

USE OF HOT WATER FOR SOIL-BORNE DISEASE CONTROL

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Control of Verticillium wilt of tomato

Effect of hot water treatment on the occurrence of Verticillium wilt of tomato was examined in a commercial greenhouse that has been heavily infested by *V.dahliae*, a causal pathogen of tomato Verticillium wilt, for more than 10 years. In July 25, 2001, 200L/ m² of hot water boiled at 95°C by diesel-fired boiler was sprayed onto the soil surface by the dragging system at the treatment speed of 18 m²/h. Seven days after the treatment, fertilizers and organic compost were supplied to the soil and then tomato seedlings were planted in the following days. Tomato plants have been grown in the greenhouse until at the end of June in 2002. Symptom appearance has been monitored throughout the production term. At the end of the harvest, the final disease incidence was evaluated by the occurrence of yellowing between the main veins on older leaves. No comparative control was prepared within the greenhouse. By the hot water treatment, disease incidence has dramatically reduced from 99.4% (before in 2001) to 16.0% (after in 2002) and, as a result, total yield in 2002 increased 39.4% (Table 1).

Long term suppression of tomato corky root

Duration of the suppressiveness of tomato corky root caused by *Pyrenochaeta lycopersici* by hot water treatment was evaluated in greenhouse trials over 3 years from 1999 to 2001. In October 1999, just before the first cultivation, 300 L/m² of hot water at 95°C was sprayed onto the soil surface in a greenhouse infested by *P.lycopercisi* by the same dragging system. After fertilizers were supplied, tomato plants were planted and grown until at the end of June in 2000. In the following years, 2001 and 2002, tomato plants were successively grown in the same greenhouse without applying hot water treatments. Exactly the same size and type of infested greenhouse was used as a control, in which dazomet, metam sodium and chloropicrin were independently applied in 1999, 2000 and 2001, respectively, just before transplanting in the each year. In the first and second year, no symptom of

corky root rot was observed in the both greenhouses and satisfactory yields were obtained. In the third year, 2002, symptoms of corky root were observed but the disease severity in the both was significantly low as to be 16.3 for hot water treatment and 7.3 for soil fumigation (Table 2). These results demonstrate that the suppressiveness achieved by the hot water treatment last at least 3 successive production period over 3 years.

Soiless culture media can be effectively disinfested

Phytophthora root rot of gerbera (*Gerbera hybrida*) has been widely spread not only in the greenhouse production but also in a rockwool hydroculture that has been introduced to escape the disease in the former, traditional soil culture system. Because the causal agent is *Phytophthora cryptogea* that propagate through zoospore *via* water, the disease spreads to the whole soilless culture system even in a case that one of the beds is contaminated by the pathogen. As there has been no effective method to disinfect the contaminated rockwool media, hot water treatment was applied at the time of replanting in a commercial grower's greenhouse. Heat resistant dripping tubes were placed on the rockwool media and the beds were covered with transparent plastic film to prevent heat loss. Then hot water of 65 to 80°C was supplied through the dripping tubes until the whole rockwool media were fully immersed. After 1hr, hot water is drained and refilled to uniformly heat the media. This refilling treatment was repeated three times to ensure that the rockwool media were completely disinfested without the damage onto hydroculture materials. By hot water treatment, temperature of the rockwool media exceeded 60 °C and lasted for more than 5 hours. As a result, Phytophthora root rot was completely suppressed, while in a control that the infested media were just replaced with the new ones, the disease occurred at the incidence of 6% (Table 3).

In conclusion, hot water treatment can be effectively applied not only to suppress the soil-born diseases of tomato but also to disinfest rockwool media repeatedly used in the hydroponic culture. Further trails for the diseases occurred in various crops and cultivation systems, such as Fusarium wilt of tomato and spinach, Monosporascus root rot and root knot, of cucurbits etc. are now being tentatively underway in Japan.

<Reference>

Uematsu,S., Nishi,K, and Kita,N. 2003. Hot water soil sterilization begins in Japan. Farming Japan vol.37(2):35-41.

Table 1. Effect of hot water treatment on the occurrence of Verticillium wilt of tomato

Production year	Disease		Total yield(t/ha)
	Incidence(%) ¹	Severity ²	
2001 (before treatment)	99.4	66	123.2 (100) ³
2002 (after treatment)	16.0	5	171.7 (139)

¹percentage of the number of diseased plants, ²calculated from $100 \times \Sigma(\text{disease index from 0 to 4} \times \text{number of the diseased plants}) / (4 \times \text{number of the total plants examined})$, ³percentage for the comparison

Table 2. Comparison of hot water treatment and chemical fumigation on the occurrence of tomato corky root in the successive 3 -year trials

Year	Hot water treatment			Chemical fumigation		
	Application	Disease ¹ Severity	Yield (t/ha)	Application	Disease ¹ Severity	Yield (t/ha)
1999	Yes	0	188.3	Dazomet (200kg/ha) ²	0	165.0
2000	No	0	168.5	Metam sodium (300L/ha) ²	0	157.8
2001	No	16.3	155.3	Chloropicrin (200L/ha) ²	7.3	142.3

¹calculated from $100 \times \Sigma(\text{disease index from 0 to 4} \times \text{number of the diseased plants}) / (4 \times \text{number of the total plants examined})$, ²amount of application per hectare

Table 3. Suppression of Phytophthora root rot of gerbera in hydroponic culture by hot water treatment on the infested rockwool media

Temperature of hot water treated	Disease incidence ¹ (%)	Occurrence ¹ of dead plants (%)
50 °C	31.3	10.1
55~60	20.6	16.5
60	0	0.3
65	0	0.9
New rockwool	6.0	3.4

¹percentage of the number of diseased or dead plants in 10 to 20 beds, respectively.