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EFFECT OF GIBBERELLIN ON THE GROWTH AND INTERNAL COMPONENTS OF SELECTED VEGETABLE PLANTS

CHA, Jong Whan

(Dept. of Biology, Coll. of Education, Seoul National Univ.)

車鍾煥 : 栽培植物의 生育 및 成分에 미치는 지베레린의 影響

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ABSTRACT

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The effect of GA on the growth as well as on the internal components of the leaves of ordinary vegetable plants under the soil culture was investigated. A relatively small difference in GA concentration applied showed a marked influence on the growth and constituents of the plants observed. The increase of growth was related to a highly significant digree with the intensity of GA. Chlorophyll and carotene content in the leaves were significantly with increasing concentration of GA, except for some plants. The growth in all examined plants did not correspond to the contents of chlorophyll and carotene. In contrast the ascorbic acid in the leaves treated with GA decreased in proportion to the GA concentrations. Chlorophyll and ascorbic acid values differed greatly during the two experiments and the difference was proved significant. Carotene content varied with chlorophyll although the ratio of chlorophyll to carotene was not so high as that obtained by Beck and Redman [3].

INTRODUCTION

Since the discoveery of gibberellin (GA*), it has been investigated with much interest in Japan and recently in the western countries, especially in America and England, as reviewed by Stowe & Yamaki [20]. Many earlier investigators have noted growth response, the leaf expansion, and dry weights of the bushy plants, dwalf plants, cotton and maize etc. [4][5][9] Many people have studied and are studying the flowering of plants[17][23] but this experiment is going to take a differentent sample for study. This present study is carried on to discover any possible responses to GA in growth and internal components in the six major vegetables grown in Korea.

MATERIALS AND METHODS

On May 19, August 22, and September 22, 1959, seeds were planted for the third time in pots filled with loam. After germination the seedlings were thinned, leaving 12 uniform seedlings in each pot.

*The abbreviaton GA will be used in this paper. Gibberellin was kindly supplied by the Kyowa Fermentaion Industries, Tokyo.

The vegetable plants of Korean Radish (*Raphans Sativa* L. var *viviparumm* Ragel), Korean Cabbage (*Brassica Campestris* L.) Seoul Lettuce(*Lactuca Scariola* L. var *sativa* Bisch), Beet Green(*Beta vulgaris*), *Chrysanthemum coronarium* L. var *spationm* Bailey (Chrysan.) and Seoul spinach (*Spinacia olracea* L.) were used as the experimental plants.

A week after germination the soil was fertilized with 60 kg. of N, 20 kg. of K, 20 kg. of P in the form of potassium, calcium nitrate and superphosophate per hectare respectively. A week after application of the fertilizers, the seedlings of each pot were treated with GA four times once every four days, spraying sufficient amount on all leaves. The concentrations of GA applied were: 0 (control), 0.1, 1, 5, 10, 50, 100, 200 ppm respectively. One day after the last treatment the plants were sampled for analysis. The pH-value of the soil solution indicated 6.0-6.4.

The second experiment which all procedures were the same as in the first experiment, was performed 2 weeks after the first. A part of the plants was harvested from each series for determination of the fresh and dry weights and leaf-area. The stomata cells were measured on the adult leaves. The growth rate was also measured once a week and the flowering was observed in the remaining plants and many other chrysanthemums, handling with GA five times at intervals of one week. The ascorbic acid was determined with 2-4 Dinitrophenylhydrazine method according to Roe as modified by Choi [6]. For the ascorbic acid detemination, one leaf was taken from one of the plants in each level, and then the leaves were divided longitudinally into halves avoiding the midrib, and weighed. For the chlorophyll estimation, six smaples were taken from leaves in each series by a cork borer and then the fresh weight was determined before extraction. The method used for extraction of chlorophyll was based on that of Willstäter and Stoll as modified by Scherts. The total chlorophyll was separated from the carotinoid pigments but no attempt was made to seperate either chlorophyll A from chlorophyll B or carotene form Xanthophyll.

