

벼 발아중 염화아연 독성이 유리 Proline과 유기산 함량에 미치는 영향
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Effects of Zinc Chloride Toxicity on Free Proline and Organic Acid Content in Rice Germination

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Objectives

This research is to find growth response, free proline content and organic acids in rice grown at different zinc chloride concentrations.

Material and Methods

- Plant material : One rice(*Oryza sativa* L. cv. Ilpumbyeo)
- Germinated conditions : Air temp. of $30 \pm 1^\circ\text{C}$, a RH of constant $75 \pm 1\%$, and photon flux density of $400 \mu\text{mol m}^{-2}\text{s}^{-1}$, for 7days
- Heavy metal treatment : Zinc chloride 100, 120, 140 ppm
- Data taken : Chlorophyll(Cock et al. 1976), Free proline(Bates 1973), Organic acid(Yang et ai. 1994)

Results and Discussions

- Early growth response and chlorophyll content : The highest concentration of zinc chloride 140ppm prohibited root elongation as 0.1cm as much as 46 times, and germination rate was also decreased in all zinc chloride treatments, particularly, treatment of zinc chloride 140 ppm was 13%(Table 1).
- Changes of free proline content : As zinc chloride concentration is increased, free proline content was slightly increased during germination. At three days, there was totally higher increment in all zinc chloride treatment including the control. Particularly, compared with the control, the free proline content of zinc chloride treatment(140ppm) at the 3 days was highest as $4,873 \mu\text{M}$ (Table 2).
- Changes of three organic acid content : Malic acid concentration in zinc chloride 140 ppm increased by approximately 4 times, and citric and succinic acid content were also slightly increased in all zinc chloride treatments. We observed that content of three organic acids and free proline at only 3 days after zinc chloride treatment was at the same time increased in all zinc chloride treatments except for control(Table 3).

Table 1. Effects of zinc chloride on root length, germination rate and chlorophyll content in rice cultivar, Ilpumbyeo.

ZnCl ₂ concentration (ppm)	Root length [†] (cm)	Germination rate [†] (%)	Chlorophyll content [†] (mg/g fresh wt.)
Control	4.6a [¶]	93a	1.38a
100	2.6b	68b	1.06b
120	0.3c	32c	0.45c
140	0.1c	13d	0.27d

[†]Measured at the seven days after treatment of zinc chloride solution.

[¶]Means in each column followed by the same letter are not significantly different at the 5% level by DMRT.

Table 2. Effects of zinc chloride on free proline content in rice cultivar, Ilpumbyeo.

ZnCl ₂ concentration (ppm)	Free proline content (μ M/10g fresh wt.)		
	1 DAT [†]	3 DAT	5 DAT
Control	2,345	2,232d [¶]	2,187
100	2,873	3,286c	3,021
120	3,449	4,678b	3,320
140	3,592	4,873a	3,641

[†]Days after treatment of zinc chloride solution, respectively.

[¶]Means in each column followed by the same letter are not significantly different at the 1% level by DMRT.

Table 3. Effects of zinc chloride on three organic acid content in rice cultivar, Ilpumbyeo.

ZnCl ₂ concentration (ppm)	Organic acid content(μ M/10g fresh wt.) [†]		
	citric acid	malic acid	succinic acid
Control	3.3	23.8d [¶]	2.3
100	6.8	88.3c	4.6
120	7.1	91.5b	5.1
140	7.5	103.7a	5.3

[†]Measured at the three days after treatment of zinc chloride solution.

[¶]Means in each column followed by the same letter are not significantly different at the 1% level by DMRT.