Kinetin 浸種處理가 벼(*Oryza sativa* L.) 發芽中 銅 毒性 輕減에 미치는 影響

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Effects of Seed Soaking of Kinetin on Minimizing Copper Toxicity In Rice (*Oryza sativa* L.) Germination

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實驗目的

本 實驗은 水稻의 發芽에 있어 重金屬 stress中 銅毒性에 對한 發芽率 向上과 銅毒性 輕減을 爲한 栽培對策의 一環으로 植物生長調整劑인 kinetin을 處理하여 發芽 및 根 生長을 促進시키면서 重金屬 汚染을 輕減시키기 위하여 遂行하였다.

材料 및 方法

一般型(Japonica)인 일품벼와 統一型(Indica)인 향미벼 1號를 實驗 材料로 하여 草長, 根長, 生體重, 發芽率 等의 生育特性과 遊離 proline 含量, 植物體 銅含量, 蛋白質 밴드 패턴, SOD (Superoxide dismutase) 活性度의 差異를 調査하였다.

結果 및 考察

1. kinetin 處理에 따른 生育은 일품벼에서는 草長의 境遇 kinetin 10^{-3}M 處理가 無處理와 銅 60 ppm 處理에 비해 生育이 良好하였고 뿌리의 生長도 優勢하였다.

2. 葉綠素 含量은 두 品種 供히 銅 60 ppm 處理에 비해 無處理가 含量이 가장 높았으며 kinetin 10^{-3}M, kinetin 10^{-4}M, kinetin 10^{-5}M의 處理順으로 낮은 含量을 나타내었다.

3. 銅 含量의 蓄積에 對한 含量 差異는 kinetin의 濃度가 낮을수록 銅 含量이 增加하였고 일품벼의 境遇 銅 60 ppm 處理에서 銅 含量은 잎에서 1,797 ng, 種子에서 1,340 ng으로 가장 높은 含量을 보였고 향미벼 1號에서도 銅 60 ppm 處理에서 銅 含量이 잎과 種子에서 各各 1,590 ng, 1,260 ng이었다.

4. 品種間 蛋白質 밴드의 패턴은 處理間 差異가 있었는데 일품벼가 kinetin 10^{-3}M 處理에서 54.4 kDa에 새로운 蛋白質 밴드가 나타났다.

5. 發芽日數別 SOD 活性度는 일품벼의 境遇 無處理에서는 差異를 보이지 않았고 銅 60 ppm 處理에서 發芽 後 3日째 1,299 EU로 가장 높은 活性度를 보이다가 發芽 後 5日째부터 漸次 減少하였고 향미벼 1號에서는 發芽 後 3日째 銅 60 ppm 處理에서 1,260 EU의 活性度를 나타내다가 發芽 後 5日째부터 減少하는 傾向이었다.

6. 遊離 proline 含量은 品種間 差異를 보이지 않았으나 SOD 活性과 마찬가지로 發芽 後 3日째 銅 60 ppm 處理에서 높은 含量의 差異를 보였지만 發芽日數가 經過할 수록 減少하였다.

Table 1. Analytical conditions of atomic absorbance spectrophotometer for copper element by flame atomization

Element	Light source	Lamp current (mA)	Wave length (nm)	Slit size (nm)	Flames
Copper	Hallow cathode	15	324.8	0.7	Air/acetylene

Table 2. Effect of plant growth regulator, kinetin on copper treatment in two rice (*Oryza sativa* L.) cultivars

Cultivars	Treatments	Plant height (cm)	Root length (cm)	Fresh wt. (g/30 plants)	Germination rate (%)
Ilpumbyeo	Untreated control	3.4 b	3.7 a	2.4 a	92 a
	Copper 60 ppm	2.5 d	0.1 c	1.9 c	40 c
	Kinetin 10^{-3} M	3.5 a	1.2 b	2.1 b	92 a
	Kinetin 10^{-4} M	2.9 c	0.1 c	1.8 d	68 b
	Kinetin 10^{-5} M	2.1 e	0.1 c	1.5 e	60 c
Hwangmi-byeo # 1	Untreated control	2.9 b	2.9 a	1.9 a	92 a
	Copper 60 ppm	2.3 e	0.1 c	1.5 c	56 c
	Kinetin 10^{-3} M	3.8 a	1.1 b	1.8 b	88 a
	Kinetin 10^{-4} M	2.8 c	0.1 c	1.5 c	72 b
	Kinetin 10^{-5} M	2.7 d	0.1 c	1.4 d	44 d

Means in each column followed by the same letter are not significantly different at the 5% level into one cultivar according to Duncan's multiple range tests.

