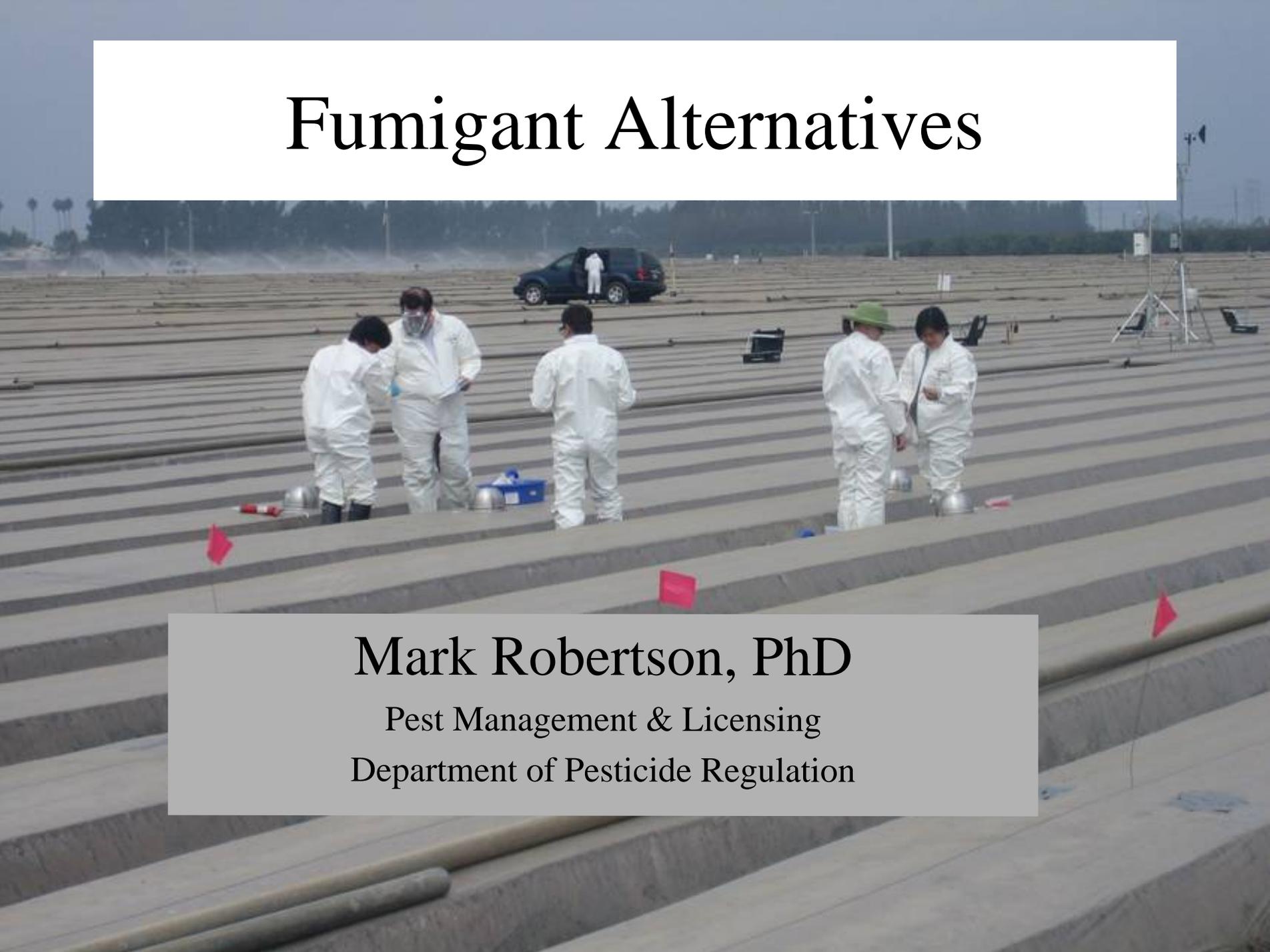


Fumigant Alternatives



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Overview

- **Current practice**
 - Principal fumigants
 - Fumigant characteristics
 - Risks & hazards
 - Application methods
- **Alternatives**
 - Mitigation practices
 - New Fumigants
 - Fumigant substitutes
 - Cultural practices

