



ProFume[®] Gas Fumigant Update: Diverse Uses for Commodity Protection

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History of ProFume[®] gas fumigant

- Early 1950's - Research by The Dow Chemical Company for an alternative to methyl bromide (MB) for structural fumigation
- 1961 – Vikane[®] gas fumigant, sulfuryl fluoride (SF) as the active ingredient, introduced to protect homes and structures from drywood termites and other pests
- Today - More than two million structures, including museums, cathedrals, historical landmarks, rare book libraries, and scientific and medical research laboratories, have been fumigated with Vikane to eradicate pests



Fumigation of Chemistry Research Building (1.4 million ft³), University of Florida, Gainesville, FL



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History of ProFume[®] gas fumigant

- 1995 – At the request of progressive food industries, Dow AgroSciences began investigation of SF as a MB alternative for post-harvest insect control
- Dow AgroSciences formed partnerships with leading stored product researchers, fumigators, distributors and food industries around the world to develop ProFume



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Dow AgroSciences Commitment to Your Industry

- **New Sulfuryl Fluoride Manufacturing Plant in Pittsburg, California**
 - Commissioned in July 2007
 - State-of-the-art manufacturing technology
 - World scale production
 - Ability to meet long term global needs



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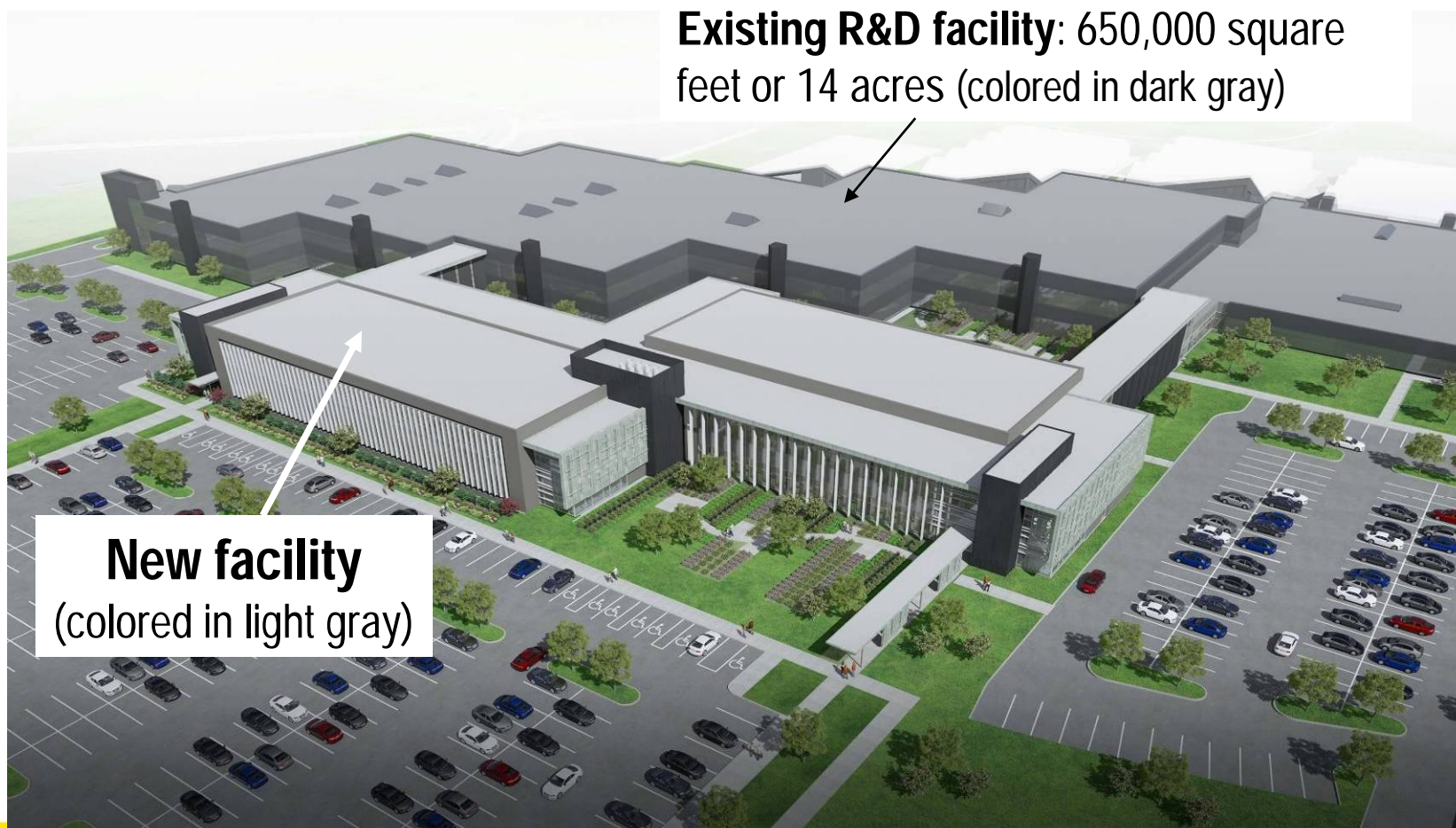
Dow AgroSciences Investing in Agriculture

