

ETHYLENE DIBROMIDE AND METHYL BROMIDE FUMIGATION OF PERSIAN LIMES AND LEMON-LIMES¹

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Abstract. Fumigation tests were conducted with commercially processed Persian limes, *Citrus aurantiifolia* cv. Tahiti (Christm.) Swingle, and lemon-limes, a reported hybrid of *Citrus aurantiifolia* X *Citrus limon* (L) Burm. f., to determine their susceptibility to damage by ethylene dibromide (EDB) and methyl bromide (MB) at rates required to meet regulatory requirements of certain countries and states. No damage could be attributed to either fumigant and neither showed evidence of increasing fruit yellowing. To the contrary, MB decreased fruit yellowing.

Florida Persian limes, *Citrus aurantiifolia* cv. Tahiti (Christm.) Swingle, and lemon-limes, a reported hybrid of *C. aurantiifolia* X *C. limon* (L) Burm. f., destined for foreign and domestic markets, in areas where citrus is produced, are required to be fumigated due to the presence of the Caribbean fruit fly, *Anastrepha suspensa* (Loew) in the growing area. Florida is constantly threatened with the introduction of other fruit flies such as the Mediterranean fruit fly, *Ceratitis capitata* (Wied.). Establishment of such fruit flies in the lime-producing areas would lead to even more restrictions on fruit movement and increased requirements for fumigation to meet regulatory requirements.

Market acceptance of limes is related to color (1, 2). A marked preference is exhibited by purchasers for green or light-green fruit, whereas, yellowing or yellow fruit is considerably less desirable.

Due to the concern of Florida lime and lemon-lime growers that fumigation with ethylene dibromide (EDB) or methyl bromide (MB) may damage fruit or induce yellowing, tests of these fumigants were conducted to ascertain the effects. Additional analyses of the effects on different size classes of fruits were also conducted.

Materials and Methods

A 100 cu ft atmospheric pressure chamber was used for the fumigation tests with methyl bromide. This chamber is equipped with a squirrel-cage fan capable of completely circulating the volume of air in the chamber 2 times per minute. The fan forces the air up through a 2-inch diameter pipe to a 2-inch perforated pipe mounted along the ceiling. This arrangement facilitates circulation of MB throughout the chamber and the material to be fumigated. Technical grade methyl bromide, without chloropicrin, was used. To meet present recommendations for surface pest fumigation, 3 lb. of MB was used per 1,000 cu ft of chamber space for 2 hr of exposure at 70°F or above, followed by aeration for 1 hr.

The 10,000 cu ft atmospheric chambers located at the Doyle Conner Building in Gainesville were used to fumigate with EDB. These chambers are utilized to fumigate citrus fruit to meet regulatory requirements. Each chamber is equipped with a 10,000 cu ft capacity fan which moves the air from floor level and exhausts between the ceiling

of the semi-trailer and the load. Fruit undergoing tests were placed within a semi-trailer loaded with citrus. The recommended USDA schedule of 8 oz of technical grade ethylene dibromide per 1,000 cu ft of chamber space for a 2-hr exposure period at 70°F or above was used. The loads were aerated in the chamber for 1 hr following treatment.

Prior to each fumigation test, all fruit were hand-graded for removal of decaying and damaged fruit. Pantastico et al. (3) noted that rough handling was associated with rapid disappearance of the desirable dark green peel color. Therefore, to avoid inconsistent results, only firm undamaged fruit were selected for testing. Selected fruit were sized as follows:

| Diameter (inch) | Size Designation |
|-----------------|------------------|
| 1.87 | 63 |
| 2 | 54 |
| 2.25 | 48 |
| 2.5 | 42 |
| 2.75 | 32 |

The sized and graded fruit were packed into commercial cartons for fumigation.

Following fumigation, all treated fruit were held for 24 hr at room temperature to simulate the 24-hr aeration required for commercial shipments. The fruit were then held at 48°F for 3 weeks. All treated fruit and control fruit were inspected at 7-10 days and 21-29 days after treatment. The 1-week inspection was made to correspond with the time for the fruit to arrive at the western domestic market. The 3-week inspection corresponds with the time required for the fruit to reach the Japanese market when shipped to western ports and then by container ship to Japan.

Thirty-six lots, consisting of 1,841 fruit, were involved in the test. Eight lots were utilized as controls (4 limes and 4 lemon-limes). Fourteen of the treated lots were limes (8 MB and 6 EDB), and 14 of the treated lots were lemon-limes (8 MB and 6 EDB). Treatment dates were: October 10, 1979, December 5, 1979, and January 11, 1980. All treatments were conducted at temperatures of 70°F or above.

Results and Discussion

No damage was observed to the peel of limes or lemon-limes that could be attributed to fumigation with either methyl bromide or ethylene dibromide. In the first series fumigated on October 10, 1979, untreated lemon-limes exhibited considerable skin injury, but fruit fumigated with MB exhibited a lesser incidence of this injury. This skin injury appeared related to maturity of the fruit, yet was not observed in subsequent tests including more mature fruit.

The limes fumigated with MB exhibited less color change than either the untreated control or those fumigated with EDB (Table 1). Limes fumigated with EDB exhibited a slightly higher incidence of yellow fruit (2% more than the control) and a significantly greater percentage of green fruit (16% more than the control).

The lemon-limes fumigated with MB exhibited a considerable reduction in color change from green to yellow compared to the untreated control (Table 1). In comparison to the MB-fumigated lemon-limes, the fruit treated with EDB exhibited a greater loss of green coloration. The

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Table 1. Color of limes and lemon-limes at 21 days after treatment with methyl bromide (MB) (3 lb. per 1,000 cu ft for 2 hr) or ethylene dibromide (EDB) (8 oz per 1,000 cu ft for 2 hr).^z

| Variety | Treatment | Total of Fruit | Fruit Color | | |
|-------------|-----------|----------------|-------------|---------------|----------|
| | | | % Green | % Light-Green | % Yellow |
| Limes | MB | 539 | 39 | 55 | 6 |
| | EDB | 297 | 47 | 41 | 12 |
| | Control | 201 | 31 | 59 | 10 |
| Lemon-Limes | MB | 342 | 69 | 26 | 5 |
| | EDB | 323 | 49 | 36 | 15 |
| | Control | 139 | 51 | 27 | 22 |

^zNo comparison should be made between EDB and MB, since fumigation requirements mandate the specific use of EDB or MB, depending on the target pest.

EDB-treated fruit remained greener than the untreated control.

Some significant color changes occurred between size classes in the different tests; however there was no appreciable difference in the summed data. The larger fruit exhibited slightly more yellowing than the smaller fruit in both the fumigated lots and the control.

Fumigation of limes and lemon-limes with methyl bromide and ethylene dibromide did not result in any observable peel damage, nor did it adversely affect the fruit color. Retention of the desired green color may be extended by fumigation with methyl bromide.

Literature Cited

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