灰分은 相反되는 傾向을 보였다.
- 마. 無機成分 組成을 살펴보면, 多量元素인 K, Ca, Mg 등은 遮光區에 비해 無遮光區에서 높았으며, 有機物 施用量이 많을수록 顯著하게 높았으나 微量元素는 遮光條件과 有機物 施用量에 따른 組成의 差異를 보이지 않았다.
- 바. 遊離 아미노酸 組成의 含量은 遮光區에 비해 無遮光區에서 높았으며 有機物 施用量이 많을수록 높은 傾向을 보였고 Arginine이 가장 많은 含量을 보였다.
- 사. 粗사포닌 含量은 遮光區에 비해 無遮光區에서 높았으나 有機物 施用量에는 一定한 傾向이 없었다.
- 아. 香氣成分은 總 44種이 同定되었는데 1-hexanol, *cis*-3-hexenol, *trans*-2-hexenal 등이 높은 組成을 보였고 無遮光區에 비하여 遮光區(55%)에서 높았고 有機物 施用量이 많을수록 顯著히 增加하는 傾向이었다.
- 자. 綜合的으로 볼 때 地上部 및 地下部 生育은 遮光에 비해 無遮光區에서 良好하나 香氣成分은 無遮光에 비하여 遮光區에서 높아 芳香性이 높은 高品質의 더덕을 生産하기爲해서는 遮光과 有機物을 多量施用해야 할 것으로 思料된다.

Table 1. Meteorological environments as affected by shading conditions

Shading level	Temp.(°C)			Soil temp. (°C)	Relative light intensity (Lux.)	Light intensity (Lux.)
	max.	mini.	mean			
Non-shading	34.1	10.4	22.3	22.8	75.5	96,300
Shading 55%	28.0	9.8	18.9	3.5	73.5	42,620

Table 2. Physicochemical properties of soils

Shading level	Application rate (per 10a)	pH (1:5)	O.M (%)	P <sub>2</sub> O <sub>5</sub> (ppm)	Ext. (me/100 μ)			SiO <sub>2</sub> (ppm)
					K	Ca	Mg	
Non-shading	Native soil	6.9	8.5	324	1.07	9.35	1.91	132
	Organic matter 10 M/T	6.2	5.0	226	1.22	6.27	1.95	110
	Organic matter 30 M/T	5.4	6.5	116	0.38	5.68	1.44	89
	Mean	6.2	6.7	222	0.89	7.10	1.77	113
Shading 55%	Native soil	6.7	2.6	240	0.88	6.98	1.18	121
	Organic matter 10 M/T	6.6	2.9	223	1.18	5.78	0.98	96
	Organic matter 30 M/T	5.7	3.4	136	0.40	4.79	0.92	78
	Mean	6.3	3.0	200	0.82	5.85	1.03	98

Table 3. Growth characteristics as affected by shading condition and organic matter application rates

Shading level	Application rate (per 10a)	Vine length (cm)	Leaf		Fresh root wt. (g/plant)
			length (cm)	width (cm)	
Non-shading	Native soil	328	39	6.4	45.1
	Organic matter 10 M/T	356	38	6.6	52.3
	Organic matter 30 M/T	376	41	5.9	57.1
	Mean	353	39	6.3	51.5
Shading 55%	Native soil	318	35	7.6	24.2
	Organic matter 10 M/T	322	39	8.9	25.2
	Organic matter 30 M/T	299	33	7.2	32.4
	Mean	313	35	7.9	27.3

Main plot : LSD(0.05) ----- 1.8  
 Sub plot : LSD(0.05) ----- 1.3  
 Interaction(main plot × sub plot) ----- 1.5

Table 4. Composition of crude components as affected by shading condition and organic matter application rates

Shading level	Application rate (per 10a)	Crude component(%)				Moisture (%)	Saponin (%)
		protein	fat	fiber	ash		
Non-shading	Native soil	8.63	1.69	2.47	3.44	81.8	4.8
	Organic matter 10 M/T	5.56	1.73	2.46	4.21	81.7	4.4
	Organic matter 30 M/T	5.14	1.73	2.50	5.32	80.7	4.4
	Mean	6.44	1.72	2.47	4.32	81.4	4.5
Shading 55%	Native soil	6.50	1.37	2.60	5.21	78.1	2.6
	Organic matter 10 M/T	7.25	1.64	2.41	4.12	77.8	2.0
	Organic matter 30 M/T	8.13	1.64	2.45	3.63	79.5	3.6
	Mean	7.29	1.55	2.48	4.32	78.5	2.7