Current fumigation practice

- Agricultural
- Structural
- Post-harvest, stored products



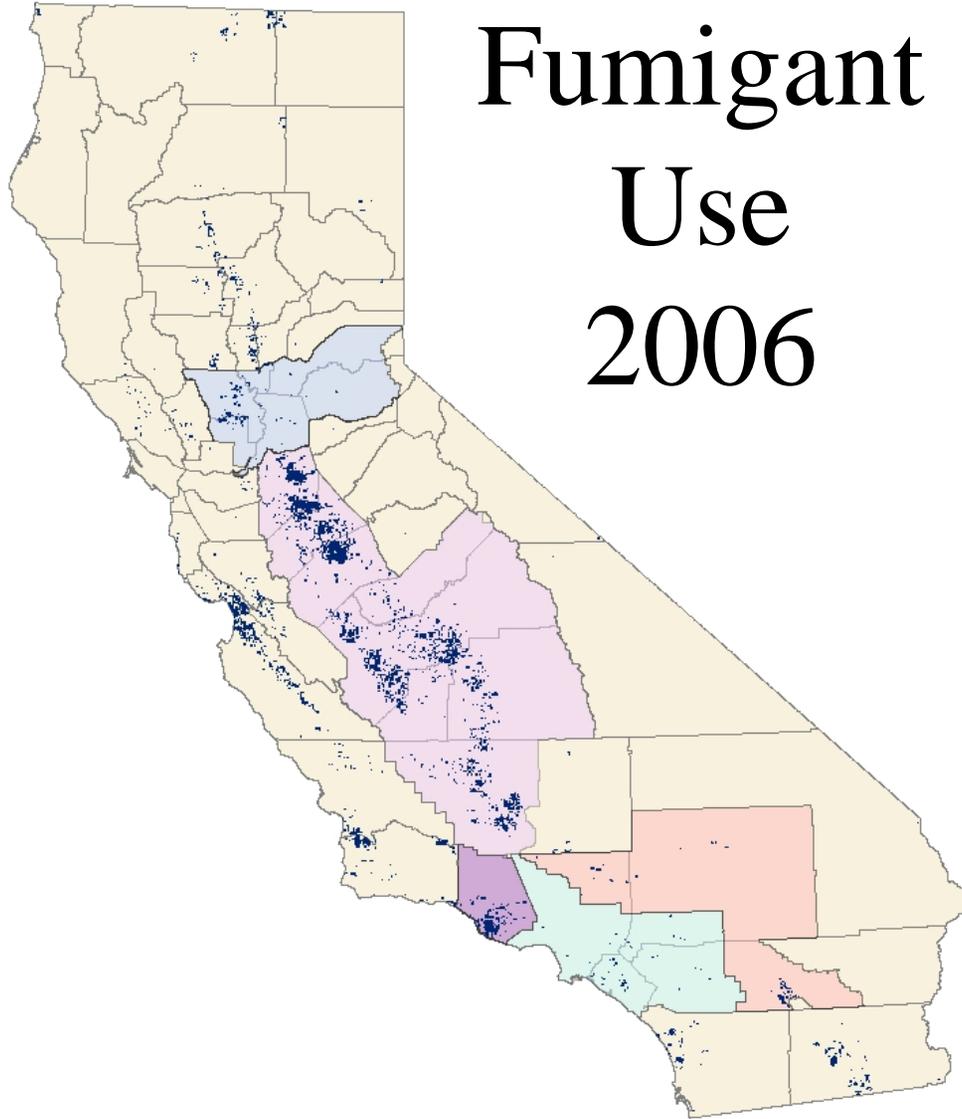
Principal Fumigants

- **Metam, Methyl isothiocyanate, (MITC)** (Production Ag)
- **1,3-Dichloropropene, (1,3-D)** (Production Ag)
- **Methyl bromide (MeBr)** (Production Ag,
Structural, Stored Products)
- **Chloropicrin** (Production Ag)
- **Sulfuryl fluoride** (Structural)
- **Sodium tetrathiocarbonate (Enzone)** (Production Ag)
- **Aluminum phosphide** (Production Ag,
Structural, Stored Products)

Pounds applied
Top Seven fumigants in 2006

AI	1996	2001	2006
METAM-SODIUM	15,501,650	12,460,997	11,362,375
METAM-POTASSIUM	0	464,882	3,202,884
1,3-DICHLOROPROPENE	1,956,846	4,141,173	8,591,883
METHYL BROMIDE	16,124,148	6,625,336	6,518,683
CHLOROPICRIN	2,814,318	4,278,136	5,018,831
SODIUM TETRATHIOCARBONATE	543,229	375,487	171,194
ALUMINUM PHOSPHIDE	105,291	99,856	148,735
Total	37,047,478	28,447,868	35,016,591

Fumigant Use 2006



Top 10 Crops 2006

Lbs. of Fumigant Used (about 70% of total)

CROP	1991	2006
STRAWBERRY	6,384,458	8,210,243
CARROT	2,698,286	6,042,263
TOMATO	1,090,196	3,281,503
POTATO	672,885	1,791,055
NUT TREES	1,038,564	1,429,521
GRAPE	1,540,160	1,339,616
PEPPER, FRUITING	217,196	1,092,854
STONE FRUIT	1,773,343	1,028,012
SWEET POTATO	198,675	992,507

