

Methyl Bromide as a Fumigant

- ✉ MeBr was identified as an ozone depleter in 1985.
- ✉ Montreal Protocol of 1987 established use reduction plan.
 - ✉ Gradual phase-out to ease economic losses.
 - ✉ Developed countries to achieve 100% reduction by 2005 (Montreal protocol of 1997).

Critical Uses and Exemptions

- ✉ Some uses have been defined as critical and use is allowed (at least until a satisfactory replacement is developed).
- ✉ Mainly quarantine and preshipment fumigation uses.
- ✉ New protocol wording allowed ‘Critical Use Exemptions’.
- ✉ If no viable alternatives existed, a ‘case’ could be submitted for use at a defined level to be continued.
- ✉ Use rates for SE states estimated to allow MeBr use to continue on strawberries and selected vegetables.

Critical Use Exemptions

- ✉ Allow research into alternatives while allowing growers to continue use.
 - ✉ New fumigation materials used in conjunction with MeBr - chloropicrin, herbicides, etc.
 - ✉ New fumigants - MeI, dazomet, MITC-materials.
 - ✉ Old fumigants with new partners - Telone products.
- ✉ Improve fumigation efficiency.
 - ✉ maintain efficacy but reduce rate.

How Does Fumigation Work?

- ✉ It is a disinfestation (disinfection) process.
 - ✉ Cleansing of an inanimate surface of harmful microbes.
 - ✉ Reducing pathogens to below a critical threshold so disease won't develop (as soon).
 - 📄 Not 100% reduction - pathogen rebound.
 - 📄 Some beneficial microbes must remain.

Important Parameters for Disinfestation

- ✉ Nature of the surface - unmanageable; soil is nonhomogenous; large surface area.
- ✉ Level of organic matter.
 - ✉ Humus - little management; varies with soil type.
 - ✉ Detritus - manageable; crop or weed residue.
 - ✉ Biota - little control; varies with soil type and use.
- ✉ Contact time - manageable??
- ✉ 'Dose' - rate of fumigant - manageable??

Soil Microbes

- ✉ Soil is a complex environment with an extremely numerous and diverse biota.
- ✉ 25,000 to 30,000 lbs per acre ft. of life.
 - 📄 13,000 - 14,000 lb of fungi.
 - 📄 12,000 lb of bacteria.
 - 📄 1,800 lb of actinomycetes.
 - 📄 200 lb of protozoa.
 - 📄 50 lb of nematodes.
- ✉ Algae, mites, & insects - variable but significant.
- ✉ All organic - absorb/deplete fumigant dose.

Contact Time

- ✉ Key element in any disinfestation process.
- ✉ Within 48 hrs. MeBr under PE mulch film has exerted lethal effect because concentration has declined to sub-lethal levels. (good cond.)
 - ✉ Effect = rate x time.
- ✉ Damage to plants after 7 day plant back period?
 - ✉ Bad fumigation conditions?
 - ✉ NH_3 -toxicity - $(\text{NH}_2)\text{CO} + \text{H}_2\text{O} \rightarrow \text{NH}_3 + \text{CO}_2; \text{NH}_4^+$.
 - ✉ Nitrifiers in soil - $\text{NH}_3 \rightarrow \text{NO}_3^-$; slow to reestablish.
- ✉ Increased contact time = more efficacy at reduced rates.

