

Effect of Gibberellic Acid on the Internode Elongation of Rice Cultivars

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Gibberellic Acid 處理가 水稻品種의 節間伸長에 미치는 影響

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ABSTRACT

Seven different rice cultivars treated with different levels of gibberellic acid (0, 10, 50 and 100 PPM GA₃) at panicle initiation stage showed retardation effect on the panicle length and the 2nd internode from the top, where as, the total culm lengths were remarkably elongated, about 50-120% in short varieties and about 10-15% in the tall varieties over the control, mainly, because of the lower internodes elongation. The 2nd internode of Gamadi variety from Nepal was almost entirely shortened with GA₃ application.

INTRODUCTION

The endogenous gibberellins (GA₃) present in the minute amounts in higher plants, play an important role in the growth and development of various parts,⁴⁾ and, one of their most obvious functions within the hormonal system is to regulate the rate of growth and final length of internodes.⁵⁾ Since Yabuta (1935)¹²⁾ isolated the endogenous GA from the rice plant, some workers reported the effects of GA-like substances on the physiological and morphological characters of the rice

plant.^{3,6,8,9)} And, the GA contents of the rice plants vary among cultivars, growth stage and cultural-practice conditions.^{7,11)} Suge and Murakami (1968)¹⁰⁾ found no significant differences of endogenous GA content between tall and dwarf rice lines except in Tan-ginbozu, a dwarf variety. Harada and Vergara (1971)¹⁾ suggested that lack of endogenous gibberellin is not the only factor responsible for dwarfness.

The experiment was conducted with an aim to study on the response of internode elongation to exogenous GA₃ with different concentrations sprayed at panicle initiation stage by using seven different rice cultivars collected from different countries.

MATERIALS AND METHODS

Seven different rice cultivars from four countries were used in this experiment to observe the induced effect of exogenous GA₃ on internode elongation and panicle length (Table 1). These varieties were sown on April 25 and transplanted on June, 5, 1979 (40 days old seedlings) to the field at 15x30cm. spacing with single seedling/hill. Fertilizer was applied at the rate of 150Kg N, 100Kg P₂O₅ and 150Kg K₂O/ha. Before panicle initiation stage,

eight plants of each variety were transferred to 1/500a plastic pots with one plant/pot, and grown further in the glass house with appropriate care. Four different levels (0, 10, 50 and 100 PPM) of GA3 solution with a small quantity of wetting agent were sprayed on the plants each with two replications as the foliar application at the panicle initiation stages. The panicle and the internode lengths of the main tillers were measured at

harvesting time.

RESULTS AND DISCUSSIONS

Effects of GA3 on the panicle length and internode elongation of seven tested rice cultivars were examined, and the results obtained are shown in Table 2.

Applied GA3 induced retardation effect on

Table 1. Heading date, panicle length and culm length of the tested rice cultivars.

Name of cultivar	Origin	Heading date	Panicle length	culm length
Tongil	Korea	Aug. 9	22 cm	56 cm
Jinheung	"	" 19	21	84
Paltal/Hoyoku	Japan	" 15	19	60
Waesung #5	"	" 5	18	40
Gamadi	Nepal	" 14	19	69
Pokhareli Masino	"	" 23	26	131
IR 8	IRI	" 21	22	51

panicle length at higher concentration, whereas, it accelerated the total culm length, mainly, due to lower internode elongation in all the tested cultivars

Fig. 1. shows the response of panicle length of tested cultivars to GA3 when applied at panicle initiation stage. Panicle length was reduced with higher concentration of GA3, but the range of response varied among cultivars. IR8 and Jinheung showed reduced panicle length at lower concentration of GA3 (10PPM), whereas, Waesung #5, Paltal/Hoyoku, Tongil and Gamadi showed remarkable decrease in panicle length at higher concentration only (100PPM), and a tall cultivar, Pokhareli Masino indicated the gradual decrease along with the concentration of GA3. It suggests that there is negative effect of exogenous GA3 on panicle length when applied at panicle initiation stage of the rice cultivars tested in this experiment.

Applied GA3 induced elongation of total culm lengths remarkably in all the tested rice cultivars, mainly, because of elongation of existing lower internodes (3rd to 6th from the top), although 2nd to 3rd internodes from the top have been affected adversely. And, the 2nd top internode

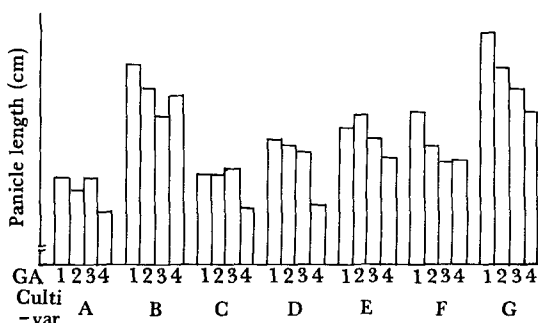


Fig. 1. Effect of GA3 application on the length of panicle in rice cultivars

Note : GA (ppm) : 1=0, 2=10, 3=50, 4=100
Cultivar ; A=Waesung #5, B=IR8
C=Pal/Hoyo., D=Tongil, E=Gamadi
F=Jinheung, G=Pokhareli Masino.

of Gamadi cultivar was almost entirely shortened, where as, the 1st internode was remarkably elongated. Therefore, the induced culm length elongation was the result of the existing lower internodes elongation, and not due to increase in internode numbers.