- **On March 4, 2010 Dow AgroSciences announced a \$340 million multi-year Research and Development expansion in Indianapolis**
 - **More than 550 scientific and commercial jobs to be added as the company delivers innovation for agriculture**
 - **Includes construction of a 175,000 square foot research and development building as well as a 14,000 square foot greenhouse on the company's corporate campus**



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New R&D Building to House State-of-the-Art Technology





Key Benefits of ProFume[®] gas fumigant

- Broad-spectrum, effective and reliable control of rodents and all pest life stages
- Non-corrosive to equipment or electronics
- Non-flammable
- Low reactivity (no odor potential or off flavors)
- Excellent penetration and rapid aeration
- Flexibility to optimize current schedules and downtime
- Fumiguide[®] program and other Precision Fumigation[™] tools and techniques



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General Use Pattern

- **Varies based on country registration**
- **Residential and/or non-residential structures**
- **Stationary transportation vehicles (railcars, shipping containers, trucks, etc., excluding aircraft)**
- **Temporary and permanent fumigation chambers**
- **Storage structures**
- **Food handling establishments (e.g., pet food facilities, bakeries, food production facilities, mills, warehouses, etc.)**



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Commercial Adoption of ProFume[®] gas fumigant Structural Fumigations in North America

- During the first 5 years (2004-08) following commercial launch of ProFume[®], fumigators voluntarily provided Dow AgroSciences with fumigation records that documented:
 - Fumigations at 250 locations in 31 US states, Puerto Rico, and 3 Canadian Provinces
 - Nearly 40% of the structures had been fumigated 2-8 times with ProFume over successive years, indicating customer satisfaction and adoption



Farmer's Rice Cooperative, Sacramento, California, USA



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ProFume[®] gas fumigant Parameters in North America by Fumigation Category¹

