Effect of Sodium Hypochlorite as a Disease Control against Violet Root Rot Caused by *Helicobasidium mompa* on Apple Trees

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Abstract

This study was performed to control disease, enhance vigor through rhizospheric rooting and then recover tree growth using sodium hypochlorite (NaOCl) against violet root rot disease on apple trees in Chungbuk province. From the experimental results in a field that drenched NaOCl according to concentration on an apple cultivar 'Sansa' seriously infected to violet root rot, 0.5% NaOCl treatment showed significant difference at the range of both 5~10 cm and above 30 cm for shoot length and induction of rooting on root stock in subsoil. Also, 0.25% and 0.5% NaOCl treatments improved 51.4% and 58.4% for relative crown density that based on the number of leaves and average leaf area, respectively. Moreover, the two treatments were different significantly on both fruit weight and total soluble solid from the analysis for fruit characteristics as well as much about 2 times from the analysis of starch content for fruiting shoots. In conclusion, our results suggest that one time drenching to 10L per a tree of 0.25~0.5% NaOCl in mid-May could be effective to control the violet root rot caused by *H. mompa* and also, improve the vigor recovery with rooting on rhizosphere on apple trees.

***Additional key words*:** Apple tree, violet root rot, sodium hypochlorite, disease control

Materials & Methods

- This study was performed at an apple orchard of Chungbuk province in 2013～2014.
- The tested 'Sansa' , an apple cultivar, was over 6-year-old trees.
- The used sodium hypochlorite (NaOCl) was 8% assay and then diluted to 0.5, 0.25 and 0.1% with agricultural water, respectively.
- Each diluted NaOCl solution was drenched one time at soil surface including collar with 10 L per a tree around mid-May.

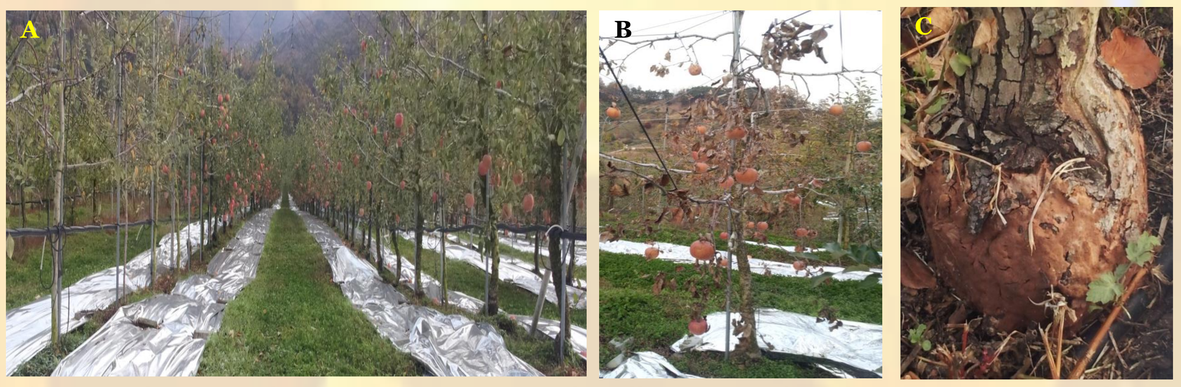

Fig. 1. The typical crown symptom and collar sign of violet root rot caused by *Helicobasidium mompa*. A, the serious infected orchard; B, the crown dieback symptom; C, the typical collar sign.

Results

Fig. 2. Suppression of the fruiting body and rooting induction post-treatment for NaOCl 0.5% in the apple tree infected to violet root rot in field. A; pre-treatment; B, root primordia post-treatment; C, rooting post-treatment. An arrow indicates root primordia and rooting on infected tree.