The gibberellin, in general, has been known to promote the rate of growth and final length of internodes in various plants.⁵⁾ Harada and

Table 2. Effects of foliar application of GA3 on the panicle length and internode elongation in tested rice cultivars.

GA	Panicle length	Culm length	Length of internode					
			1st	2nd	3rd	4th	5th	6th
ppm	cm	cm	cm	cm	cm	cm	cm	cm
<u>Waesung #5</u>								
0	15.2	39.3	22.2	8.1	6.0	3.0		
10	13.9	71.0	27.7	8.0	15.9	19.4		
50	15.3	79.0	28.7	9.5	18.4	22.4		
100	12.3	88.4	27.1	12.2	26.5	22.6		
<u>IR 8</u>								
0	25.3	41.3	21.8	8.1	6.1	3.5	1.8	0.5
10	23.1	68.3	25.5	10.5	4.1	4.1	9.9	14.2
50	20.5	83.8	25.6	4.6	5.5	14.2	21.2	12.7
100	22.7	79.8	21.9	5.0	5.9	14.4	20.6	12.0
<u>Paltal/Hoyoku</u>								
0	15.6	48.9	23.3	10.2	7.0	8.4	0.5	
10	15.6	62.0	26.7	9.9	5.7	6.8	12.9	
50	15.9	86.8	24.6	6.5	12.4	21.9	21.4	
100	12.5	73.7	16.8	5.9	8.8	16.3	25.9	
<u>Tongil</u>								
0	18.5	47.8	23.9	12.2	8.8	2.9	0.5	
10	18.0	92.5	26.1	10.4	18.9	19.1	18.0	
50	16.8	97.3	26.8	9.2	17.2	27.3	16.8	
100	12.7	93.3	19.2	7.4	17.1	31.2	18.4	
<u>Jinheung</u>								
0	21.0	74.9	34.5	15.9	10.3	8.5	5.0	0.7
10	18.1	101.3	35.0	17.0	9.5	10.9	19.6	9.3
50	16.4	99.1	32.6	13.4	7.6	10.6	16.4	18.5
100	16.8	117.5	33.2	12.4	9.0	14.3	21.6	27.0
<u>Pokhareli Masino</u>								
0	27.9	130.6	51.1	32.8	20.6	13.5	9.6	3.0
10	24.8	146.8	50.4	32.4	20.0	15.7	15.1	13.2
50	23.0	160.6	49.5	30.0	16.2	20.0	28.7	16.2
100	21.0	149.5	43.4	26.5	13.7	14.2	25.9	25.8
<u>Gamadi</u>								
0	19.5	68.5	5.8	23.1	23.1	11.0	5.5	0.5
10	20.8	65.9	21.1	7.7	13.0	12.3	11.8	0.5
50	18.7	81.2	18.8	1.0	11.5	19.7	22.5	7.7
100	17.0	84.1	13.5	1.1	14.0	23.8	23.5	8.2

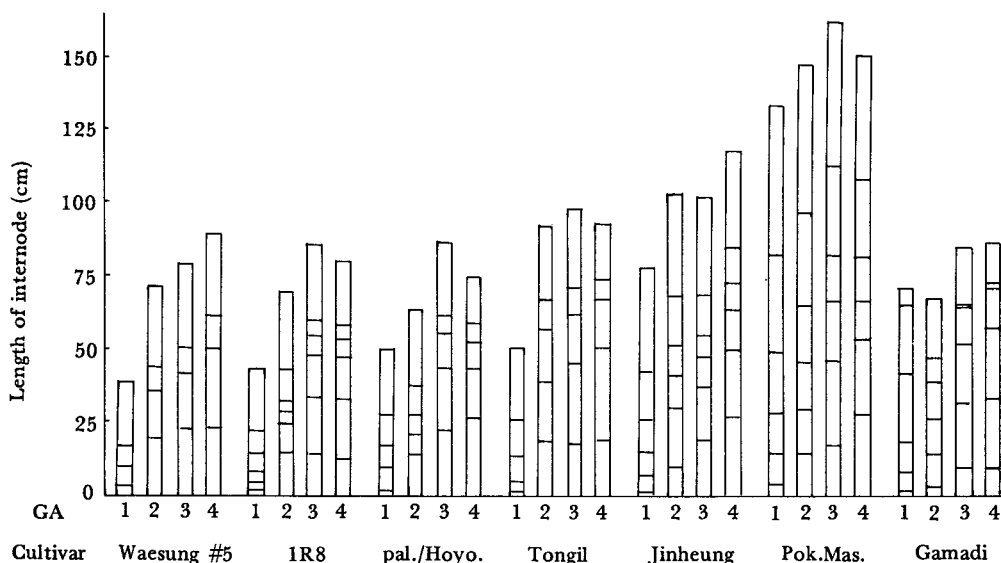


Fig. 2. Effect of GA₃ on the internode elongation of the tested cultivars (internode from the top)