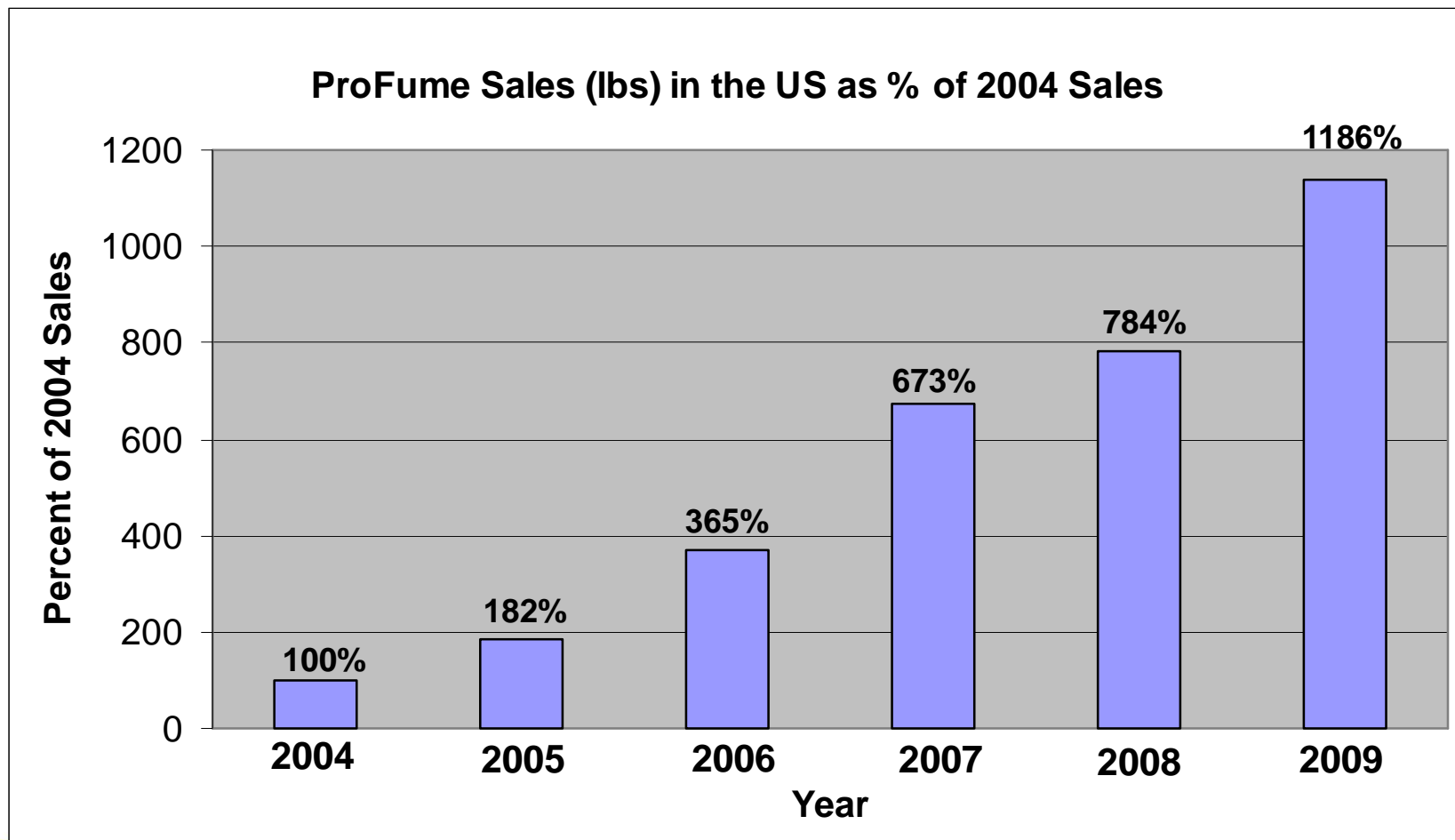
Fumigation Category	Mean Volume x 1000 (ft ³)	Mean Est. °F	Mean Planned Exposure Time (h)	Mean Actual Half Loss Time (h)	Actual Dosage (oz-h/ 1000 ft ³)	Mean Final Dose (lb/ 1000 ft ³)
All Mills & Warehouses	1,234	84	29.8	13.9	628	2.7
Commodity Bin, Bin Warehouses, Chambers, & Stacks	216	74	44.6	43.8	787	1.7

