DEVELOPMENT OF A NEW SOIL DISINFESTATION WHICH WORKS UNDER LOW TEMPERATURE.

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There are many soil disinfestation techniques such as chemical fumigation, anaerobic soil disinfestation (ASD), steaming, hot water irrigation, solarization, and so on. Farmers use the disinfestation technique suitable for their cropping systems. In Japan, suitable season for soil disinfestation and crop production is overlapping and many farmers reluctantly do soil disinfestation in unsuitable cold season. Because anaerobic soil disinfestation depends on soil microbial activity, it is unstable under relatively low (< 25°C) soil temperatures. Effect of chloropicrin fumigation also diminishes under low temperature.

Effects of ASD using ethanol and wheat bran on *Fusarium oxysporum* f. sp. *lycopersici* was compared under different incubation temperature. For ethanol treatment, 4 kg soil placed in plastic box was inundated with 1 L of 0.5 to 2.0% (v/v) ethanol. For wheat bran treatment, 4 kg soil was mixed with 40 g wheat bran and inundated with 1 L of distilled water. Pathogen inoculum packet was buried in the center of the soil and the soil was incubated at 30, 20, and 10°C for 14 days. Then, the packet was retrieved and survival of the pathogen was checked by dilution technique using selective medium. As the results, the pathogen was effectively suppressed in all ASD treatment under 30°C, while effect of all ASD treatment markedly diminished under 20 and 10°C (Table 1).

Fungicidal activity of chloropicrin was also evaluated under different incubation temperatures. *F. oxysporum*, *Diaporthe sclerotioides*, and *Verticillium dahliae* were grown on potato dextrose agar, and their agar plugs were obtained. The plugs were placed in glass jar and fumigated with chloropicrin for 2 and 4 hours under 15 and 25°C. Then, viabilities of the pathogens were confirmed on fresh potato dextrose agar. As the results, chloropicrin was less effective under low temperatures (Table 2).

Artificially infested soil was also used for fumigation tests. Sterilized soil (perlite, Light-colored Andosol, and Brown Lowland Soil) was mixed with bud cells of *F. oxysporum* and the soil moisture content was adjusted appropriately for chloropicrin fumigation. The infested soils were placed in glass jar and fumigated with chloropicrin at 25 and 15°C for 3hours. Then, survivals of pathogen were evaluated by dilution plate technique. Chloropicrin was less effective at 15°C (Table 3).

As described above, both ASDs and chloropicrin are less effective when they are applied at low temperature. In that condition, decomposition of organic material used in ASD delays and the residual material might facilitate resurgence of pathogens. Chemical fumigants that remained in the soil might give adverse effect to plants.

During several trials, we discovered that *F. oxysporum* f. sp. *lycopersici* was effectively suppressed in soil which was amended with a certain experimental material (EM powder), irrigated by water and incubated at 15 and 10°C while ASD using wheat bran and 1% (v/v) ethanol were not effective (Table 4). After the soil treatment, tomato seedlings were transplanted to the soil. Any adverse effect on tomato was not observed during 4 weeks (data not shown).

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Table 1. Effect of ASD treatment under different temperatures.

Treatment	Number of *Fusarium oxysporum* f. sp.

	lycopersici (log CFU/g dry matter)		
	30°C	20°C	10°C
UTC	7.68[a]	7.25[a]	7.35[a]
Water	2.58[b]	6.70[b]	7.43[a]
ASD			
0.5% ethanol	<1.31	5.81[c]	5.93[c]
0.75% ethanol	<1.30	5.25[d]	4.50[d]
1.0% ethanol	<1.31	5.65[c]	4.05[e]
2.0% ethanol	<1.32	5.21[d]	7.32[ab]
Wheat bran	<1.33	2.90[e]	6.72[b]

Three replications were made.

Table 2. Viabilities of pathogens after chloropicrin fumigation for 2 hours.

Temp. (°C)	Conc. (mg/m^3)	Survival number of pathogen		
		Fusarium oxysporum	*Diaporthe sclerotioides*	*Verticillium Dahliae*
25	0	3	3	3
	1660	—	—	3
	2490	—	—	0
	3320	1	3	—
	6640	0	0	—
15	0	3	3	3
	6640	—	—	1
	9960	2	2	—
5	0	3	3	3
	8300	—	—	1
	9960	—	3	0
	14940	3	—	—
	16600	1	—	—

Three agar disks of test pathogens were used.

Table 3. Effect of chloropicrin fumigation on *Fusarium oxysporum* f. sp. *lycopersici* in soil.

Temp. (°C)	Conc. (mg/m³)	Perlite	Light-Colored Andosol	Brown Lowland Soil
25	0	5.3 (0.0) *	4.2 (0.1)	5.1 (0.0)
	208	3.7 (0.1)	1.9 (0.1)	4.1 (0.0)
	415	<1.7	<1.8	1.7 (0.0)
	623	<1.7	<1.8	<1.7
15	0	5.6 (0.0)	5.4 (0.0)	5.5 (0.0)
	623	3.5 (0.0)	4.4 (0.0)	4.8 (0.1)

* log CFU/ g dry soil (± S.E.)

Table 4. Effect of an experimental material treatment on *Fusarium oxysporum* f. sp. *lycopersici*.

Temp (°C)	Treatment	Water	log CFU/g dry matter		
			1 W	2W	3w
10	Water	+	6.4[a]	6.5[a]	6.5a
	0.5% WB	+	6.2[ab]	5.4[ab]	5.3c
	1.0% WB	+	5.8[ab]	5.2[ab]	5.4bc
	0.5% EM	+	5.9[ab]	4.3[b]	4.2e
	1.0% EM	+	1.2[c]	1.2[c]	2.1f
	1.0 % WB + EM	+	5.2[b]	5.6[ab]	4.8d
	1.0% EM no water	—	—	—	5.7b
15	UTC	—		6.0a	5.9[a]
	Water	+		5.7ab	5.5[b]
	1.0% WB	+		5.2b	4.6[c]
	1.0% EM	+		ND (<2.0)	ND (<2.0)
	1.0% WB + EM	+		2.6c	3.7[d]

%, (w/w) WB, wheat bran EM, experimental material