SOIL DISINFESTATION TRIALS AGAINST FUNGAL PATHOGENS OF LISIANTHUS PLANTS

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Introduction

The production of ornamental plants continues to be a prospering and expanding industry across Japan. The most destructive pathogenic microorganisms for ornamental production are the soil-borne Fusarium wilt diseases pathogen, *Fusarium oxysporum* and bacterial wilt disease pathogen, *Ralstonia solanacearum* against *Eustoma grandiflorum* (lisianthus) plants in Japan. Once these diseases have broken out, plants are rarely suitable for commercialization. When the diseases have become established in a production system, many approaches for achieving suppression have been explored, but most have not met the high standard for zero diseases threshold demanded by the industry. Furthermore, no curative control method is currently available. Therefore, soil disinfestation is an essential agricultural practice to conquer soil-borne diseases and thereby ensure crop productivity. Chemical soil disinfestations (CSDs), for example, chloropicrin fumigants are known as chemical soil fumigation as the most effective method to control soil-borne diseases for long years. However, sufficient suppressive efficacies of soil-borne diseases have not been provided by chloropicrin with conventional application methods. Anaerobic Soil Disinfestations (ASDs) had been developed as an environmentally friendly alternative to CSDs.

The purposes of our study were to conduct fields experiments in a *Eustoma grandiflorum* (lisianthus) monoculture system, and to verify the disinfestation efficiencies of CSD with chloropicrin tablet formulation and ASD with diluted ethanol as the carbon source.

Materials and methods

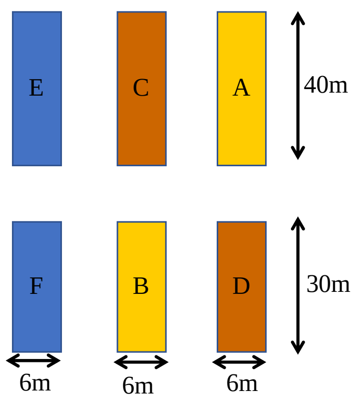
Field experiments were conducted in 6 greenhouses (6 m in width x 30 m or 40 m in length) in Okinoerabujima-island, Kagoshima located in the southern part of Japan in August, 2017. This region is characterized by a subtropical plateau monsoon climate and the soil type is classified as a Calcaric Dark Red soils (Luvisols, Cambisols). Lisianthus had been consecutively cultivated more than a decade and thereby suffered severe Fusarium and Bacteria wilt diseases in these experimental fields.

Six treatments, A) 0.75 % Et and C) 1.0 % Et at 610m^3 covered with a Ground-King 5 (TIF, Ground-King 5, C.I.Kasei CO.,LTD.) , B) ASD with 0.75 % ethanol (Et) and D) 1.0 % Et at 610m^3 ha^{-1} covered with a conventional polyethylene (PE, 0.05 mm thickness) film, F) CSD with chloropicrin tablets (100,000 tablets ha^{-1}, 300 L active ingredient (ai) ha^{-1}) covered with a Ground-King 5, E) CSD with chloropicrin tablets (100,000 tablets ha^{-1}, 300 L ai ha^{-1}) covered with a TIF (High-Barrier, Iwatani Materials Corp.), respectively, in Fig. 1. These treatments lasted for 4 weeks.

For sequential changes of physicochemical soil environmental properties in ASD treatment sites, Eh and soil temperature were measured using Thermo Scientific Eh meters. Before and after each soil disinfestations, densities of *Fusarium oxysporum* and *Ralstonia solanacearum*, and just before harvesting, wilt flowers were investigated.

Results and discussion

Wilt disease pathogens, *Fusarium oxysporum* and *Ralstonia solanacearum* usually survives into deep layer soils more deeply than 50 cm (Table 1). In these field experiments, unevennesses of suppressing diseases were large in each treatment plot, but 1.0 % Et-ASDs relatively provided better efficiencies of suppressing pathogens densities and decreasing wilt disease ratios than other treatments. Moreover, both CSD covered with TIF and Et-ASD treatments significantly decreased wilt disease ratios from former cultivations. Taken together, these results indicate that the Et-ASD treatment might be a promising disinfestation practice to control soil-borne disease in the Lisianthus monoculture system.



	material	treatment	covering film	Wilt disease ratios of former cultivations (%)
A	ethanol	0.75% 610m^3/ha	TIF (Ground King 5)	ca. 40
B			Polyethylene	ca. 40
C		1.00% 610m^3/ha	TIF (High-Barrier)	ca. 70
D			polyethylene	ca. 70
E	chloropicrin tablets	100,000 tablets/ha	TIF (High-Barrier)	ca. 10 to 20
F			TIF (Ground King 5)	ca. 10 to20

Fig. 1 Field plots layout of CSD and ASD experiments.

Table 1 *Fusarium oxysporum* densities pre- and post-CSD and Et-ASD and wilt disease ratios

	soil depth	*Fusarium oxysporum* densities*		wilt disease ratio (%)	
		pre-treatment	post-treatment	1st cultivation	2nd cultivation
A	20	79 ± 86	40 ± 90	4.6	7.0
	50	0 ± 0	14 ± 30		
B	20	66 ± 81	37 ± 55	8.0	34.8
	50	28 ± 39	0 ± 0		
C	20	66 ± 113	12 ± 27	2.8	12.0
	50	39 ± 58	0 ± 0		
D	20	369 ± 318	0 ± 0	3.8	25.6
	50	0 ± 0	0 ± 0		
E	20	213 ± 217	25 ± 55	5.0	17.0
	50	28 ± 38	0 ± 0		
F	20	128 ± 166	26 ± 57	3.4	28.8
	50	14 ± 31	26 ± 58		

*CFU/g dry soil, values (means ±SD, n=5)

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