¹2004-2008 data

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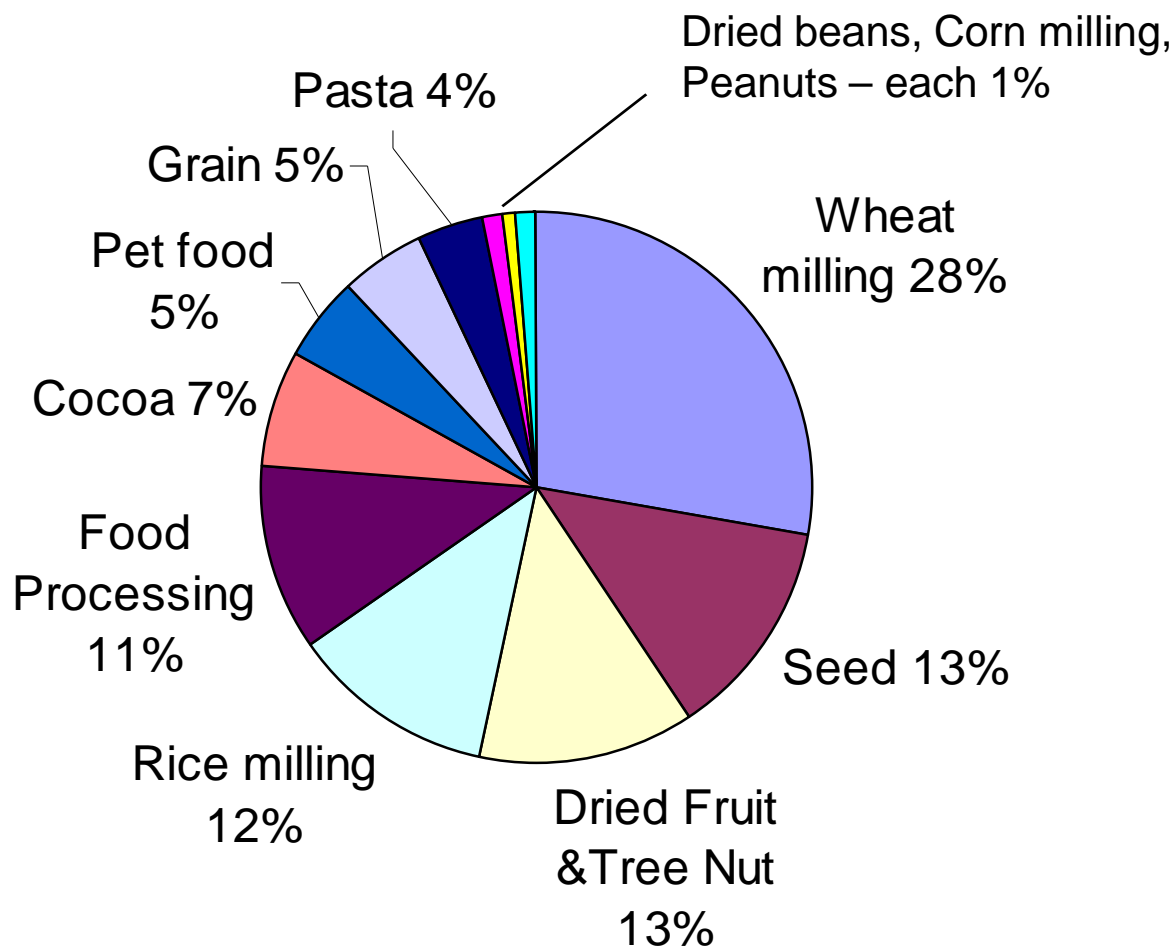
Adoption of ProFume[®] gas fumigant (US Sales)



