TEN YEARS OF METHYL BROMIDE ALTERNATIVES RESEARCH AND DEVELOPMENT: LESSONS LEARNED.

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Beginning in 1995 and continuing to the present, our research group has conducted over 150 field experiments with various methyl bromide alternatives for sponsors that have included state and federal agencies, product manufacturers, and grower "stakeholder" groups. Some of these studies have resulted in publication in scientific literature and/or summary presentations at annual meetings of the MBAO. Many more have been conducted as part of confidential research and development programs, and as such, have generated data that have not been openly available to the public. Nevertheless, in the course of conducting these projects, we have learned some important scientific, regulatory, and industry lessons that can be shared with those currently working on methyl bromide alternatives. They are summarized in this presentation as follows:

1. The role of application technology in working with chemical fumigants that are gasses at ambient temperatures can profoundly affect experimental and commercial product results. This fact became obvious early in our experience with Dow AgroSciences and BASF, and provided a basis for all subsequent research with fumigants since that time. Examples are given of reduced yields and phytotoxicity from poorly applied fumigants in strawberries.

2. Some of the more effective alternative fumigants are toxic chemicals that are closely scrutinized by regulatory agencies, and as such, must ultimately use local county agents to enforce use guidelines. Many times these workers have a limited understanding of the complex chemical processes that truly affect the behavior of fumigants in the environment. In the practice of everyday enforcement, this creates continual conflict between the applicator and local regulators at the field level, with the grower groups left somewhere in the middle. The more important issues relating to this phenomenon are discussed as follows:

    a) Flux as it relates to buffer zones.

    b) Fumigant degradation and allowable rates.

    c) Acceptable application methods.

    d) Fumigant exposure toxicology and personal protective equipment.

3. Organic strawberry production in California can be an alternative to soil fumigation providing several criteria are met. Criteria and examples are discussed as follows:

    a) The soil borne disease inoculum is low at planting. I.e. preplanting soil sampling for *Verticillium* with Salinas growers.

    b) The cultivar or plant type chosen is tolerant to diseases. The newer cultivar releases, Diamonte and Ventana, are generally too susceptible for use in these alternative production systems.

    c) Plastic mulch that is suppressive to weed seed germination is used. Data are presented for black, green, white and clear mulch for strawberry production.

d) The market is such that a premium price is paid for fruit. Weeding and other cultural costs are compared between organic and conventional production systems and related to market income.

4. Strawberry plug plant technology can be a viable nursery option to soil fumigation, providing specific requirements are met with respect to the following factors:

    a) The cultivar must be well adapted to this technology. Ventana is compared to Camerosa for earliness and total yields.

    b) The tip source must be completely free of disease incidence. In the 2002 production season, *Colletotrichum* infected runner tips were distributed throughout the US plug plant industry from a Canadian producer. Once this material was in optimal conditions in the greenhouses, the disease spread throughout these operations and impacted this technology thereafter. It is only now regaining momentum.

    c) There must be an agronomic or marketing advantage such as productivity in non fumigated soil, earliness, or greater total yields to justify the higher cost of production.

    d) Currently, our group produces organically certified plug plants in small quantities in a pilot program for fruit growers in California. The early results from the fall 2005 season are discussed.

5. Most alternative fumigants will be marketed at higher prices to the end user. However, this actual cost of use includes storage, transportation, regulatory compliance overhead, community relations, cost of funds, adjustments, and many other “hidden” expenses unique to the fumigation business.

6. Small plot experiments are helpful in determining potential benefits of fumigation in specific situations, but large block demonstrations and successive regional usage patterns can differ markedly from expectations. Replication of these studies now in place on the coast is helping to clarify the benefits and limitations of Inline and C35, metham sodium, and more recently, Iodomethane, to the end users.

7. Many manufacturers remain reluctant to provide fumigants directly to the farmer end users as has been commonplace with methyl bromide based fumigants in the past. Reasons frequently cited are inconsistent and variable application technologies, safety in storage and use with professional applicators, minimization of regulatory risk overall, and simplicity of distribution. It is doubtful whether growers will ever again have direct access to fumigants on their farms.

8. California tomato production can benefit from soil fumigation through control of incidental diseases such as corky root, as well as catastrophic diseases such as *Verticillium*. Metham sodium remains an inexpensive preplant soil treatment being practiced by most ground tomato producers, while coastal pole tomato growers are favoring Inline and Chloropicrin EC.

9. Cut flower and other ornamental growers have an added disadvantage with production in non fumigated soils, since their plant genetics are largely disease susceptible, and breeding programs for plant tolerance are rare in this agricultural sector. This is due to the diversity of plant species included in this group, and the fact that breeding selections are made predominantly for aesthetic reasons.