Fumigant characteristics

- Broad spectrum biocides; although with differential activities on target pests:
 - Weeds, Nematodes, Bacteria, Fungi, Arthropods, Vertebrates
- Generally used one time as a preplant treatment
- Usually a gas, good soil infiltration

Risks & hazards

- Human health
- Phytotoxicity
- Environmental hazard
 - Water contamination
 - Ozone
 - VOC
- Nuisance

Standard application methods

Product	Typical application method
Methyl Bromide	350 lbs/ac, broadcast shank, tarped
Chloropicrin	200 lbs/ac, broadcast shank, tarped
Telone (1,3-D)	35 gal/ac, broadcast shank
InLine (1,3-D for drip)	25 gal/ac, drip application
Metam Sodium	75 gal/ac, broadcast shank, water seal







Alternatives: Mitigation practices

- Increase application depth
- Timing of application
- Soil amendments (increase degradation)
- Water seals
- Tarps
- Drip application

Alternative Fumigants

- Iodomethane or Methyl iodide--Target insects, fungi, nematodes, weeds
 - Effectiveness comparable to MeBr, human health concerns
- Propargyl bromide (PrBr)--Broad spectrum activity
 - Not new but revival of interest
- Propylene oxide--Target: fungi, nematodes, weeds
 - Used in stored products but now extended to soil
- Biofumigants:
 - Pennycress seed meal--Target: fungi, nematodes, weeds
 - DMDS dimethyl disulfide--Target: insects, fungi, nematodes, weeds
 - Strawberry yields comparable to MeBr

Alternatives: Fumigant substitutes

- Combinations of other pesticides
 - Herbicides, Nematocides, Fungicides, Insecticides, Antibiotics, Rodenticides
- New types of pesticides or new use in soils
 - *Muscodor albus*--Target: bacteria, fungi, nematodes
 - *Bacillus subtilis*--Target: fungi
 - *Bacillus thuriengensis*--Target: nematodes
 - DADS Diallyl Disulfide--Target: *Sclerotium cepivorum*

Alternatives: Cultural Practices

- Fallow
- Hand weeding
- Cover crops, (Competition, Biofumigant)
- Crop rotation (Host range & Biofumigant)
- Disease and pest resistant crop varieties
- No tillage
- Trap crop
- Solarization (Tarping)
- Barriers (mulches & tarping)
- Anaerobic sterilization

Conclusions

- No simple replacements
- Combinations of cultural practices with new and existing pesticides show promise
- New models for controlling soil pests and diseases are being developed
- Mitigation, replacements, and alternatives generally increase costs

Fumigant Alternatives for Methyl Bromide Prior to Turfgrass Establishment

J. BRYAN UNRUH, BARRY J. BRECKE, JOAN A. DUSKY, and JOHN S. GODBEHERE²

Weed Technology. 2002. Volume 16:379–387

Potassium azide was as effective as MeBr in controlling ‘Coastal’ bermudagrass, yellow and purple nutsedges, alexandergrass, broadleaf signalgrass, tall and sharppod morningglories, and various winter annual broadleaf weeds, but it failed to provide acceptable control of redroot pigweed. 1,3-Dichloropropene + oxadiazon did not control yellow nutsedge, purple nutsedge, or Coastal bermudagrass. Similarly, this combination treatment failed to control carpetweed but did provide 83% control of the winter annual weed species, 71% control of alexandergrass and broadleaf signalgrass, and $\geq 80\%$ control of tall morningglory, sharppod morningglory, and redroot pigweed. Dazomet + combination treatments provided control of Coastal bermudagrass at Jay; however, control of common bermudagrass, alexandergrass, and broadleaf signalgrass was not acceptable at Arcadia. Sedge species control with dazomet + combinations was poor ($<63\%$) at both sites. Iodomethane, a treatment not yet registered by the U.S. Environmental Protection Agency (EPA), controlled weedy grass species, sedge species, and broadleaf weeds present at the two locations under different environmental conditions. Metam-sodium alone and MS + chloropicrin, tarped and untarped, and MS + 1,3-D provided acceptable weed control; however, MS + chloropicrin covered with a plastic tarp for 48 h was the best MS treatment. Metam-sodium + chloropicrin, with plastic tarp, controlled weedy grass and broadleaf species equal to MeBr; however, unacceptable sedge species control at Jay and Arcadia was 56 and 79%, respectively. Metam-sodium applied alone failed to control redroot pigweed; however, MS + combinations provided control. **These studies confirm that no EPA-registered fumigant alternative to MeBr, applied alone or in combination for preplant turf soil fumigation, exists.**