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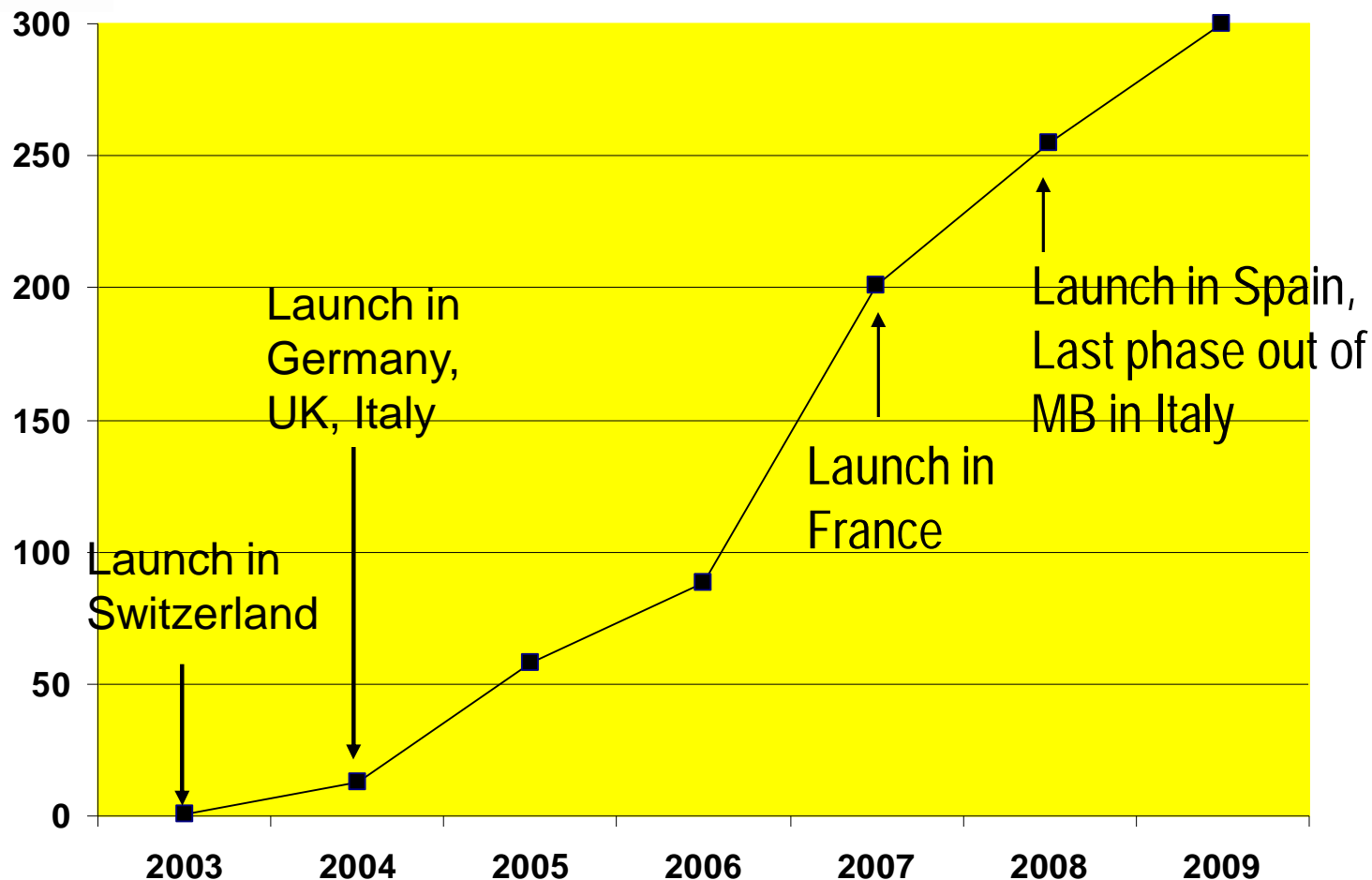
Percent of Projected 2010 Sales of ProFume[®] gas fumigant by Market



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Annual Number of Structural Fumigations With ProFume[®] gas fumigant in Europe



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ProFume® Case Studies: Cocoa

- In the USA, cocoa beans now fumigated with ProFume - collaborative research effort between Dow AgroSciences, cocoa fumigators, and Chocolate Manufacturer's Association (CMA)
 - Cocoa beans and fractions fumigated at maximum CT dosage rate (1500 oz-h/1000 ft³) with ProFume had a marginal increase in F- that was much lower than the MRLs granted by the USA-EPA
 - CMA conducted sensory evaluations using ProFume-fumigated cocoa - concluded the results are satisfactory



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ProFume[®] Case Studies: Cocoa

- ProFume[®] is more economical than methyl bromide for this use pattern
 - Sorption of SF into cocoa beans is much lower than that of methyl bromide under identical conditions (Phillips et al., Oklahoma State Univ.)
- A commercial efficacy trial demonstrated that ProFume killed the target pests in bioassay (including Indian meal moth eggs) at low temperatures (45°F)
 - 20 h fumigation - Accumulated CT dosage 750 oz-h/1000 ft³



Commercial fumigation of cocoa beans using ProFume

The cocoa industry in the USA has converted to ProFume, fumigating tarped stacks, shipping containers, and warehouses



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ProFume[®] Case Studies: Seeds