EXPERIMENTAL RESULTS

I. Growth.

Height. The height was measured periodically once a week. The following is a part of the measurements. The results seen on Fig. 1 were measured one day before the second experiment. Plants of each series grew equally and as the concentration increased, lettuce and chrysan. grew well. In the stage of 200 ppm, the edge of the leaves was burned and dried up. Although no leaves of cabbage wilted, they were considerably discoloured. In other words, chlorosis was observed unmistakably. Although the concentration was less than 200 ppm, the lettuce plants grew so quickly that they could not stand erect. Fig. 1 represents the relationship between growth and the GA concentrations in terms of regression line. The general tendency is thus easily seen. In root growth, no effect of GA was observed.

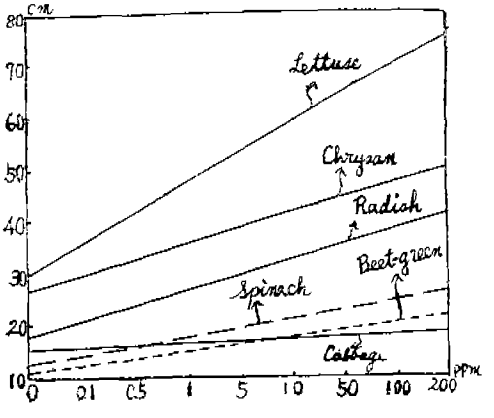

Fig 1. Effect of concention of the gibberellin in soil culture on the growth of six vegetable crops.

Fresh and dry weights. The determination of fresh and dry weights was restricted to the aerial parts of the plants only. The Fig. 2 showed the general tendency in fresh and dry weights, indicated almost the

same in comparison, and as the concentration became higher, dry and fresh weights increased remarkably in lettuce. It was found that the height, and fresh and dry weights were in this case increased, as was reported by Brian et al[4]. Similar results were obtained by Wittwer, Bukovac[23], and Kline[16].

The leaf-area. In the leaf-area, spinach changed most markedly according to various concentrations of GA, and lettuce, radish, beet green, and cabbage changed very little. The higher the concentration, the narrower became the leaf-area. Especially lettuce and chrysan, changed so much that they could easily be seen to the naked eyes. The above result coincide with those of Ergle[9], Witter & Bukovac[23].

Size of stomata cell. As observed in table 2, the plants receiving GA increaesed the size of stomata cell compared with those of control. The radish increased it more notably than the lettuce and cabbage. The above results were almost the same as Hayashi et al[10].

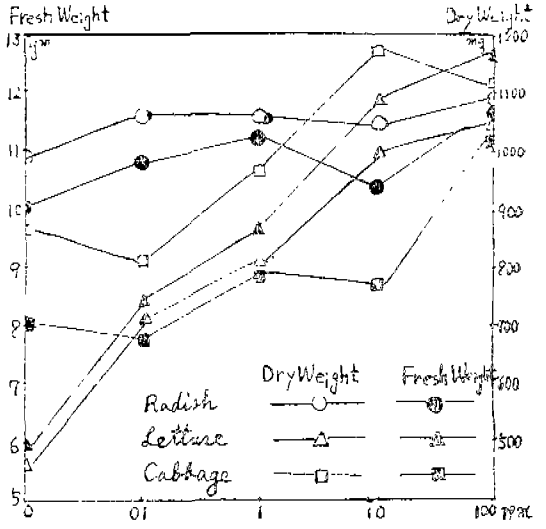

Fig 2 Effect of concentrations of gibberellin in soil culture on the dry and fresh weights of three vegetable crop plants.

Table 1. Effect of concentrations of the gibberellin in soil culture on the leaf-area of five vegetable plants.