Main plot : LSD(0.05) ----- 0.3  
 Sub plot : LSD(0.05) ----- 0.4  
 Interaction(main plot × sub plot) ----- 0.8

Table 5. Content of inorganic elements as affected by shading condition and organic matter application rates

Shading level	Application rate (per 10a)	Inorganic element (ppm)							
		K	Ca	Mg	Fe	Mn	Zn	Na	Cu
Non-shading	Native soil	10.02	3.62	0.37	0.01	0.17	0.04	0.00	0.09
	Organic matter 10 M/T	15.03	3.97	0.33	0.01	0.17	0.04	0.00	0.08
	Organic matter 30 M/T	16.27	4.25	0.31	0.00	0.20	0.05	0.00	0.08
	Mean	13.77	4.01	0.34	0.01	0.18	0.04	0.00	0.08
Shading 55%	Native soil	8.43	3.60	0.24	0.02	0.17	0.05	0.03	0.07
	Organic matter 10 M/T	11.93	3.26	0.28	0.01	0.15	0.04	0.05	0.08
	Organic matter 30 M/T	13.81	3.97	0.33	0.00	0.19	0.04	0.01	0.09
	Mean	11.39	3.61	0.28	0.01	0.18	0.04	0.03	0.08

Main plot : LSD(0.05) ----- 1.10  
 Sub plot : LSD(0.05) ----- 4.01  
 Interaction(main plot × sub plot) ----- 6.43

Table 6-1. Changes of free amino acids as affected by shading condition and organic matter application rates

Shading level	Application rate (per 10a)	Free amino acid content (mg/dry wt.)							
		Lys	His	Arg	Asp	Thr	Ser	Glu	Pro
Non-shading	Native soil	1.44	0.87	18.12	1.66	0.99	0.11	8.01	1.11
	Organic matter 10 M/T	1.48	0.89	18.66	1.89	0.98	0.13	8.06	1.18
	Organic matter 30 M/T	1.49	0.93	18.89	1.87	1.00	0.15	8.11	1.19
	Mean	1.47	0.90	18.56	1.81	0.99	0.13	8.06	1.16
Shading 55%	Native soil	1.04	0.43	17.11	1.41	0.96	0.09	7.47	1.14
	Organic matter 10 M/T	1.06	0.44	17.44	1.43	0.96	0.10	7.47	1.10
	Organic matter 30 M/T	1.09	0.47	17.54	1.46	0.99	0.12	7.89	1.16
	Mean	1.06	0.45	17.36	1.43	0.97	0.10	7.61	1.13

Main plot : LSD(0.05) ----- 0.87  
 Sub plot : LSD(0.05) ----- 0.54  
 Interaction(main plot × sub plot) ----- 1.01

Lys: lysine, His: histidine, Arg: arginine, Asp: aspartic acid, Thr: threonine, Ser: serine, Glu: glutamic acid, Pro: proline.

Table 6-2. Changes of free amino acids as affected by shading condition and organic matter application rates

Shading level	Application rate (per 10a)	Free amino acid content (mg/dry wt.)							
		Gly	Ala	Val	Met	Ile	Leu	Tyr	Phe
Non-shading	Native soil	1.18	1.88	1.43	0.44	1.11	1.08	0.58	1.97
	Organic matter 10 M/T	1.32	1.91	1.39	0.34	1.76	1.11	0.59	2.08
	Organic matter 30 M/T	1.39	1.94	1.55	0.38	1.32	1.33	0.68	2.18
	Mean	1.30	1.91	1.46	0.38	1.40	1.17	0.62	2.08
Shading 55%	Native soil	1.16	1.76	1.11	0.10	1.01	1.04	0.57	2.00
	Organic matter 10 M/T	1.19	1.77	1.11	0.18	1.00	1.00	0.58	2.10
	Organic matter 30 M/T	1.20	1.98	1.17	0.23	1.05	1.05	0.55	2.22
	Mean	1.18	1.84	1.13	0.17	1.02	1.03	0.57	2.11

Gly: glycine, Ala: alanine, Val: valine, Met: methionine, Ile: isoleucine, Leu: leucine, Tyr: tyrosine, Phe: phenylalanine.