Methyl Bromide Uses Globally

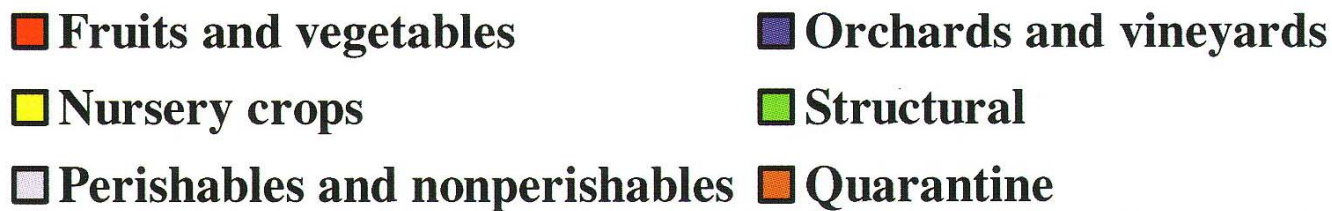
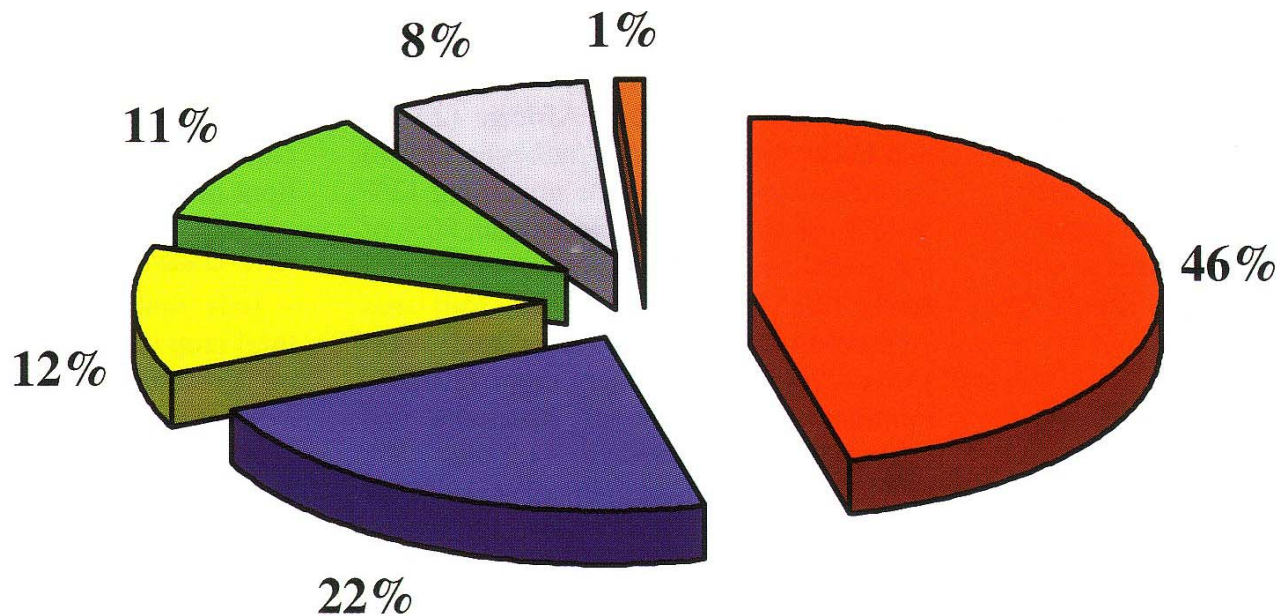


Fig. 2. Distribution of global methyl bromide use among different applications during 1992 (51,68).

