

On the Budget of Mineral Nutrients of Ginseng Plant

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Abstract

Mineral contents of soil in two-year-old ginseng plantation, of the top-dressings for ginseng and of the green grasses (Chung-Cho) were analyzed in order to clarify budget of inorganic nutrients of ginseng plant. The amount of mineral nutrients contained in soil of two-year-old ginseng plantation had 36 times of nitrogen, 1.2 times of phosphorus and 20 times of potassium as compared with the requisition of two- to six-year-old ginseng plants per m². In consideration of the lack of phosphorus, it is recommendable to use bone mill as top dressing, which contains higher content of phosphorus than other top-dressings.

In the previous paper¹⁴⁾ studies were made on seasonal uptake of mineral nutrients and dry matter production with four-year-old ginseng plant. The mineral nutrients supplied to ginseng plantation were gradually decreased with time elapsed. The rate of decreasing was greater in chemical fertilizer than in Yacto. The amount of manure applied in the current year and growth in dry weight of ginseng plant were no significant difference among fertilizer levels. The amounts of mineral nutrients per unit dry weight were directly proportional to the amounts of supplied with chemical fertilizer at early period of growing season but with Yacto at the late of seasonal changes of total nitrogen(T-N), available phosphorus(A-P) and potassium(K) contents per unit dry weight in each organ were high in the middle of May, but, decreased steeply in the middle of June, thereafter slowly decreased in leaves and stems but gradually increased in roots. The mineral nutrients were translocated into aerial organs from roots during early growing period, however, the absorbed mineral nutrients were stored in root after the growth of aerial organs. The requisition of mineral nutrient of ginseng plant were 8.3~9.9 kg of T-N 1.2~1.5 kg of P and 6.4~7.9 kg of K per 10 a for five years.

This paper was to deal with budget of the mineral nutrients of ginseng plant deduced from the components of soil in two-year-old ginseng plantation, of green

grasses(Chung-Cho) which generally was utilized as basic compost and of top-dressing which is additional fertilizers.

Material and Method

Materials used here were top-dressings, green grasses and soil of two-year-old plantation. The top dressings collected just before it were used a manures for ginseng in the early in May. The green grasses which species were most frequently used as the soil basic compost and/or as raw material of a component of Yacto by cultivators were harvested in the early of June. Soil samples collected from the main production of localities in which 2-year-old plantation were sampled at 5-10 cm depth in the early of May. The top-dressing and the green grasses dried at 80°C, powdered and stored for chemical analysis. Soil sample dried in air, sieved with 2 mm sieve and used for analytical works. Chemical analyses were the same as the methods in previous paper¹⁴⁾.

Results

1. The Nutrients Content in Chung-Cho(green grasses)

Table I showed the contents of inorganic components obtained from 15 species of green grasses, which have been used in purpose to use top-dressing, to improve the soil quality and to a basic compost of ginseng plantation. There were diverse variations of the amounts of inorganic components in the different plant species, *i. e.*, the herbs tended to have higher contents of inorganic elements than the trees and shrubs. It is a common that 5 kg (range of 3-18kg) of fresh green grasses usually applied to ginseng plantation per 3.3m² ^{7,8)}. As 5 kg of fresh green grasses are corresponds to 2 kg of dry grasses if this converts to mean value in Tabel I, the content of N, P and K are 40g, 3.34g and 25g per 2kg dry weight grasses, respectively.

As 1,500kg of green grasses (600kg of dry weight equivalent) was applied to 10 a for the prearrangement soils, for ginseng plantation it could be calculated as 12 kg of N, 1 kg of P and 7.5 kg of K were supplied.

2. Fertility of Soils in Two-year-old Ginseng Plantation

Table II showed the chemical properties of soils collected from at 52 samples of two-year-old ginseng plantation at the chief producing places. The amounts of each components were various in each production place and the range between the amount of maximum and minimum also was wide. The average values of components consisted of 102.54 mg of T-N, 0.59 mg of A-P and 42.45 mg of K per 100g of dry soil. The T-N contents out of these results were similar to those of the prearrangement plantation for ginseng culture reported by Kim¹⁰⁾. The amounts of available soil

Table I. Nitrogen, phosphorus and potassium contents in several green grass plants, which mixed in soil and plowed down for preparation of the ginseng plantation(mg/g. dry wt.).

