

# EFFICACY OF ETHYL FORMATE AS A QUARANTINE FUMIGANT FOR THE CONTROL OF PESTS IN FRUITS

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## Introduction

In Korea, 10% of methyl bromide (MB) consumption (average 100 tonne MB pa) was used to treat imported oranges and bananas for QPS purpose in 2006. Korea has been importing 125,000 tonne oranges and 279,000 tonne of bananas annually. Mandatory fumigation with MB was carried out on most imported oranges (94.4%) and some imported bananas (20%) in order to meet National Plant Quarantine Service (NPQS) requirement. Since ethyl formate (EF) as a fumigant was first found effective for grain fumigation on box-cars in Australia, current chemical strategies involving safer and environmentally friendly chemicals make it appropriate to carry out further commercialization on EF as a potential methyl bromide (MB) alternatives. EF is currently registered as a fumigant on dried fruit in Australia and is used as a food additive for various reasons worldwide. Recently there has been more research into use of EF for durable commodities because of its valuable attributes such as fast kill (<1 days), safe use for grains and cereals, rapid breakdown and possible protectants as well as fumigant properties. Recent field trials showed success in terms of maximum residue level (MRL) without forced aeration, threshold limit value (TLV <100ppm for fumigation period), flammability limit and maintenance of quality (germination and colour *etc*). Recently BOC has developed VAPORMATE<sup>®</sup> (16.7wt% EF in liquid carbon dioxide) in order to eliminating flammability and use the synergistic effect of carbon dioxide. VAPORMATE has been registered as a pesticide in Australia and New Zeland and registration applications is being processed in South and East Asia. While VAPORMATE as durable commodity and structure fumigants is well demonstrated, VAPORMATE as a perishable commodity fumigant for quarantine purpose is under investigation. This study evaluated the efficacy of EF as a quarantine fumigant for control of the two common fruit pest, the two spotted mite (*Tetranychus urticae*) and the citrus mealybugs (*Planococcus citri*).

## Laboratory bioassays

The EF exposures were carried out at 21±2°C in gas-tight 8L glass desiccators for 4 hours. The desiccators were sealed with glass stoppers containing a septum through

which EF was dosed and gas sample were taken for analysis by gas chromatography. After 4 hours of fumigation, the desiccators were opened in the fume hood for aeration. Mortality of adult and nymph was assessed under a microscope. Hatching rate of eggs was investigated after incubation for 4~5 days.

## Results and Discussions

Table 1. Toxicity of EF to two spotted mites and citrus mealybugs

Species	Stage	LC <sub>50</sub> (mg/L)	LC <sub>95</sub> (mg/L)	LC <sub>99</sub> (mg/L)	Slope (±SE) <sup>a</sup>	DF	x
<i>T. urticae</i>	Adult	4.96	7.39	8.71	9.51(±1.1)	23	2.56
	Egg	12.68	36.82	55.95	3.63(±1.3)	23	15.43
<i>P. citri</i>	Adult	5.19	8.25	10.00	8.18(±1.5)	23	2.84
	Nymph	2.89	5.58	7.34	5.77(±1.4)	26	5.46

<sup>a</sup>Standard error

According to Simpson et al (2004) studies of EF alone and in combination with liquid carbon dioxide against mixed age stage of two spotted mites with strawberries, resulted in incomplete control, while multiple application of EF increased mite mortality. Also, they found the concentration of CO<sub>2</sub> for EF fumigation is critical because mortality of target pest species is variable depending on CO<sub>2</sub> level.

In our study, more systematic data to control different stages of two spotted mites and citrus mealybugs in terms of estimated CT in Table1. The LC values are useful fundamental data for future practical trials because dose of EF in fumigation chamber is variable depending on sorption to target fresh fruits, loading factors and their application methods (formulated with CO<sub>2</sub>) as well as fumigation conditions. The L(Ct)<sub>99</sub> values of EF are 96 and 21gh/m<sup>3</sup> against eggs of two spotted mites and adult citrus mealybugs, respectively. The dose of EF and variable concentration of CO<sub>2</sub> is not examined phytotoxicity to target fresh fruits but will be investigated systematically in future practical applications.