

# 가

## Effect of Nitrogen Fertilization Levels and Irrigation on Calcium Content in Apple Fruits

Jong Seung Choi and Jong Myung Choi  
*Division of Horticulture and Landscape Architecture, Pai Chai University*

가  
가  
가  
가

Treatments with increased amount of nitrogen fertilizer had less calcium content than those of conventional fertilization in 'Starkrimson' apple fruits. When  $\text{CaCl}_2$  solution was applied as tree spray, treatment of conventional fertilization had increased fruit calcium content and decreased occurrence of spotted disorders. Better in increasing fruit calcium content was secured in treatment of conventional nitrogen fertilization. The irrigation effect to sandy loam soil where 'Fuji' apple fruits were planted were observed in fruit enlargement and increase of calcium content in leaves and fruits.

**Key words :** Apple, Nitrogen fertilization, Calcium content, Irrigation, Spotted disorder

가

(Hanger, 1979).

가

(Tromp, 1979).

가

1. 가 pF 2.4 2.5  
 2  
 3  
 23 , 7 26 10 4 6  
 6  
 ( )  
 3 (3 ) 2

10a 7.4 kg 3 22.2 kg  
 3.7 kg 6.4 kg  
 50%  
 2  
 0.4% CaCl<sub>2</sub> 54  
 8 10 10 6  
 4 2

1.  
 CaCl<sub>2</sub> 3 2 2 0.4%  
 6  
 1

Automatic Nitrogen Analyzer(distillation unit  
 Buchi 322, control unit Buchi 342, auto titrator  
 E 526, Dosimat 665, Epson HX-20 )

가  
 가  
 가  
 가

ternary solution  
 vanadate  
 (Gilford 260)

(Perkin Elmer 2380) 가

가  
 Drake (1966)  
 가

NaOH  
 가

2. 가  
 /M26 7

Table 1. Effect of amount of nitrogen fertilized and CaCl<sub>2</sub> spray on mineral content of 'Starkrimson' apple fruits.

N level <sup>z</sup>	CaCl <sub>2</sub> spray <sup>y</sup>	Mineral content in fruits				
		N (%)	P (%)	K (%)	Ca (μg · g <sup>-1</sup> )	Mg (μg · g <sup>-1</sup> )
<i>Peel</i>						
3N	+	0.40 bc <sup>x</sup>	0.040 ab	0.52 a	560 ab	1,280 a
3N	-	0.41 b	0.040 ab	0.49 a	410 bc	1,473 a
1N	+	0.46 a	0.047 a	0.53 a	709 a	1,480 a
1N	-	0.36 c	0.038 b	0.47 a	399 c	1,347 a
<i>Flesh</i>						
3N	+	0.33 a	0.080 ab	0.87 a	168 ab	266 ab
3N	-	0.27 a	0.081 ab	0.80 b	139 b	249 ac
1N	+	0.34 a	0.100 a	0.82 ab	198 a	274 a
1N	-	0.26 a	0.066 b	0.83 ab	141 b	241 c
<i>Core</i>						
3N	+	0.52 ab	0.089 a	1.14 a	512 a	433 ab
3N	-	0.47 ab	0.075 ab	1.06 a	584 a	431 ab
1N	+	0.58 a	0.097 a	1.10 a	692 a	487 a
1N	-	0.42 b	0.064 b	1.10 a	618 a	407 b

<sup>z</sup> Amounts of nitrogen applied; 7.4 kg/10a(1N) and 22.2 kg/10a(3N).

<sup>y</sup> Six times splay application of 0.4% CaCl<sub>2</sub> solution in every 10 days from Aug. to Sept.

<sup>x</sup> Mean separation within columns in each fruit part by Duncan's multiple range test, 5% level.

cork spot (Ford, 1979; Richardson Lombardo, 1979) 가

斑點性 ( 2). 가

가

(Stiles, 1964), 가

Table 2. Effect of amount of nitrogen fertilized and CaCl<sub>2</sub> spray on quality and occurrence of spotted disorders in 'Starkrimson' apple fruits.

