BIOLOGICAL SOIL DISINFESTATION (BSD) TECHNIQUES WITH DILUTED ETHANOL

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Methyl bromide (CH_3Br) was a major fumigant used in Japan to control soil-borne diseases in crops such as cucumbers, gingers, tomatoes, melons, green peppers, etc. The use of CH_3Br as a soil fumigant was phased out as stratospheric ozone-depleting substance in 2005, but no new chemical or non-chemical alternative has yet been commonly used as its substitute. For now, chloropicrin (trichloronitromethane) and 1,3-dichloropropene (1,3-D) are seen as the best alternatives to CH_3Br. Although these two fumigants are not recognized as stratospheric ozone-depleting substances such as methyl bromide, their rapid volatilization causes air pollution that is a public health concern. Economically feasible new soil fumigation techniques are desired eagerly by growers. The BSD techniques with diluted ethanol have been developed to prevent soil-borne diseases.

This project was conducted by NIAES, Central Agricultural Experiment Station of Hokkaido Research Organization, Chiba Prefectural Agriculture and Forestry Research Center, Kanagawa Agricultural Technology Center, Gifu Prefectural Agricultural Technology Center, Gifu Prefectural Hilly Agricultural Institute, Tokushima Agriculture Forestry, and Fisheries Technology Support Center, and Japan horticultural Production and Research Institute and Japan Alcohol Corporation, from FY2008 to FY 2011, and subsidized by the grant “Research and development projects for application in promoting new policy of Agriculture Forestry and Fisheries (2019)” from the Japanese Ministry of Agriculture, Forestry and Fisheries.

The main purposes of this project were (1) to clarify the mechanism of these BSDs; (2) to optimize and adapt the methods to each agricultural conditions; and (3) to draw up an implementation manual regarding BSDs with diluted ethanol. Consequently, we summarized the key points of our project results as below

1: The suppression mechanisms of soil-borne pathogens are accountable for differences in their sensitivities to changes in physical and chemical soil environments.

2: Because these diluted ethanol solutions to apply for BSDs have little direct effect on soil-borne pathogen, the ethanol material does not meet the category of pesticides in Japan. Therefore, this ethanol material is not to subject to control under the pesticide regulation, and farmers are able to use these BSD techniques.

3: The implementation manual and details of technical data on BSDs with diluted

ethanol (**Fig. 1**)were published. The manual and technical data in Japanese are available for download from the URL below.
http://www.niaes.affrc.go.jp/techdoc/ethanol/

Table 1 Example of the application of BSD techniques with diluted ethanol

crop	disease	ethanol concentration (%, v/v)	aplication rate (L/m^2)
cucurbitaceous vegetable	phomopsis rot	1～2%	100～200
spinach	fusarium wilt	0.5～1%	100～200
strawberry	yellows, anthracnose	0.5～2%	100
tomato	brown root rot	0.75%	200
carnation	bacterial stem rot	2%	100～150
cucumber	root-knot	0.5～1%	100～200

Table 2 Cost comparison with the conventional soil fumigation techniques

material	cost(thousand yen/1000m^2)		
	material	device	light, heating and water utility
ethanol	112～223	16	22
wheat-bran	38	–	23
rice-bran	24	–	23
molasses	70～100	16	45
chloropicrin	62	8	4
dazomet	49	3	4
D-D	14	8	4
iodomethane	162	8	4

* At this point, alcohol formulation for biological soil disinfestation is sold with the packaging container of a Bag-in-Box (BiB) of 20L and for about 2,900 yen. The ethanol content of this alcohol formulation is less than 65% v/v. In the near future, a significant cost cut will be available by the use of a reusable large-sized container or a tank truck, and by the rationalization of distribution.

Fig. 1 The implementation manual (left) and details of technical data (right) on BSDs with diluted ethanol