(m²/one plant)

Species / Concent	Lettuce		Cabbage		Radish		Spinach		Beet Green	
Cont	7201	100%	14980	100%	9390	100%	1184	100%	1494	100%
0.1 ppm	7900	109	14646	99	9142	98	1300	109	1646	110
0.5 〃	9736	135	15272	102	9462	101	1702	143	1448	100
1 〃	14992	208	15610	104	9302	99	2260	198	1676	112
5 〃	15624	217	17482	116	9872	105	2556	216	1616	108
10 〃	18974	263	19412	129	15198	161	3356	283	2042	136
50 〃	14928	207	17292	115	12428	132	3465	292	2192	146
100 〃	12166	168	16398	112	17216	183	3565	301	2342	157
200 〃	18728	260	18624	124	19632	209	3628	305	2752	184

Table 2. Effect of concentration of the gibberellin in soil culture on the stomata cell of three vegetable crop plants (unit: μ)

Species / Cocent	Lettuce	Cabbage	Radish
0	26.4	19.8	19.8
0.1 ppm	33.0	22.4	28.7
1 〃	33.7	23.1	29.7
10 〃	33.0	23.1	29.4
100 〃	35.3	24.1	30.4

Flowering. As a part of this experiment the flowering was observed. In chrysan., receiving less than 200ppm GA, the flowering occured two or three days later than the rest. Furthermore the flowering was promoted in radish and lettuce, as observed in table 3. The lettuce receiving more than 100 ppm fell down without flowering because of over growth. For the reason of accelerated flowerings, Witter et al[25] stated that the bean, tomato, lettuce were over grown by GA. Chyrsanthemun does not show large effects in this respect.

II. Internal components.

Vitamin C. The content of ascorbic acid of plants in this experiment was also reduced with the increasing GA concentration. The ascorbic acid in reduced form also showed the same result as total

Table 3. Flowering phenomena of radish and lettuce to different treatments of gibberellin in soil culture.

Specis	Radish		Lettuce	
Concent	Days to flowering from sowing	Days of promotion	Days flowering from sowing	Days of promotion
0	74	0	78	0
0.1 ppm	72	2	74	4
1 〃	60	14	71	7
10 〃	48	26	70	8
100 〃	46	28	—	—

ascorbic acid (Table 5). Keller & Minot[14] found that in ten samples of fresh turnips the Vitamin C content varied from 75-160 mg per 100g fresh weight. The results of this experiment showed approximately the same. Vitamin C in beet green and chrysan, showed a little larger content than that of Choi's result[7].

Table 4. Effcet of concentrations of the gibberellin in soil culture on the content of total ascorbic acid (in mg/100g fresh weight) of vegetable plants.

	Species Concent	Radish	Cabbage	Lettuce	Chrysan.	Spinach	Beet Green
1st	Cont.	142.09	102.40	40.02	39.24	173.26	38.47
	0.1 ppm	150.24	100.12	41.52	37.46	172.26	38.31
	0.5 〃	154.02	101.42	39.85	36.71	173.48	37.24
	1 〃	140.04	98.23	35.54	39.14	170.42	35.36
	5 〃	142.10	84.03	39.22	34.74	172.62	36.49
	10 〃	132.32	85.02	36.12	36.33	172.42	34.40
	50 〃	139.09	96.46	32.23	35.66	140.32	35.00
	100 〃	129.28	67.32	37.71	33.71	132.62	34.40
	200 〃	130.24	73.74	34.73	32.61	142.01	34.46

	Species Concent	Radish	Cabbage	Lettuce	Chrysan.
2nd	Cont.	158.08	105.31	49.12	42.92
	0.1 ppm	156.47	107.65	50.52	35.69
	0.5 〃	150.49	94.36	45.61	40.32
	1 〃	135.39	106.66	46.54	37.18
	5 〃	153.94	96.21	45.22	34.79
	10 〃	150.62	99.31	43.12	37.73
	50 〃	151.48	90.21	47.52	35.83
	100 〃	150.36	91.86	44.71	33.77
	200 〃	142.10	83.05	40.83	32.70

Table 5. Effect of concentrations of the gibberellin in the soil culture on the ascorbic acid contents of reduced form (in mg/100g fresh weight) of vegetable plants.