Note : GA(ppm) ; 1=0, 2=10, 3=50, 4=100

Nakayama (1974)³⁾ reported that the gibberellin (10-100PPM) applied at the panicle initiation stage induced the retardation of 2nd and 3rd internodes from the top in a dwarf rice cultivar Tan-ginbozu.

The panicle of the Gamadi cultivar from western Nepal does not exert at all at heading stage under natural condition, and the grains mature within the leaf sheath only. The phenomenon has not yet been identified. The difference in response to GA₃ applied shown by this cultivar on the internode elongation, particularly, the 1st and 2nd internodes from the top might be related with the panicle enclosing character which needs further investigation.

Culm length of Waseung #5, Jinheung and Gamadi cultivars was elongated gradually with higher concentration of applied GA₃, where as, that of other cultivars were shorter at 100PPM than at 50PPM. The degree of response to GA₃ in culm length of dwarf cultivars (below 50cm) was higher than tall cultivars tested in this experiment. And, the GA₃ application resulted in the increase of culm length about 50-120% over the control in dwarf cultivars, while it was 10-15%

in case of tall cultivars.

It is generally recognized that lack of endogenous GA may limit the total height of some plants.⁵⁾ In rice plants, many tropical tall indica cultivars may have high amounts of endogenous GA content, and therefore, would not respond remarkably to GA application. But Harada and Vergara (1971)¹⁾ indicated that lack of endogenous GA is not the only factor responsible for dwarfness, and Suge and MuraKami (1968)¹⁰⁾ reported that nine tested rice cultivars (except Tan-ginbozu) contain approximately the same gibberellin activity as tall genotypes do.

The difference in response to GA₃ between tall and dwarf groups of rice cultivars in this experiment were in the culm length elongation. Dwarf cultivars responded higher (50-120%) than tall cultivars (10-15%), and the major differences in the culm length elongation among the tested cultivars resulted not from the increase in number of internodes, but from the elongation of existing lower internodes, specially lower two or three internodes.

摘 要

GA 處理가 水稻品種의 穗長 및 節間伸長에 미치는 影響을 檢討하기 위하여 栽培地가 다른 短稈 및 長稈의 7 個 品種에다 GA₃ 농도를 0, 10, 50 및 100 ppm의 5 個水準으로 하여 幼穗形成期에 處理하고 收穫期에 穗長 및 節間伸長 程度를 調査 檢討하였으며 그 結果를 要約하면 다음과 같다.

1. 穗長은 GA₃ 高濃度에서 감소되었는데 반응농도와 감소정도는 品種에 따라 달라 진흥과 IR 8 은 저농도(10ppm)에서부터, 왜성 5號, 팔달/Hoyoku, 통일 및 Gamadi는 고농도(100ppm)에서만, 그리고 長稈인 Pokhareli Masino는 GA₃ 농도 증가에 따라 점진적으로 감소되었다. ○

2. GA₃ 處理는 모든 品種의 稈長을 현저하게 증가시켰는데 그 增加程度는 短稈品種(50 cm 정도)에서는 50~120%, 長稈品種에서는 10~15%로 短稈品種에서 더 컸다.

3. GA₃ 處理 농도에 따른 稈長의 增加 반응은 品種에 따라 달라 왜성 5號, 진흥 및 Gamadi는 供試濃度 범위 내에서는 GA₃ 농도 증가에 따라 점차적으로 增加되었으나 그외의 品種들은 100ppm에서의 稈長이 50ppm에서보다 작아 고농도에서 억제 效果를 나타내었다.

4. GA₃ 處理는 節間伸長을 조장하였으나 節間數는 增加시키지 않았다.

5. GA₃ 處理에 따른 節間伸長 반응은 節位에 따라 달라 농도가 높아질수록 下位 3~6位 節間の 伸長이 현저하게 조장되는 반면 上位 2~3位 節間은 반대로 단축되는 경향이였다. ○

6. Nepal의 在來品種 Gamadi는 自然狀態에서 이삭이 전혀 추출되지 않고 열초속에서 登熟되는 品種인데 GA處理에 따라 제 1節位 節間이 伸長되는 반면 第 2節位 節間은 거의 흔적만 남을 정도로 단축되어 GA에 대한 반응이 特異하였다.

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