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Studies on the Acceleration of Germination in Carrot Seed (II)

Effects of X-ray and Ultraviolet light in the Germination of Carrot Seed

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당근種子 發芽促進에 관한 研究 (第2報)

당근종자 발아에 미치는 X-ray, Ultraviolet Light 의 영향

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ABSTRACT

The treatment of X-ray was manipulated with the large focus of X-ray which was produced the capacity of 90 kilovoltage and 30 milliamphere in the distance of 50 centimeter. The germination of each group irradiated with X-ray for 5, 6, and 7 seconds was more delayed in the growth of carrot seed than those of the control group. However the germination of each group irradiated with X-ray for 2, 3, and 4 seconds was rather accelerated than those of the control group.

The irradiation of ultraviolet light was carried out in the distance of 20 centimeter by Toshiba germidical lamp which appeared the wavelength of 2537 A°. The germination of each group irradiated with ultraviolet light for 9, 15, 20, and 40 minutes was more delayed than those of the control group, but the germination of carrot seed was accelerated by adequate dosage of ultraviolet light.

Consequently it was suggested for the author that the inhibited substance contained in carrot seed would be certain fatty substance, because the germination of carrot seed was more accelerated by the treatment of acetone than those of X-ray and ultraviolet light.

INTRODUCTION

It has been currently studied on the effects of radiation influenced on the living things by many works. The radiant energy in a living thing gives rise to various chemical changes by the excited energy of radioactivity. Besides, it induces the atom, radical and molecule of metabolic substance which consist of the most important factor of a living thing. The function arised from the radiant energy in a living thing much complex. The effects which appeared in some living things with the irradiation of X-ray and gamma ray were reported by some workers. Rubenfeld (1962), Harber (1961) and Williamt *et al.* (1961) investigated on the function of gamma ray, and Isayev (1961) reported on the biological influence which appeared by neutron irradiation.

Although there have been reported some studies on the effects of radiation in plant organ, relatively little is known concerning effects of X-ray and ultraviolet light in germination of carrot seed. On the other hand, in the course of studies on the acceleration of seed germination, we have frequently been faced with the problem of irradiation which the plant growth can be accelerated by a low dosage of radiation. For this reason, the author made an effort to experiment on the acceleration of germination in carrot seed.

MATERIALS AND METHODS

The seeds of *Daucus carota* Linne imported from Japan were used in these experiments. The methods used here were similar to those described for *Nasturtium* seed by Fujii and Ishikawa (1962). 100 seeds were used for each treatment of X-ray, ultraviolet light, and acetone which the germination rate were most accelerated in previous experiment (Kwon, 1968). The treatment of X-ray were manipulated with the large focus of X-ray which was produced the capacity of 90 kilovoltage and 30 miliamphere in the distance of 50 centimeter. The irradiation of ultraviolet light in distance of 20 centimeter was carried out by Toshiba germicidal lamp which was irradiated with the wavelength of 2537 Å. Each dish for germination was wrapped with a thick black paper and the dish placed in an incubator was usually controlled at 25°~27°C during the dark period.

The hypocotyls of seed germinated on the third day after the irradiation of two radiations were counted as those germination rate and measured the length of it by Vernier Caliper.

RESULTS

In the treatment group of X-ray, the germination of group irradiated for 3 seconds was more accelerated than the other group as shown in Table 1. At the same time, the germination of group irradiated for 4, 5, 6, and 7 seconds was delayed more than the control group. However the germination of group irradiated for 2 seconds was paralleled with the control group.

The germination of group irradiated for one second seemed to be accelerative at first, but those of them were delayed gradually more than the germination of control group.

By the way, the germination of group irradiated for 2 seconds was more accelerated than those of control group.

As shown in figure 1, the hypocotyl of carrot seed treated with adequate dosage of X-ray was well grown more than those of unirradiated group.

Table 1. Effect of X-ray influenced on germination rate of carrot seed.