	Species Concent	Radish	Cabbage	Lettuce	Chrysan	Spinach	Beet Green
1st	Cont.	45.42	37.23	20.30	17.24	92.67	19.12
	0.1 ppm	49.12	36.41	19.46	24.46	96.72	13.46
	0.5 〃	52.97	34.73	13.95	15.22	94.92	24.36
	1 〃	34.64	36.71	24.64	22.16	89.42	21.07
	5 〃	29.25	30.42	22.14	16.09	89.48	13.18
	10 〃	48.49	41.36	15.21	12.74	40.92	21.36
	50 〃	28.56	27.90	9.46	11.48	68.76	14.62
	100 〃	27.10	32.42	14.36	10.16	67.96	14.09
	200 〃	40.80	22.50	11.60	15.10	49.42	9.74

	Species / Concent	Radish	Cabbage	Lottuco	Chrysan
	Cont.	48.51	43.45	18.24	21.82
	0.1 ppm	42.41	39.94	18.19	19.64
	0.5 〃	39.42	46.62	19.71	18.37
2nd	1 〃	47.50	29.53	20.02	20.05
	5 〃	40.32	28.72	16.92	17.62
	10 〃	40.13	38.36	16.70	14.98
	50 〃	34.26	37.48	15.06	10.72
	100 〃	38.94	42.05	14.20	16.46
	200 〃	32.32	32.02	14.61	12.23

It was also noticed that the ascorbic acid content increased with the growth of the plants. That is to say, the ascorbic acid content was reduced in the order spinach, radish, and cabbage. In the second experiment quantitative analysis of the ascorbic acid content was not made for spinach and beet green.

Chlorophyll. The chlorophyll content in plants is given in milligrams for fresh weight and per square centiometer of surface area. Regardless of the kinds of vegetable plants the content of chlorophyll decreased despite the treatments with different concentration of GA. But the amount of chlorophyll in the plants in the first experimental was found considerably higher than that of the second experimental series (Table 6). The difference between species was examined in the first experiment. The results: lettuce has the greatest content of chlorophyll followed by spinach, radish, beet green, and chrysan. The chlorosis was observed in cabbage. In the second experiment the chlorophyll content was found highest in chrysan and lettuce, while cabbage and radish contain the least (Table 6). The linear growth was promoted by GA treatment, but this has nothing to do with photosynthesis of chlorophyyll.

Table 6. Effect of concentrations of gibberellin in soil culture on the content of chlorophyll of six vegetable plants.

	Species / Unit / Concent	Radish mg/100g fresh weight	Radish mg/100 cm²	Cabbage mg/100g fresh weight	Cabbage mg/100 cm²	Lettuce mg/100g fresh weight	Lettuce mg/100 cm²
	Cont.	180.11	10.58	148.99	8.40	196.49	5.60
	0.1 ppm	166.75	9.68	140.18	7.94	186.49	5.26
	0.5 〃	164.25	9.86	144.41	9.02	190.97	5.48
1st	1 〃	186.83	11.74	134.85	7.14	190.77	5.44
	5 〃	160.17	9.64	118.74	7.08	178.42	5.16
	10 〃	150.10	8.52	118.71	7.06	160.65	4.56
	50 〃	148.40	8.80	116.29	6.68	166.26	4.82
	100 〃	148.47	8.82	124.81	7.12	160.82	4.56
	200 〃	150.23	8.36	114.62	7.00	164.42	4.68
	Cont.	120.14	7.78	128.88	6.98	116.39	4.28
	0.1 ppm	104.06	7.44	96.87	6.72	132.73	3.92
	0.5 〃	98.82	6.86	98.82	6.76	126.27	3.72
2nd	1 〃	98.61	6.72	98.48	6.84	140.59	4.18
	5 〃	100.24	7.40	100.43	7.16	136.39	4.12
	10 〃	102.18	7.40	98.78	6.72	136.37	4.08
	50 〃	94.32	6.56	98.29	6.52	130.29	4.00
	100 〃	106.83	7.72	94.43	6.62	128.07	3.64
	200 〃	96.24	6.62	92.32	6.54	132.02	3.94

	Species / Unit / Concent	Chrysan mg/100g fresh weight	Chrysan mg/100 cm²	Spinach mg/100g fresh weight	Spinach mg/100 cm²	Beat Green mg/100g fresh weight	Beat Green mg/100 cm²
	Cont	164.42	—	198.29	13.34	174.42	10.32
	0.1 ppm	166.25	—	190.25	13.34	178.43	10.48
1st	0.5 〃	166.15	—	192.12	13.66	170.62	10.24
	1 〃	162.42	—	178.42	11.84	158.76	9.44