Species	Water content (%)	N	P	K	Date
Herb and Grass					
<i>Artemisia vulgaris</i> var. <i>indica</i> (쑥)	71.5	17.72	1.75	33.51	July 4
<i>Erigeron canadensis</i> (망초)	76.4	17.24	2.29	15.74	"
<i>Glycine soja</i> (콩)	80.5	38.28	2.75	21.83	Aug. 21
<i>Sophora angustifolia</i> (코삼)	70.8	30.28	1.38	11.68	July 4
<i>Miscanthus sinensis</i> (참억새)	72.8	11.48	1.25	21.83	"
<i>Arundinella hirta</i> (새)	66.5	8.28	0.89	13.20	"
Mean	61.2	20.55	1.72	19.63	"
Shrub and Tree					
<i>Stephanandra incisa</i> (국수나무)	64.5	14.32	1.09	13.71	July 4
<i>Spiraea prunifolia</i> (조팝나무)	61.8	19.88	2.60	16.25	"
<i>Securinega suffruticosa</i> (광대싸리)	68.5	29.12	2.42	20.31	"
<i>Lespedeza bicolor</i> (싸리)	68.6	24.96	1.43	32.00	"
<i>Quercus dentata</i> (떡갈나무)	60.2	22.28	1.20	10.15	"
<i>Quercus serrata</i> (졸참나무)	56.1	20.24	1.06	8.63	"
<i>Quercus acutissima</i> (상수리나무)	54.0	15.96	1.52	7.50	July 26
<i>Quercus acutissima</i> (상수리나무)	51.0	14.60	1.47	7.50	Aug. 26
<i>Corylus sieboldiana</i> (참깨암나무)	56.8	13.20	0.70	6.60	July 24
<i>Alnus hirsuta</i> (물오리나무)	60.0	21.48	2.15	7.80	July 26
<i>Alnus hirsuta</i> (물오리나무)	56.0	22.80	2.05	6.90	Aug. 26
Mean	59.8	19.84	1.61	12.49	
Total Mean	60.5	20.20	1.67	16.06	

Table II. Chemical properties of soil in two-year-old ginseng plantation from the chief producing district(mg/100g dry soil)

District	No. of samples	pH (range)	Loss in ignition	Chemical components		
				T-N (Range)	A-P (Range)	K (Range)
Pochoun(포천)	9	5.39 (4.6-6.4)	6.03	73.20 (48.00-116.00)	0.99 (0.07-2.36)	34.39 (24.40-49.70)
Kangwha(강화)	3	6.13 (5.1-7.2)	3.99	38.67 (28.00-44.00)	1.73 (0.91-1.21)	47.18 (22.50-82.50)
Kimpo(김포)	17	4.95 (4.3-6.2)	5.52	95.29 (24.00-180.00)	0.60 (0.17-1.10)	47.62 (23.45-65.65)
Gumsan(금산)	16	5.50 (4.7-6.5)	6.79	94.50 (44.00-116.00)	0.21 (0.08-0.65)	36.18 (20.65-61.90)
Pungi(풍기)	5	5.18 (4.9-5.6)	7.98	198.00 (172.00-236.00)	0.17 (0.14-0.19)	69.06 (52.50-86.50)
Chungbuk(충북)	2	5.25 (4.9-5.6)	5.93	160.00 (117.00-208.00)	1.28 (1.07-1.49)	31.90 (28.15-35.65)
Mean	52	5.29±0.65	6.04	102.54±52.47	0.59±0.67	42.45±18.47

per 10a of ginseng plantation, with which a ridge made up 84 cm wide, 27 or 30 cm height, 180 cm length per kan and with 2.404 of specific gravity of soil, were 294 or 327 ton/10a in case of 27 cm or 30 cm in ridge height, respectively. If convert the amounts of inorganic nutrients in soil of two-year-old ginseng plantation in Table II into the amount of nutrient of available soil per 10 a, they were 302~335kg of N, 1.74~1.93 kg of P and 125~139 kg of K in 27~30 cm of ridge height per 10a.

3. Chemical Constituents of Top-dressings

The contents of inorganic constituents of top-dressing materials used frequently by the cultivators were shown in Table III. The contents of T-N and K were contained as the highest value in dregs of sesame, soybean and costorbean, and P was also contained of the highest content in bone mill. The compost of an old wall composed mainly with clay and hay, which was known as a good top-dressing for ginseng plant from old times traditionally contained only a little for the components of three mineral elements.