- Dow AgroSciences conducted extensive research evaluating seed of grass, wheat, corn, cotton, soybean and canola in collaboration with three major seed companies
- Comparative tests were conducted between phosphine and ProFume, under varying exposure periods and temperatures
- Results concluded that fumigating all tested seed types at 750 oz-h/1000 ft³ did not negatively impact germination or interact with seed treatments, and compared well with phosphine regarding germ impact



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ProFume® Case Studies: Seeds

- Major seed companies in the USA have adopted ProFume for their seed fumigations
 - ProFume offers flexibility compared to phosphine in reducing the fumigant exposure time, important when seed warehouses are on tight schedules to fumigate seeds prior to shipment
 - All areas of a seed production facility can be fumigated with ProFume, including those with valuable electronic equipment (sizing towers, packaging lines) that could be damaged from phosphine



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ProFume[®] Case Studies: Grass Seed Warehouses

- Oregon market (USA)
- Rodents are the primary pest
- Chloropicrin no longer supported for this use
- Low dose makes ProFume[®] a very economical and effective alternative



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ProFume® Case Studies: Grain fumigation

- Efficacy on strains of phosphine-resistant red flour beetle, *Tribolium castaneum*, indicated no cross-resistance to SF
 - Resistance issues with ProFume are not anticipated because of use patterns, unique mode of action, and lack of known cross-resistance to other fumigants
- Phosphine-resistant lesser grain borer, *Rhyzopertha dominica*, is widespread globally



Lesser grain borer

(Photo: University of Kentucky)

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ProFume[®] Case Studies: Grain fumigation



- **Fumigation of rice and corn in CA have successfully converted from phosphine to ProFume where phosphine-resistant lesser grain borer is present**
 - **Using a J-fan at the base of the bin and introducing ProFume in the top of the sealed bin results in ProFume dispersing to the bin base, up to 120 ft in 3 h**
 - **ProFume exposure times average 48-72 h**
 - **ProFume offers flexibility to rapidly fumigate and aerate grain immediately prior to shipment, reliable control, and the absence of particulate residues**



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Stewardship and Training

Prior to sale or use of ProFume[®] gas fumigant, fumigators are required to do the following:

- **Undergo training:**
 - Classroom – review stewardship, labeling, safety, dosage calculation, FMP, fumigation procedures and special fumigations
 - Academy – Hands-on workshop implementing classroom lessons
 - Supervised Fumigation
- **Sign stewardship agreement and have required safety equipment (such as clearance detector)**
- **Follow-up stewardship training is required annually**
- **To date, more than 800 fumigators in the US have been trained to use ProFume**

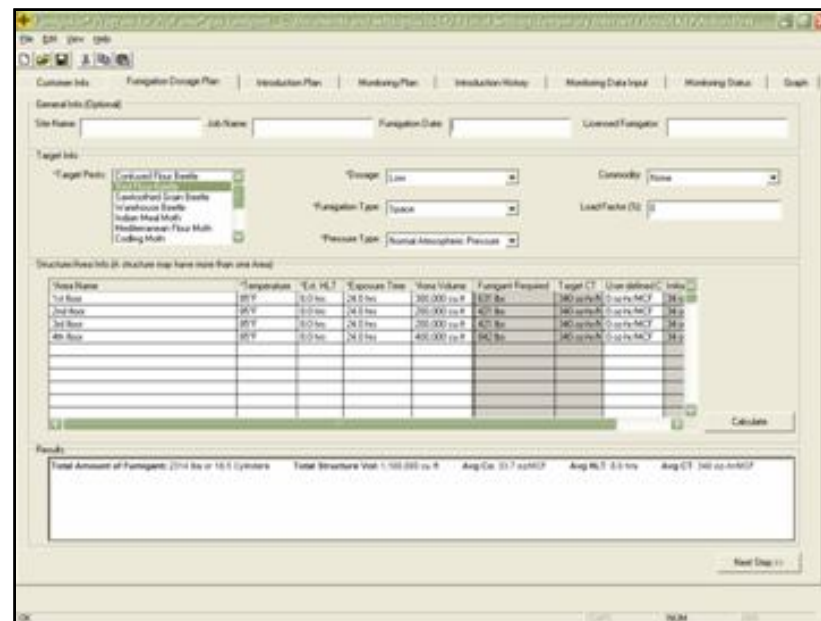


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ProFume[®] gas fumigant Dosages