	5 〃	144.29	—	174.92	11.34	144.32	8.08
	10 〃	140.67	—	178.42	10.60	140.42	7.96
	50 〃	136.63	—	180.08	11.92	134.24	7.48
	100 〃	140.26	—	156.32	10.50	124.54	6.78
	200 〃	130.12	—	158.32	10.52	132.15	7.24
	Cont	158.34	—	—	—	—	—
	0.1 ppm	150.92	—	—	—	—	—
	0.5 〃	160.23	—	—	—	—	—
	1 〃	150.18	—	—	—	—	—
	5 〃	140.62	—	—	—	—	—
2nd	10 〃	120.62	—	—	—	—	—
	50 〃	142.25	—	—	—	—	—
	100 〃	118.42	—	—	—	—	—
	200 〃	104.42	—	—	—	—	—

Carotene. The carotene content of the plants grown under various treatments varied remarkably. As the concentration of GA was increased, there was a reduction of carotene content. Carotene was higher in the plant of the first experimental series than in those of the second experimental series in all vegetables tested. Table 6 and Table 7 also shows that there was always considerably more chlorophyll present than carotene. Delcano[8] and other investigators found that variations of the carotene content in willow and soy bean correspond to the variation of chlorophyll content. And consequently the ratio of yellow and green pigments remains constant. According to Beck and Redman[3] the content of chlorophyll on the average was 36.5 times greater that of carotene. In this study, however, the result shows no similar relationship, but the content of chlorophyll on the average was only about 4.7 times greater than carotene. In fact little difference was noted between contents of chlorophyll and carotene. The comparisons did show, however, that the distribution of carotene paralleled with that of the chlorophyll.

Table 7. Effect of concentions of the gibberellin in soil culture on the content of carotene of six vegetable plants.

Species		Radish		Cabbage		Lettuce	
Unit Concent		mg/100g fresh weight	mg/100 cm²	mg/100g fresh weight	mg/100 cm²	mg/100g fresh weight	mg/100 cm²
	Cont.	34.89	2.04	30.52	1.69	30.70	0.87
	0.1 ppm	29.60	1.69	28.25	1.52	29.60	0.84
	0.5 〃	31.28	1.85	28.74	1.58	27.62	0.79
	1 〃	32.56	2.03	25.62	1.48	28.17	0.77
1st	5 〃	30.39	1.83	24.42	1.35	26.42	0.75
	10 〃	30.52	1.66	22.20	1.30	25.90	0.74
	50 〃	27.25	1.60	22.92	1.32	24.32	0.70
	100 〃	28.73	1.68	23.90	1.48	25.13	0.73
	200 〃	29.77	1.78	23.82	1.40	25.13	0.74
	Cont.	28.40	1.82	31.25	2.26	30.12	0.88
	0.1 ppm	31.40	2.09	28.40	2.02	30.06	0.88
	0.5 〃	29.32	1.94	28.02	1.84	25.77	0.90
	1 〃	27.13	1.82	23.02	1.72	29.77	0.82
2nd	5 〃	26.84	1.94	20.91	1.77	20.22	0.86
	10 〃	30.67	2.04	20.85	1.69	23.70	0.84
	50 〃	26.17	1.86	26.42	1.76	24.08	0.84
	100 〃	27.85	2.02	19.00	1.52	22.18	0.86
	200 〃	26.18	1.74	23.82	1.74	20.32	0.83