Table 1. Length of shoots pre-treatment for NaOCl by concentration in the apple tree infected to violet root rot in field

Treatments	Length of shoots per tree (cm)					
	<5	5～10	10～20	20～30	30≤	No. of mean shoots per tree
Healthy	6.0±3.1 a[Z]	24.0±3.8 a	6.7±1.2 a	0	0	36.7±2.4 a
Control	8.0±2.1 a	1.3±1.3 b	0 b	0	0	9.3±0.9 b
Fungicide	9.3±0.7 a	3.0±0.6 b	0.3±0.3 b	0	0	12.7±1.5 b
NaOCl 0.1%	12.3±1.8 a	0 b	0 b	0	0	12.3±1.8 b
NaOCl 0.25%	8.0±2.1 a	1.7±0.7 b	0 b	0	0	9.7±2.0 b
NaOCl 0.5%	9.7±1.7 a	4.3±0.3 b	0 b	0	0	14.0±1.5 b

[Z]Means separation within columns by 5% DMRT.

Table 2. Length of shoots post-treatment for NaOCl by concentration in the apple tree infected to violet root rot in field

Treatments	Length of shoots per tree (cm)					
	<5	5～10	10～20	20～30	30≤	No. of mean shoots per tree
Healthy	0 a[Z]	0 b	9.7±2.2 a	11.3±1.9 a	20.3±2.4 a	41.3±4.1 a
Control	0 a	2.3±0.9 c	1.7±0.3 b	0.3±0.3 b	10.0±1.2 c	9.3±1.0 b
Fungicide	1.3±0.9 a	6.7±1.2 ab	3.3±0.3 b	0.7±0.7 b	15.7±1.8 bc	12.7±1.5 b
NaOCl 0.1%	1.7±0.9 a	4.0±0.6 bc	5.0±1.2 b	3.7±1.2 b	17.3±3.0 bc	12.3±1.8 b
NaOCl 0.25%	0 a	6.3±0.9 ab	3.3±0.9 b	1.7±1.7 b	16.0±2.1 bc	9.7±2.0 b
NaOCl 0.5%	0 a	7.7±0.9 ab	5.0±0.6 b	3.3±0.7 b	21.7±2.2 b	14.0±1.5 b

[Z]Means separation within columns by 5% DMRT.

Table 3. Change of crown density post-treatment for NaOCl by concentration in the apple tree infected to violet root rot in field

Treatments	Crown density (%)			
	Pre-treatment	Post-treatment	Increasing degree[Z]	Relative recovery degree[Y]
Healthy	40.0	100	250	-
Control	16.0±1.2 a[X]	16.7±1.7 c	104	-
Fungicide	15.3±0.7 a	23.3±1.7 bc	152	31.6
NaOCl 0.1%	15.3±1.8 a	28.3±1.7 b	185	43.8
NaOCl 0.25%	14.0±1.2 a	30.0±2.9 b	214	51.4
NaOCl 0.5%	15.3±1.3 a	38.3±3.3 a	250	58.4

[Z]post-treatment/pre-treatment×100.
[Y](Each treatment-control)/each treatment×100 in increase degree.
[X]Means separation within columns by 5% DMRT.

Table 4. Difference of apple fruit characteristic post-treatment for NaOCl by concentration in the apple tree infected to violet root rot in field

Treatments	No. of fruit setting	Weight (g)	Firmness (kg·8 mmØ $^{-1}$)	Total soluble solid (˚Brix)	Acid content (%)
Healthy	57.0±2.3 a[Z]	238±6.9 a	4.9±0.1 a	13.3±0.2 bc	0.43±0.04 b
Control	21.0±2.7 bc	189±4.7 c	4.9±0.1 a	13.2±0.2 c	0.47±0.11 a
Fungicide	23.0±1.7 bc	201±4.2 bc	4.9±0.1 a	13.1±0.1 bc	0.46±0.04 a
NaOCl 0.1%	20.3±4.9 c	204±8.4 bc	5.0±0.1 a	13.5±0.2 bc	0.47±0.00 a
NaOCl 0.25%	31.0±3.1 b	215±4.0 b	5.0±0.1 a	14.0±0.2 a	0.46±0.02 a
NaOCl 0.5%	22.7±2.9 bc	208±5.2 b	4.9±0.1 a	13.8±0.1 ab	0.46±0.01 a

[Z]Means separation within columns by 5% DMRT.

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