Treated group	Treated time (seconds)	Germination period(%)					
		2	3	4	5	6	7days
X-ray	1	18	55	65	70	75	75
"	2	17	53	70	78	80	80
"	3	22	68	80	88	90	90
"	4	12	55	73	76	82	82
"	5	10	50	62	70	75	75
"	6	12	48	60	68	73	73
"	7	10	50	62	70	75	75
Control	—	17	53	73	75	77	77

Under this given condition, the germination rate of carrot seed was not accelerated by only

a low dosage of radiation, but also adequate dosage of them. The hypocotyl growth of carrot seed irradiated with adequate X-ray was effective in the acceleration of germination.

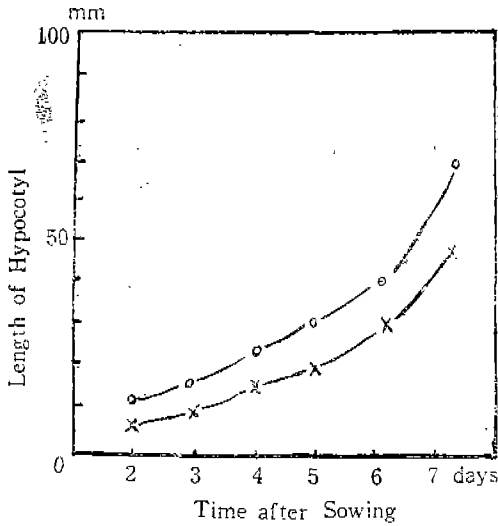


Fig. 1. Hypocotyl growth of carrot seed irradiated with X-ray.
 ○-○: X-ray group irradiated for 3 seconds
 ×-×: Control group

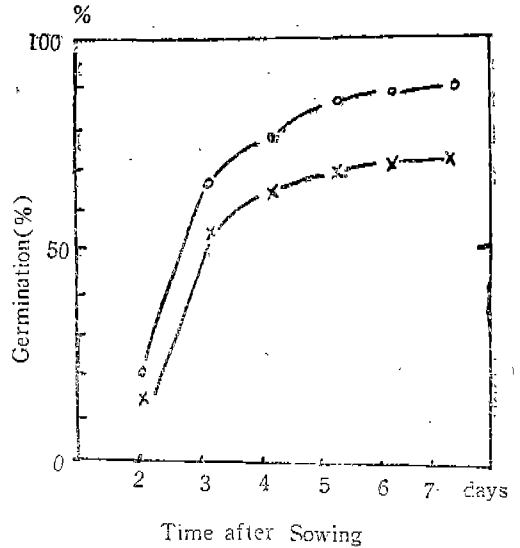


Fig. 2. Effect of X-ray influenced on the germination of control seed.
 ○-○: X-ray group irradiated for 3 seconds
 ×-×: Control group

Effect of X-ray influenced on the germination of carrot seed was obviously shown in Fig. 2. In the germination rate of carrot seed, the group irradiated with adequate dosage of X-ray had showed a good result as compared with the control group.

Both the hypocotyl elongation and the germination rate of carrot seed were equally increased at the same time.

Table 2 illustrates the effect of ultraviolet light and acetone in the germination rate of carrot seed.

In the treatment group irradiated with ultraviolet light, the group treated with ultraviolet light for 30 seconds was also germinated most rapidly among the groups treated with the other dosage of ultraviolet light.

However the germination of group irradiated for 9, 15, 20, and 40 minutes was clearly delayed as compared with those of control group.

Table 2. Effects of ultraviolet light and acetone influenced on germination rate of carrot seed

Treated group	Treated time (minutes)	Germination period (%)						
		2	3	4	5	6	7 days	
UV-light	9	10	40	45	54	60	60	
"	15	13	42	50	60	68	68	
"	20	17	52	70	75	77	77	
"	30	20	57	75	80	82	82	
"	40	15	48	62	70	75	75	
Acetone	30	24	72	83	91	91	91	
Control	—	17	53	73	75	77	77	

At the same time, the germination of group irradiated for 30 minutes was more accelerated than those of control group, but this result of germination which appeared in the treatment of

30 minutes was more delayed than the treatment group of acetone.

The result of Fig. 3 which appeared the hypocotyl growth of carrot seed was promoted by the treatment of acetone rather than adequate X-ray and ultraviolet light.