	Species	Chrysan		Spinach		Beet green	
	Unit Concent	mg/100g fresh weight	mg/100 cm²	mg/100g fresh weight	mg/100 cm²	mg/100g fresh weight	mg/100 cm²
1st	Cont.	32.49	—	30.62	2.16	32.26	1.85
	0.1 ppm	33.23	—	32.06	2.25	32.72	1.89
	0.5 〃	31.52	—	33.00	2.34	26.13	1.51
	1 〃	30.68	—	26.24	1.87	27.39	1.61
	5 〃	30.17	—	27.22	1.60	26.56	1.47
	10 〃	29.25	—	29.62	1.96	29.63	1.69
	50 〃	27.37	—	25.48	1.68	28.43	1.51
	100 〃	29.49	—	26.89	1.76	24.50	1.34
	200 〃	24.75	—	29.74	1.81	26.29	1.43
2nd	Cont.	24.22	—	—	—	—	—
	0.1 ppm	22.98	—	—	—	—	—
	0.5 〃	27.26	—	—	—	—	—
	1 〃	28.08	—	—	—	—	—
	5 〃	20.09	—	—	—	—	—
	10 〃	19.83	—	—	—	—	—
	50 〃	20.54	—	—	—	—	—
	100 〃	21.22	—	—	—	—	—
	200 〃	19.92	—	—	—	—	—

Table 8. Variance ratio on various components of six vegetable plants to different treatment of gibberellin.

Dependent Variable Component	Species	$\Sigma(y^2)t$	$\Sigma(y^2)c$	$\Sigma(y^2)h$	$\Sigma(y^2)e$
Total Vitamin C	Radish	1407	** 20.13	** 105.0	4.13
	Cabbage	2117	* 4.00	5.00	47.00
	Lettuce	490	2.50	** 62.00	5.37
	Chrysan	134	** 7.00	2.00	2.12
	Spinach	4685	** 50.30	—	11.3
	Beet green	134	* 3.97	—	1.21
Rediuced form Vitamin C	Radish	1002	1.50	0.08	49.00
	Cabbage	667	1.26	3.69	23.21
	Lettuce	250	2.67	0.01	8.50
	Chrysan	291	** 7.21	4.28	4.25
	Spinach	6729	**350.00	—	1.33
	Beet green	342	2.08	—	13.85
Dependent Variable Component	Species				
Chlorophyll	Radish	18276	2.17	** 212.0	77.0
	Cabbage	5843	* 4.80	** 95.0	42.3
	Lettuce	11562	0.70	** 70.0	134.5
	Chrysan	5148	** 6.64	* 7.40	75.5
	Spinach	4220	**262.0	—	1.5
	Beet green	6637	**667.0	—	1.4
Carotene	Radish	758	** 6.33	4.17	12.25
	Cabbage	216	** 7.00	1.00	3.25
	Lettuce	178	* 5.30	4.24	3.25
	Chrysan	3433	2.82	1.57	107.13
	Spinach	688.1	3.12	—	4.43
	Beet groon	164.5	**13.5	—	1.38

**Sign'ficant at the 1% level *Significant at the 5% level

DISCUSSION

The data presented in the preceding sections shows that little variation of concentrations of the GA sprayed on the leaves of six vegetable plants tended to reduce the amounts of chlorophyll, carotene, and ascorbic acid. The effects of vegetative growth indicated a rapid, often remarkable, lengthening of the stems or internodes and an increase in height. Namely, it is noticed that there was an antagonizing effect between growth rate and the variations of the internal components. The promotion of growth rate shows surely in the lettuce, the chrysan, and the radishes. The rate of increase in the linear growth, the fresh and dry weights, and the leaf-area shows approximate coincidence. The increase of growth is attributable to the elongation of the cells. But the results of this experiments did not indicate any clear propotional relationship between the rate of growth and the variations of the contents of chlorophyll and carotenoid pigments in the six vegetable plants. Such results seem highly illogical, since as mentioned by Beck and Redman, all energy involved in growth processes is thought to enter the plants though the catalytic activity of chlorophyll. Carotene serves directly or indirectly as a growth promoter. These experiments show that the chlorophyll reduction is probably due to other chemical effects of GA and have no connection with accelerating the nutrition and metabolism of plants. Namely the rate of growth was increased by treatment of GA, but chlorophyll was decreased. These results indicate no relationship between elongation of cells and photosynthesis depending on chlorophyll. In order to evalute quantitatively the interrelationships among the internal components, the data obtained in these experiments was treated statistically by analysis of variance to reach the general conclusion.

(1) $\Sigma(y^2)t$: Sum of squares on degrees of freedom 17.

