Effects of Silicon on the Endogenous Gibberellic and Jasmonic acid Levels in Rice

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Objectives

Response of gibberellic and jasmonic acid biosynthesis by elevated silicon supply was investigated in rice plant.

Materials and Methods

○ *Soil Culture*: Five day old rice seedlings of Daesanbyeo, Junambyeo and Dongjinbyeo, which were grown on the bed-soil for rice nursery, were transplanted into pots filled with paddy soil. Two levels of silicon(100 kg or 200 kg Si/10a) were provided as a silicate fertilizer at 5 days after transplanting, and grown in growth chamber for 12 days. Seedlings were grown at 30 ℃ for 12h /20 ℃ for 12h (day/night) under 800 μmol $m^{-2}s^{-1}$ of light intensity. Plants were harvested at 12 days after silicon supply for analysis of gibberellins.

○ *Solution Culture*: Two weeks old seedlings were transplanted at 3 cm intervals on a piece of styrofoam placed in a plastic container (25x20x15cm) filled with distilled water. One day after transplanting, seedlings were exposed to ① 0.5, 1, 2, and 4 mM of Si as sodium meta-silicate, ② 4 mM of nitrogen or 4 mM of nitrogen plus 1 mM of Si, and ③ 5 mM of calcium or 5 mM of calcium plus 1 mM of Si in distilled water solution for 6, 12, and 24 h without other mineral nutrients. Throughout all experiments, plants were grown in a controlled environment chamber with the same conditions as soil culture.

○ The extraction and quantification of gibberellins were followed the general procedure of Lee et al.(1998).

Results and Discussion

GA_1 and GA_{20} contents of three rice variety in which silicate fertilizer was applied in paddy soil were significantly increased (Table. 1). Furthermore, GAs content in rice plant treated with silicate in culture solution was increased compared to the control. Content of GA_1 was highest at 1 mM Si application among the three levels of Si treatment(Table. 2). Silicon application also changed the endogenous jasmonic acid level. In the experiment using nitrate alone and the combination of nitrate and Si, although GAs content showes significant increase with the nitrate alone, addition of Si with nitrate resulted in slightly increased GA_1 level by amounts 10% of the nitrate alone. In another experiment with calcium and calcium plus Si, supply of calcium alone slightly decreased the content of GA_1 compare with control at the 3, 6, 12 h. Meanwhile, simultaneous application of Si and calcium restored reduced GA_1 levels caused by the application of calcium.

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Table 1. Effect of silicate fertilizer levels on the gibberellin contents of three rice cultivars. Plants were grown on the bed-soil for days. Levels of GA_{20} and GA_1 were measured at 12 days after fertilizer application.

Cultivars	Silicate fertilizer (kg/10a)	GAs (ng/g D.W.)	
		GA_{20}	GA_1
Daesanbyeo	0	2.32	1.57
	100	5.77	2.47
	200	9.72	6.88
Dongjinbyeo	0	2.70	4.04
	100	6.50	6.03
	200	7.05	8.19
Junambyeo	0	2.08	4.32
	100	4.30	7.53
	200	5.27	9.20

Table 2. Effect of Si supplement in the culture solution on the endogenous levels of GAs and JA in Dongjinbyeo. GAs level were measured at 6, 12, 24 hour after application.

Sampling time	Si (mM)	GAs (ng/g D.W.)		JA (ng/g D.W.)
		GA_{20}	GA_1	
6h	0	3.43	1.42	21.04
	0.5	2.43	2.09	23.28
	1	2.47	2.82	29.97
	2	4.51	2.40	25.09
	4	2.67	2.16	24.93
12h	0	1.22	1.68	21.16
	0.5	6.77	2.35	18.19
	1	6.99	2.98	14.13
	2	1.24	2.34	13.67
	4	0.24	2.28	13.90
24h	0	1.54	2.01	10.97
	0.5	4.03	2.27	28.10
	1	4.15	2.77	32.11
	2	3.69	2.44	24.97
	4	0.83	2.47	25.01