The acceleration of germination in acetone treatment suggested for us that the inhibited substance of germination in carrot seed would be certain fatty substance.

In Fig. 4, the germination rate of carrot seed had showed 82% in the treatment of ultraviolet light for 30 minutes, 75% for 40 minutes, 73% for 20 minutes, 68% for 15 minutes, and 60% for 10 minutes.

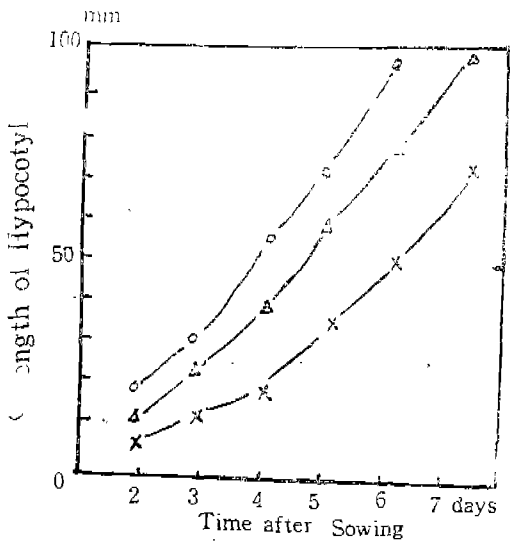


Fig. 3. Hypocotyl growth of carrot seed treated with ultraviolet light.

- : Group treated with acetone
- △—△: Group irradiated with ultraviolet light
- ×—×: Control group

In this experiment, the treatment group soaked in acetone for 30 minutes had showed the best effect and much difference in the germination of carrot seed as compared with the irradiated group by X-ray and ultraviolet light.

DISCUSSION

This experimental results were demonstrated by the occurrence of some treatments in the germination of carrot seed. Namely it was characteristic that the germination rate and growth of carrot seed were accelerated by adequate X-ray and acetone in some treatment groups. It was reported by Huthinson (1930) that the respiratory rate and reproductive rate of yeast was stimulated by the irradiation of ultraviolet light.

In the contrast to this experimental result, Luyet (1932) indicated the irradiation of ultraviolet light and X-ray could be repressed the growth and sporulation of *Mucoraceae*. Nadsen *et al.* (1962) demonstrated that the low dosage of ultraviolet light could accelerate the growth of

Zygosaccharomyces and *Mucoraceae*. Lee *et al.* (1964) reported that the low dosage of neutron could accelerate the respiratory quotient, reproductive rate, fermentative rate, and enzyme activity of *Saccharomyces*. As described above, as if many studies on some microorganism influenced with some kinds of radiation have been reported by many workers, relatively little was known on the growth of plant organ influenced with radiation.

In the results of this experiment, the suitable treatment of X-ray had showed the promoted rate of growth in the germination of carrot seed, as compared with the control group and the group irradiated with ultraviolet light. It was assumed for the author that the treatment of suitable acetone in the germination of carrot seed was one of the best method to accelerate the germination of carrot seed among some treatment groups. Although the germination of carrot seed was slightly accelerated by the irradiation of ultraviolet light, it was not a great deal of difference as compared with the unirradiated group,

摘 要

1. 90 Kv, 30 mA, 조사거리 50 cm, Large focus의 X-선에서 조사시간을 1, 5, 6, 7 초로 하였을 때에 조사하지 아니한 Control군 보다도 종자 발아는 장애를 받았으나 조사시간을 2, 3, 4, 초로 하였을 때에는 상경보다 발아가 촉진되었다.
2. 2537Å, 거리 20cm의 자외선 조사에서는 X-선의 경우와 같이 뚜렷한 발아 촉진의 현상은 나타나지 않았으나 알맞은 미량의 조사량에서는 정상보다 촉진되었다.
3. 30 분간의 Acetone 처리구에서는 X-선이나 자외선 조사에서 보다 많은 발아 촉진현상을 나타낸 것은 당근 종자속에 함유되어 있는 발아 억제물질이 지방성 물질임을 암시해 주는 것이었다.

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