N level <sup>z</sup>	CaCl <sub>2</sub> spray <sup>y</sup>	Fruit wt. (g)	Soluble solids (%)	Acidity (%)	Firmness (kg)	Spotted disorder (%)
3N	+	339 a	12.2	0.58 a	1.49 a	10.0 b
3N	-	286 b	12.2	0.53 a	1.45 a	22.0 a
1N	+	273 b	12.2	0.59 a	1.46 a	6.7 b
1N	-	269 b	12.2	0.54 a	1.49 a	10.3 b

<sup>z</sup> Amounts of nitrogen applied; 7.4 kg/10a(1N) and 22.2 kg/10a(3N).

<sup>y</sup> Six times splay application of 0.4% CaCl<sub>2</sub> solution in every 10 days from Aug. to Sept.

<sup>x</sup> Mean separation within columns in each fruit part by Duncan's multiple range test, 5% level.

2.

Treatment	pF 2.4		2.5	
	Ca (%)	Mg (%)	Ca (%)	Mg (%)
Irrigation	0.97	0.14	0.97	0.14
Control	0.97	0.14	0.97	0.14

Table 3. Effect of irrigation on mineral concentrations(%) of leaf in 'Fuji' apple grown in sandy loam soil

Treatment	N	P	K	Ca	Mg
<u>June 23</u>					
Irrigation	2.95	0.19	1.51	0.80 <sup>*</sup>	0.24
Control	2.87	0.19	1.43	0.69	0.25
<u>July 26</u>					
Irrigation	2.42	0.14	1.06	1.24	0.26
Control	2.50	0.13	1.11	1.10	0.27
<u>Oct. 4</u>					
Irrigation	2.23	0.13	1.25	1.10	0.22
Control	2.14	0.11	1.16	1.10	0.24

<sup>\*</sup> Maintained from pF 2.4 to 2.5 in soil moisture tension during growing season.  
<sup>\*</sup> Significant by T-test at 5% level.

Table 4. Effect of irrigation on calcium concentration of 'Fuji' apple fruits grown in sandy loam soil.

Treatment <sup>z</sup>	Ca concentration(μg · g <sup>-1</sup> )		Ca content(mg/fruit)	
	Peel	Flesh	Peel	Flesh
Irrigation	476	140 <sup>*</sup>	212	453 <sup>*</sup>
Control	492	122	196	356

<sup>z</sup> Maintained from pF 2.4 to 2.5 in soil moisture tension during growing season.  
<sup>\*</sup> Significant by T-test at 5% level.

Slowik(1979) 가  
 , Goode Ingram(1971) 가  
 가  
 가  
 가

Table 5. Effect of irrigation on fruit quality in 'Fuji' apple grown in sandy loam soil

Treatment <sup>z</sup>	Fruit wt. (g)	Soluble solids (%)	Acidity (%)	Firmness (kg)
Irrigation	275	14.7	0.40	153
Control	248	15.3	0.37	163

<sup>z</sup> Maintained from pF 2.4 to 2.5 in soil moisture tension during growing season.

#### IV.

- Drake, M., W. D. Weeks, and J. H. Baker. 1966. Bitter pit as related to calcium level in Baldwin apple fruit and leaves. *Proc. Amer. Soc. Hort. Sci.*, 89: 23-29.
- Ford, E. M. 1979. Effect of post-blossom environmental conditions on fruit composition and quality of apple. *Commun. Soil Sci. Plant Anal.*, 10: 337-348.
- Goode, J. E. and J. Ingram. 1971. The effect of irrigation on the growth, cropping and nutrition of Cox's Orange Pippin apple trees. *J. Hort. Sci.*, 46: 196-208.
- Hanger, B. C. 1979. The movement of calcium in plants. *Commun. Soil Sci. Plant Anal.*, 10: 171-181.
- Richardson, D. C. and P. B. Lombard. 1979. Cork spot of Anjou pear: control by calcium sprays. *Commun. Soil Sci. Plant Anal.*, 10: 383-389.
- Slowik, K. 1979. Effects of environmental and cultural practices on calcium nutrition of fruit tree. *Commun. Soil Sci. Plant Anal.*, 10: 295-302.
- Tromp, J. 1979. The intake curve the calcium into apple fruits under various environmental conditions. *Commun. Soil Sci. Plant Anal.*, 10: 325-335.