(2) $\Sigma(y^2)c$: Ratio of variance on degree of freedom 8 of GA concenrations.

(3) $\Sigma(y^2)h$: Ratio of varince on degree of freedom 1 of the period on sample collection.

(4) $\Sigma(y^2)e$: Variance of error on degree of freedom 8.

The statistics show that the variations of the chlorophyll in six plants were directly related to the levels of data of first and second expermints to a remarkable high degree, although no significant differences were evident between the concentrations. Yabuta, Simiki, Fukunaga, and Horiuchi[24] also recognized the fact that GA treatments decrease the chlorophyll content in plants, as in this experiment. It was also noticed that the relation of chlorophyll content in the six crop plants to the concentration of the GA becomes more pronounced as time lapsed.

According to Sideris and Young[19] the content of chlorophyll in the leaves of *Ananas comosus* decreases gradually as the growing period ends. This is in agreement with the belief that conditions reducing the development of chlorophyll are concomitant with the senility of leaves. Carotene content in the leaves of the six plants treated with GA varies in accordance with that of chlorophyll. The GA treatments have a direct effect on carotene in the six plants. Berstein et al[2] recognized a similar effect to this experiment when they found, that, although the leaves of different ages had nearly the same carotene concentration, it was somewhat lower in old leaves than in the younger ones. Delcano and Dick[3] also observed that there was no difference in the content of carotene between green, and yellow leaves of willow. The data obtained in these experiments may indicate that there would be a high degree of contrary between growth rate and the contents of chlorophyll and carotene, since the status of chlorophyll and carotene contents, can not solely be a main factor regulating growth of these plants. Radish, cabbage, chrysan, beet green and spinach grown in soil showed that GA treatments inflenced total ascorbic acid content to a high degree of significance. In the lettuce, however, no signi-

ficant differences were evident, in spite of the fact that the GA treatment had an effect upon the growth. In radish and lettuce it was observed that the ascorbic acid content increased significantly as the plants grew. Sideris and Young[19] stated in their investigations that ascorbic acid content was not directly proportional to that of chlorophyll in the leaves of *Ananas comusus*, although its occurrence was almost limited to the chlorophylous section of the leaves. Bernstein, Hamner and Parks[2] stated that average ascorbic acid values differed greatly in accordance with the various stages of growth. The differences in the amount of ascorbic acid observed between the first and second experiments may be explained by the fact that ascorbic acid is produced mostly in vigorous leaves than in immature ones. The patterns of distribution of ascorbic acid in leaves of six vegetable plants suggest that certain phases of metabolism rather than amounts of chlorophyll in these tissues were responsible for their ascorbic acid content. As the results was observed by Ergle[19], the constituents of plant body and its dry weight does not correspond to the growth of the plants. Wittwer et al[22] found that, although dry matter and inorganic constituents changed little in quantity, the GA treatment was found to promote the growth, as in Kentucky Bluegrass.

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摘 要

本實驗에서는 Gibberellin이 여섯作物의 生育 및 그들의 成分에 미치는 영향을 土壤栽培를 通하여 調査하였다. 植物 잎에 撒布한 Gibberellins의 比較的 적은 濃度差는 植物의 生育 및 內部 成分에 현저한 差異를 가져오는 것을 알수 있다. 濃度가 높아 짐에 따라 作物의 生育은 촉진되고 그 生育間의 差異는 有意하였다. 여섯 作物의 Chlorophyll 및 Corotene 含量은 Gibberellin의 濃度에 比例하여 감소 되었으며 이는 生長率과 크게 相反되었다. 여섯 作物의 Vitamin C의 含量은 Gibberellin의 濃度에 比例하여 감소되었다. 이 差는 무, 쑥갓 및 시금치에서 높은 有意性을 나타냈다. Chlorophyll과 Vitamin C의 含量은 發育이 진전 됨에 따라 달라지는데 이 差異는 有意한 것이다. Corotene 含量은 Chlorophyll量과 함께 變하였는데 Carotene과 Chlorophyll의 比는 Beck 및 Redman이 얻은 結果처럼 높은 것은 아니다.

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