POSTER: 1,3-D: REGULATORY ISSUES, TOXICOLOGICAL EFFECTS, ENVIRONMENTAL FATE PROPERTIES AND PRODUCT SAFETY

Roby, D.M., D.E. Barnekow, F.R. Batzer, B.A. Houtman, J.A. Knuteson, M.W. Melichar and W.S. Stott

Use - Telone* soil fumigants are currently registered as a pre-plant soil treatment used to protect more than 120 vegetable crops, field crops, and nursery crops as well as planting sites for citrus trees, deciduous fruit trees, nut trees, and berry bushes and vines. Telone soil fumigants may be applied as a pre-plant soil treatment to control all economically significant nematodes including the following types of plant parasitic nematodes: burrowing, citrus, cyst (sugar beet, soybean, carrot, and wheat), dagger, lance, reniform, ring, root knot, root lesion (meadow), spiral, sting, and stubby root. Telone soil fumigants can also be used to control garden centipedes (symphylans) and wireworms. Telone soil fumigants can suppress sugar beet Rhizomania disease, Granville wilt of tobacco, Fusarium wilt of cotton, Verticillium wilt of mint and potatoes, and aid in the control of bacterial canker of peaches. Soil fumigation with 1,3-D is a component in integrated pest management programs. These programs can include combinations with both chemical and nonchemical elements. Chemical combinations can include other fumigants such as chloropicrin and metam sodium products and nonfumigants such as contact nematicides. Nonchemical components include crop rotation and resistant varieties.

Special Review and Reregistration - 1,3-Dichloropropene (1,3-D) was placed in the reregistration and special review processes by the U.S. Environmental Protection Agency (EPA) in 1986. All studies required by various data call-ins have been submitted to EPA. The special review process requires EPA to conduct a risk and benefit analysis and publish a proposed regulatory decision (PD2/3) in the Federal Register for public comment and to obtain input from USDA and the Science Advisory Panel. Significant advances have already been made to reduce potential risks associated with use of 1,3-D.

Product Safety - Risk Mitigation: Several advances in occupational and off-site risk mitigation have been implemented including: personal protective equipment, management of end row spillage, product application rate reductions, soil sealing improvements, soil moisture management, dry disconnects and vapor recovery during bulk product transfers and planned phase out of drums by December 31, 1996. Human Risk Assessment and Refinement: Recent advancements in 1,3-D human exposure assessment including probabilistic (Monte Carlo) methods of exposure assessment and air dispersion (ISCST) modeling have allowed refinements in estimates of exposures encountered by occupational populations and populations that reside in areas of agricultural 1,3-D use. Both measured and estimated 1,3-D air concentrations for occupational and residential populations compared to the U.S. EPA IRIS Reference Concentration (20 $\mu g/m^3$) indicate that these populations are likely to be without appreciable risk of health effects during a lifetime. Further, the calculated, hypothetical cancer risks for these populations indicates that lifetime cancer risks are in the range of 1×10^{-5} to 1×10^{-8} which are generally considered to be acceptable.

Environmental Fate - Aerobic soil half-lives of 1,3-D vary with respect to soil types, ranging from 1.7 to 53 days. 1,3-D is converted to naturally occurring carboxylic acids and to CO_2. 1,3-D and its metabolites became increasingly associated with the soil matrix with time. 1,3-D has a vapor pressure of 23 mm/Hg, water solubility of 2 g/L and a hydrolysis rate of 3 to 51 days depending upon temperature conditions. The maximum depth of detectable residues in two field dissipation studies was less than 10 feet. This movement was due to diffusion rather than leaching and half-life values range from 0.6 to 84 days. 1,3-D reacts with sunlight in the presence of free hydroxyl radicals with an estimated air photolysis half-life of 7 to 12 hours. In field volatility studies, 1,3-D flux was shown to vary as a function of soil moisture and

* *Trademark of DowElanco*

temperature conditions, depth of injection, quality of soil sealing, application rates, time-of-day and number of days after application. Peak emissions occurred during late afternoon and early evening periods and a mass loss ranging from 11 to 26% of applied 1,3-D occurred 2 to 5 days following application.

Ground Water - The potential for 1,3-D to contaminate ground water is very low due to several modes of dissipation including, gaseous diffusion throughout the soil, flux through the soil/air interface, hydrolysis in water, and biological metabolism by aerobic and anaerobic microorganisms. The historical incidence of contamination is very low. There have been less than 10 detections out of 21,270 wells sampled as stated in EPA's Ground Water Data Base of 1992. All detections were less than the Maximum Contamination Level of 0.5 ppb.

Residues - Studies with radiolabeled 1,3-D have shown that the compound is rapidly degraded and the radiolabeled carbon incorporated into natural plant products. No residues of concern have been identified in the crops grown in soil fumigated with 1,3-D. A metabolism study with radiolabeled 1,3-D in lactating goats demonstrated that 1,3-D and/or its metabolic products were rapidly excreted or expired following multiple dosing at 1300 times the potential dietary exposure level for five days. A poultry metabolism study with radiolabeled 1,3-D demonstrated that 1,3-D and/or its metabolic products were rapidly excreted or expired following multiple doses at 3500 times the potential dietary exposure level for seven days. The terminal residue in laying hens presented no toxicological concern. Field residue trials have confirmed the absence of residues of 1,3-D in carrots, onions, grapes, cantaloupe, broccoli, lettuce, potatoes, pineapples, sugar beets, soybeans, oranges, peaches, cottonseed, and peanuts at a limit of quantitation of 0.01 μg/g. Therefore, no raw agricultural commodity tolerances are required.

Toxicology - Mutagenicity studies have shown that mammalian cells readily detoxify 1,3-D. There has been no teratogenicity or effect upon reproduction, even at toxic exposure levels. Older National Toxicology Program chronic studies (oral bolus) reported in rats, malignant forestomach tumors and an increased incidence of benign liver tumors, and in mice, malignant tumors in urinary bladders and forestomachs and benign tumors in lungs. An inhalation bioassay of 1,3-D conducted in rats and mice reported an increased incidence of benign lung tumors in male mice only. No other tumors related to the inhalation of 1,3-D were reported. In new chronic dietary feeding studies (by encapsulation), there was no indication of carcinogenic response in mice. A statistically-identified increase in benign liver tumors was identified in high dose group male and female rats. Numbers of benign liver tumors were also increased relative to the historical control incidences of this tumor type in males at the middle dose level. No other tumorgenic response was observed. Due to the fact that there are no detectable 1,3-D residues in crops following soil fumigation with 1,3-D, there is no dietary exposure issue. Therefore, the only relevant route of exposure for consideration of human risk incidental to agricultural use of 1,3-D is inhalation.

Mammalian Metabolism - A series of studies have been conducted to determine the pharmacokinetic behavior and metabolism of 1,3-D in rats, mice and humans. Data indicated that 1,3-D was absorbed from the skin, respiratory tract and gastrointestinal tract. Following absorption, both *cis*- and *trans*-isomers of 1,3-D were rapidly eliminated from the bloodstream of rats (half-life approximately 2-4 minutes) and humans (half-life < 10 minutes).

* *Trademark of DowElanco*