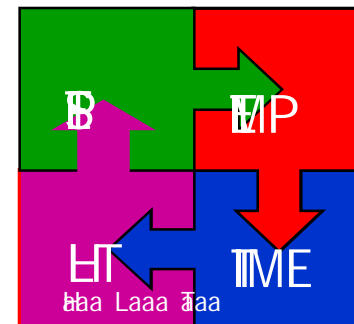
- Extensive laboratory and field trials conducted to define the dosages required to control all the life stages of target pests under a wide range of fumigation conditions
 - USDA-ARS in California, USA
 - DFA of California, USA
 - FERA (Food & Environ. Res. Agency), UK (Formerly CSL, Central Science Laboratory)
 - Julius Kuehn Institute, Germany (Formerly BBA, Federal Biological Research Center)
 - University of Milan, Italy
 - Laboratoire National des Denrées Stockées, France
- Dosages implemented in the Fumiguide[®] program for ProFume
 - An MS-Windows based program



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Fumiguide[®] program for ProFume[®] gas fumigant



- Dosage calculation tool:
 - Based on pest species & desired level of control, temperature, exposure time, volume and half-loss time (HLT)
 - Gives gas introduction instructions
 - When monitoring data are entered, program will calculate actual HLT, accumulated and predicted dosage, and update instructions on exposure time and fumigant introduction
- The Fumiguide[®] program is programmed for a global fumigation market
 - Calculations converted to English or metric units; available in multiple languages
- Records fumigation data and produces reports and graphs
- Allows “what if” scenarios to help plan and conduct fumigations
- Enables “Precision Fumigation[™]” - Takes the guesswork out of fumigation



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Quarantine Fumigation Using ProFume[®] gas fumigant

- Researchers evaluating sulfuryl fluoride for control of key quarantine pests:
 - Emerald ash borer, Asian longhorn beetle, bamboo borers (A. Barak, USDA APHIS PPQ)
 - Oak wilt fungus (E. Schmidt, Univ. Minnesota)
 - Pinewood nematode, PWN (D. Dwinell, USFS)
- Dow AgroSciences is working with regulatory authorities to get quarantine treatment schedules (such as ISPM-15) approved for sulfuryl fluoride



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Industry Support for ProFume[®] gas fumigant

- On June 24, 2009, USEPA published a registration review docket (ID # EPA-HQ-OPP-2009-0136) for sulfuryl fluoride
- During the subsequent 2 month public comment period, 26 letters submitted verified the many important attributes of ProFume[®] gas fumigant for pest control in raw and processed commodities, mills, food processing facilities, warehouses, storage facilities and other structures. Letters were submitted by:
 - 13 fumigators/distributors
 - Internationally respected researchers at Kansas State University and the American Council for Food Safety and Quality
 - 5 end-use customers
 - 5 trade associations (including North American Miller's Association and National Confectioner's Association)

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Industry Support for ProFume[®] gas fumigant

- One researcher summed up the value of ProFume[®] gas fumigant as follows:
"If the current label for sulfuryl fluoride [ProFume] were restricted or eliminated, we would have a crisis in the food and pest control industry that would reduce food quality, increase food and pest control costs, and threaten the viability of the US food supply."



Dow AgroSciences greatly appreciates the efforts of individuals and organizations to document to the USEPA the benefits of ProFume

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ProFume[®] Gas Fumigant Summary



- Sulfuryl fluoride, recognized as an excellent wood fumigant for nearly 50 years, has been developed by Dow AgroSciences for commodity fumigation
- Studies conducted in Europe and the USA have shown ProFume[®] gas fumigant fits the needs of agriculture and food industry for fast and effective fumigation of commodities, food storage, mills and food processing plants with no adverse effect on equipment, food quality and the environment when used according to the label
- Development and commercial launch success in many countries proves that ProFume is a technically and economically viable alternative to methyl bromide, and to phosphine where resistance, damage, or time constraints are issues



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Thank you!

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