Table 7. Changes of essential oils as affected by shading condition and organic matter application rates

Peak no.	Constituents	Non-shading			Shading 55%		
		native soil	organic matter 10M/T	organic matter 30M/T	native soil	organic matter 10M/T	organic matter 30M/T
1	2-pentanol	0.04	0.06	0.05	0.16	0.02	1.05
2	Isomyl alcohol	0.07	0.05	0.06	0.18	0.06	0.09
3	2-amyl furan	0.06	0.06	0.02	0.05	0.06	0.13
4	Trans-2-hexenol	0.07	0.83	4.37	1.72	1.46	5.44
5	Amyl alcohol	0.15	0.21	0.15	0.11	0.16	0.34
6	3-octanone	0.01	-	-	0.02	-	-
7	Methyl hexyl ketone	-	-	-	0.05	-	0.05
8	2-penten-1-ol	0.34	0.13	0.21	0.26	0.30	0.56
9	Methyl hexetenone	0.12	0.02	-	0.02	0.11	-
10	1-hexanol	64.6	17.2	20.9	45.9	53.2	71.6
11	Cis-3-hexanol	25.2	7.84	15.6	27.3	32.7	44.5
12	Trans-2-hexanol	89.7	0.12	42.6	62.5	76.4	150.9
13	3-methoxy isopropyl pyrazine	0.14	0.12	0.04	0.05	0.12	1.14
14	2-octanol	0.12	0.21	0.14	0.04	0.13	0.20
15	1-octen-3-ol	0.31	0.75	0.13	3.12	-	0.49
16	Acetic acid	0.21	0.03	0.02	0.12	0.21	0.18
17	Furfural	0.12	0.03	0.24	0.22	0.18	0.04
18	Benzaldehyde	0.04	-	0.01	0.02	0.06	-
19	Linalool	0.14	0.07	-	0.11	0.04	0.35
20	Cedrene	0.17	0.74	0.03	0.10	0.23	0.47
21	α-guaiene	0.06	0.23	0.11	0.12	0.07	0.10
22	Caryophyllene	0.18	1.11	0.07	0.12	0.22	0.68
23	Widdrene	0.12	1.67	-	0.09	0.11	2.95
24	ε-menthol	0.28	1.71	0.29	0.16	0.51	0.85
25	Phenyl acetic aldehyde	1.34	2.31	0.46	1.04	1.18	1.18
26	δ-guajone	0.10	0.19	0.11	0.17	0.04	0.10
27	Methyl salicylate	0.10	0.06	0.03	0.03	0.11	0.09
28	2,4-decadienal	0.22	0.54	0.03	0.20	0.27	0.33
29	Geraniol	0.09	0.42	0.05	0.13	0.14	0.20
30	Benzyl alcohol	0.16	0.52	0.03	0.20	0.24	0.31
31	BHT	1.26	2.62	0.34	1.74	1.15	1.97
32	Phenyl ethyl alcohol	0.10	0.65	0.12	0.13	0.09	0.14
33	Organic aldehyde	0.06	0.04	0.07	0.03	0.03	0.03
34	α-cedral	0.22	6.79	0.12	0.17	0.17	3.26
35	Eugenol	0.03	0.17	0.09	0.03	0.04	0.05
36	Patchouli alcohol	0.28	0.78	0.12	0.21	0.18	0.36
37	2-methoxy-4-vinyl phenol	0.11	0.34	0.04	0.16	0.18	0.36
38	α-hexyl cinnamic aldehyde	0.11	0.27	0.17	0.15	0.03	0.12
39	Diethyl phthalate	0.07	0.51	0.10	0.08	0.02	0.10
40	Octobutyl phthalate	0.11	0.50	0.24	0.15	0.14	0.24
41	Myristic acid	0.20	0.75	0.06	0.42	0.28	0.43
42	Dibutyl phthalate	0.04	0.40	0.07	0.24	-	0.05
43	Benzyl salicylate	0.11	-	0.10	0.13	-	0.09
44	Palmitic acid	1.35	9.95	0.27	2.14	1.66	3.04