Table III. The chemical components of Yacto and other composts for the ginseng growth (mg/g. d. matter)

Items	No. of sample	N	P	K
		mean±S.D(range)	mean±S.D(range)	mean±S.D(range)
Yacto (약토)	32	12.00±4.11 (3.80-21.51)	3.03±1.17 (1.05-6.74)	6.88±3.16 (2.38-13.64)
Poultry feces (계분)	11	14.47±5.52 (8.08-23.68)	25.40±8.47 (13.06-36.96)	8.68±5.53 (2.60-18.18)
Soybean (대두)	9	40.99±11.30 (27.56-62.36)	12.41±9.46 (5.33-28.92)	5.51±1.53 (3.55-52.08)
Compost of old wall(구벽토)*	8	30.10±20.10 (11.00-68.88)	0.01±0.01 (0.00-0.06)	10.50±4.20 (3.40-17.60)
Sesame, soybean dregs(깨묵)	8	48.63±12.24 (30.40-71.80)	10.20±5.17 (1.01-18.67)	48.30±43.78 (9.09-127.85)
Ashes (조목회 및 그레제)	5	14.31±15.85 (0.88-34.20)	3.19±1.40 (1.26-5.26)	4.75±0.83 (3.11-5.31)
Bone mill (골분)	2	28.80 (10.44-47.16)	54.30 (36.96-71.64)	6.51 (0.33-12.69)

*mg/10g. dry soil

Discussion

The foregoing data indicate that there are plenty of inorganic nutrients in soil of the ginseng plantation for ploughing with green grasses(Table II). Therefore, the amounts of top-dressings after the transplantation of two-year-old ginseng from nursery garden to main plantation can be estimated as follows:

$$S_t - D_t = S_{t+1}$$

$$S_{t+1} - D_{t+1} = S_{t+2}$$

Here, S_t and S_{t+1} are the contents of mineral nutrients of soils of ginseng plantations and D_t and D_{t+1} are the contents of the nutrients absorbed by the plant at t and $t+1$ years respectively. The top-dressings are not required in case of $S_{t+1} > D_{t+1}$, however, it is needed in case of $S_{t+1} \leq D_{t+1}$, and the amounts and applied period of top dressings must be determined.

On the basis of the results of this study, Table IV indicated for the required amounts of nutrients in two-to six-year-old ginseng plants (Fig. 12 in previous paper¹⁴⁾), for the amounts of the green grasses to be applied (Table I) and for the amounts of the nutrients in soil of two-year-old ginseng plantation (Table II),

It was revealed that contents of T-N, P and K in soil of six-year-old plantation have approximately 36.0, 1.2 and 20.0 times higher than for the required amounts of two-to six-year-old plants, respectively. Though the N nutrients in soil were gradually disappeared as the form of ammonia, N_2 or by leaching⁹⁾ and the K nutrient also did by leaching,¹⁵⁾ it could be thought that the loss of nutrients in soil under the shade roof of the plantation is not serious. Therefore, it is not necessary to make topdressing for N and K nutrients.

The top-dressings for P are not required because S_6 is always greater than D_6 until the time when six-year-old ginseng plant is harvested. However, the P contents in soil might be inactivated gradually. It was indicated that P nutrients supplied to soil was absorbed 12-30% and remains became insoluble.^{1,3,4)} The rate of unutilization of P component is decreased by increased organic matter, under conditions of low pH of soil and varies with changes of environmental conditions.³⁾ The pH of soil in ginseng plantation is to be low because it has much amount of the loss in ignition and do not neutralize with lime in soil so that the rate of utilization of P would be further low (Table II). Otherwise, the efficiency of P fertilizer is so slow and prolong that bone mill concentrated P content must be used to supplement the lack of phosphorus (Table III). Poultry feces having high concentrations of N and K as well as P would not be good, for it has been known that the excess of N and

Table IV. Budget of inorganic nutrients in ginseng plant (kg/10a).

	T-N	P	K
Components of soil in 2-year-old plantation	302-335	1.74-1.93	125-139
Necessary nutrients for 2~6 year-old plants	15.0-18.0	2.4-3.0	11.4-14.2
Components of green grass with 60% water			
5kg	12.0	1.0	7.5
10kg	24.0	2.0	15.0
15kg	36.0	3.0	22.5

K would inhibit the absorption of phosphorus.^{5,6,15)} Fig. 1 shows to summarize biomass,^{11,12,13)} and the content of uptake of N, P and K nutrients with aging¹⁴⁾ and its contents in soil in two-year-old ginseng plantation per m².