Table 3. *Chlorophyll content and free proline content of leaf and seed parts as affected by plant growth regulator, kinetin treatment on copper treatment in two rice (Oryza sativa L.) cultivars*

Cultivars	Treatments	Chlorophyll content (mg / g fresh wt.)	Copper content (ng /g dry wt.)	
			seed	leaf
Ilpumbyeo	Untreated control	1.33 a	500 e	581 d
	Copper 60 ppm	0.93 d	1,340 a	1,780 a
	Kinetin 10^{-3} M	1.32 ab	580 d	930 c
	Kinetin 10^{-4} M	1.29 bc	740 c	1,120 b
	Kinetin 10^{-5} M	1.27 c	1,050 b	1,790 a
Hwangmi-byeo # 1	Untreated control	0.67 a	642 e	687 e
	Copper 60 ppm	0.56 b	1,260 a	1,590 a
	Kinetin 10^{-3} M	0.66 a	660 d	980 d
	Kinetin 10^{-4} M	0.48 c	980 c	1,140 c
	Kinetin 10^{-5} M	0.39 d	1,130 b	1,280 b

Means in each column followed by the same letter are not significantly different at the 5% level into one cultivar according to Duncan's multiple range tests.

Table 4. Changes of superoxide dismutase activity on copper treatment in two ric (*Oryza sativa* L.) cultivars

Cultivars	Treatments	SOD activity (EU[1] / g fresh wt.)			
		1 DAT[2]	3 DAT	5 DAT	7 DAT
Ilpumbyeo	Untreated control	690 d	687 c	693 d	692 e
	Copper 60 ppm	1,043 a	1,299 a	897 ab	785 c
	Kinetin 10^{-3} M	799 c	1,099 b	871 c	776 d
	Kinetin 10^{-4} M	801 c	1,101 b	893 b	789 b
	Kinetin 10^{-5} M	993 b	1,125 b	899 a	794 a
Hwangmi-byeo # 1	Untreated control	723 e	719 e	714 e	720 d
	Copper 60 ppm	1,100 a	1,260 a	1,017 d	748 c
	Kinetin 10^{-3} M	800 d	1,122 d	1,041 c	752 e
	Kinetin 10^{-4} M	934 c	1,141 c	1,053 b	768 b
	Kinetin 10^{-5} M	1,037 b	1,150 b	1,080 a	788 a

Means in each column followed by the same letter are not significantly different at the 5 level into one cultivar according to Duncan's multiple range tests.
[1]EU = enzyme unit
[2]Days after treatment of copper 60 ppm.

Table 5. Changes of free proline content on copper treatment in two rice (*Ory. sativa* L.) cultivars

Cultivars	Treatments	Free proline content (μM / g fresh wt.)			
		1 DAT[2]	3 DAT	5 DAT	7 DAT
Ilpumbyeo	Untreated control	2.180 e	2.190 d	2.190 c	2.211 d
	Copper 60 ppm	3.231 b	4.986 a	3.012 a	2.787 a
	Kinetin 10^{-3} M	3.000 d	5.008 a	2.211 c	2.282 c
	Kinetin 10^{-4} M	3.181 c	4.281 b	2.290 b	2.332 b
	Kinetin 10^{-5} M	3.282 a	3.661 c	2.300 b	2.340 b
Hwangmi-byeo # 1	Untreated control	2.330 d	2.341 d	2.340 d	2.360 d
	Copper 60 ppm	3.370 a	5.825 a	2.430 c	2.487 a
	Kinetin 10^{-3} M	3.111 c	3.180 c	2.350 d	2.372 cc
	Kinetin 10^{-4} M	3.183 b	4.480 b	2.600 b	2.403 bc
	Kinetin 10^{-5} M	3.366 a	4.471 b	2.716 a	2.433 b

Means in each column followed by the same letter are not significantly different at the 5 level into one cultivar according to Duncan's multiple range tests.
[2]Days after treatment of copper 60 ppm.

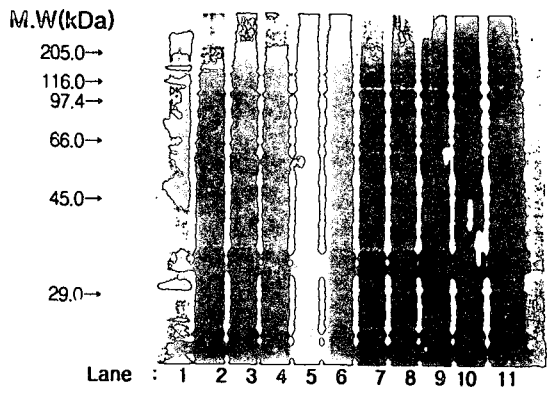

Fig. 3. Protein band patterns on copper treatment shown by SDS-PAGE for two rice cultivars of seedlings, Ilpumbyeo (Japonica type) and Hyangmibyeo #1 (Indica type). Lane no. 1.Size marker 2. Untreated control 3. Cu 60 ppm 4. Kinetin 10^{-3}M 5. Kinetin 10^{-4}M 6. Kinetin 10^{-5}M 7. Untreated control 8. Cu 60 ppm 9. Kinetin 10^{-3}M 10. Kinetin 10^{-4}M 11. Kinetin 10^{-5}M.
Lane numbers from 2 to 6 indicate the rice cultivar of japonica type.
Lane numbers from 7 to 11 indicate the rice cultivar of indica type.