Methyl Bromide Users - Worldwide

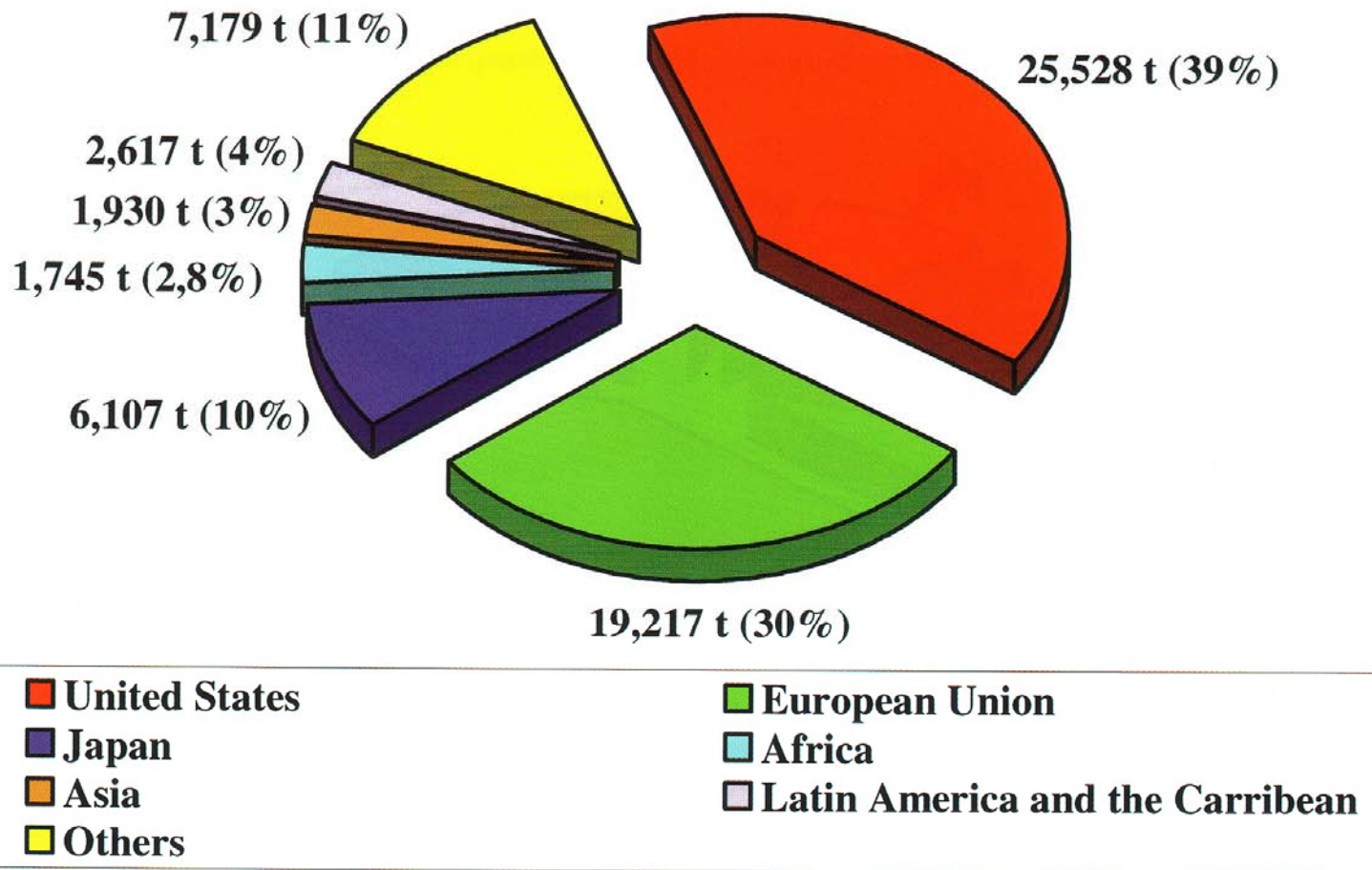


Fig. 1. World global methyl bromide use (metric tons) in 1991 (62).

Italy - A Case Study

- ✉ Italy is EU's biggest user.
 - ✉ 7,600 MT in 1995.
 - ✉ Sicily is largest regional user - 4,000 MT-1995.
- ✉ After research showed rate reduction potential, Virtually Impermeable Film was mandated for MeBr fumigation in 2000.
- ✉ MeBr use in 2001 - 3,700 MT.
 - ✉ Sicily's use in 2001 = 2,000 MT.
 - ✉ No reduction in acreage.

EU to United States

Conversion Factors: $\text{g/m}^2/\text{hour}$ to $\text{oz/yd}^2/\text{hr}$
multiply number of grams by 0.0313

Today 1 euro = \$1.31: E/m^2 to $\text{\$/yd}^2$
multiply by euros by 1.17

What is VIF?

- ✉ A composite product.
 - ✉ co-manufactured sheets of LDPE or HDPE and nylon or vinyl polymer.
 - ✉ Physical characteristics similar to PE.
 - 📄 Less stretchy; tends to be brittle.
 - 📄 reaction to temperatures is different.
- ✉ Me Br diffusion Characteristics.
 - ✉ PE - $> 50 \text{ g/m}^2/\text{hr}$ ($1.57 \text{ oz/yd}^2/\text{hr}$).
 - ✉ VIF - $< 1 \text{ g/m}^2/\text{hr}$ ($0.0313 \text{ oz/yd}^2/\text{hr}$).

Costs

✉ In Italy

✉ HD/LD PE film - \$0.06/ yd²

✉ VIF - \$0.12/ yd²

✉ Films applied with fumigant in Italy.

✉ PE with full rate of MeBr = \$0.70/ yd².

✉ VIF with 1/2-rate of MeBr = \$0.47/ yd².

What's Available in the US?

✉ European product

✉ PE + nylon

✉ PE + ethylene-vinyl alcohol polymer

✉ North American

✉ Some metallized films have much lower MeBr diffusion rates than regular PE film.

✉ Some grower and industry claims indicate that rates of MeBr under such films can be reduced by as much as 1/2.

Research

- ✉ A growing body of research in the US indicates that use of VIF will allow rate reduction of MeBr without loss of efficacy.
- ✉ Current problems
 - ✉ Consistency of performance among films and batches.
 - ✉ Laying characteristics different from PE film.
 - 📄 Requires changes in fumigation process - slow down.
 - 📄 Poor soil to film contact in some cases.
 - 📄 Greater problems with wind after laying film.

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- ✉ Replicated study to compare two VIF's and a metallized film to conventional PE film using reduced rates of MeBr.
- ✉ no crop.
- ✉ buried RKN and YNS at two depths.
- ✉ measure MeBr under films at 2, 4, 24, 48, 72, and 96 hrs.
- ✉ PE - 0, 0.5, and 1.0 rate of MeBr (200 lbs 67/33).
- ✉ VIF's and Met Film - 0.5 and 0.75 rate.