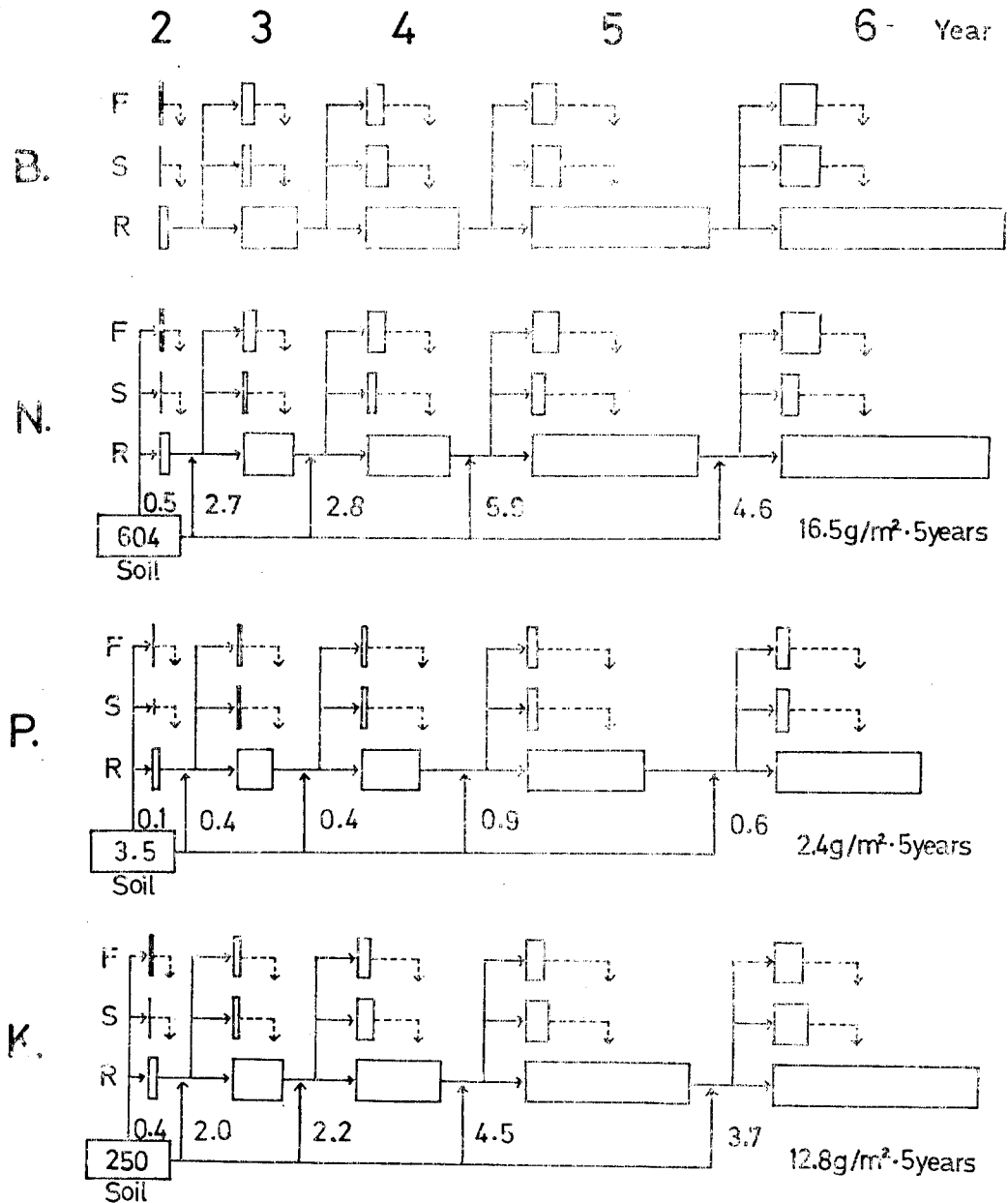


Fig. 1. Biomass, budget and uptake of inorganic nutrients with aging of ginseng plants.

B, N, P and K indicate biomass, nitrogen, phosphorus and potassium. Numerals in compartment above soil stand for the content of inorganic nutrient in soil in 2-year-old ginseng plantation, those by arrows for the amount of absorption in each year and those below of right side for total uptake of components for 5 years.

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인삼의 시비량의 수지에 관한 연구

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초 록

인삼의 2년생 포장의 토양 성분, 청초 성분 및 추비 원료를 분석하여 인삼의 무기염류 요구량과의 관계에서 추비의 시비 여부를 판정하는 기준을 시도하였다.

2~6년생 인삼 식물의 무기염류 흡수량은 칸당 32-42분식을 기준으로하여 질소 8.3~9.9 kg, 인산 1.2~1.5 kg 및 가리 6.4~7.9 kg/10 a이었다. 2년생 삼포의 토양 성분은 2~6년생 인삼의 요구량보다 질소는 36배, 인은 1.2배 및 가리는 20배나 많이 함유하고 있었다. 관용적 재배조건에서 질소와 가리는 2~6년생 인삼에 추비할 필요가 없는 것으로 판단되었지만, 인산은 2년생 포장의 함량이 적을뿐 아니라 흡수효율이 낮고, 인삼포에 유기질 함량이 많으며, 농용 석회로 토양의 산성도를 중화하지 못하는 인삼 재배의 특수성 때문에 인산 비료만은 추비할 것이 요구되었다. 인산의 추비원료로서 질소와 가리 성분이 비교적 적고 인산 성분이 많으며 지효성인 골분이 권장할 수 있는 추비로 기대되었다.