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Optimizing Alternative Fumigant Applications for Ornamental Production in Florida[1]

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Background

Florida ornamental growers continue to have limited access to methyl bromide for preplant soil fumigation through Critical Use Exemptions (CUE) and existing stocks, although this use is becoming unaffordable for most producers. CUEs are granted to commodities only when: 1) failure to provide access to methyl bromide would result in a significant market disruption, 2) no technically and economically feasible alternative is available that is acceptable from environmental and human health standpoints, 3) applicants have taken all feasible steps to minimize their use and emissions of methyl bromide, and 4) appropriate efforts are being made to evaluate, commercialize, and register alternatives for use by the applicant. Florida commodities covered under the current CUE approved for 2009 include tomato, pepper, strawberry, cucurbits, eggplant, and ornamentals (http://www.epa.gov/ozone/mbr/2009_nomination.html). The CUE for ornamentals includes cut flowers, cut foliage, herbaceous perennials, bulbs, and plant propagative material in open fields and protected environments such as tunnels, open-ended and closed hoop-houses, shade houses, and permanent greenhouses (http://www.epa.gov/ozone/mbr/cun2009/cun2009_Ornamentals.pdf).

In Florida, cut flower and other ornamental crop producers have a very limited number of alternatives to methyl bromide. The reasons for this include: 1) many fumigant alternatives have poor or inconsistent herbicidal activity; 2) the lack of registered herbicides available for these crops, and 3) the need to control previously planted cultivars volunteering as weeds within the next crop. Also, land for ornamental crop production is often in desirable coastal areas in close proximity to residential areas, where fumigant use may be limited or restricted either by proximity to potential bystanders or due to locations of wells. In addition, the number of ornamental crop species being produced is high, and species vary in pest susceptibility and sensitivity to chemical pesticides. Growers often introduce new varieties whose susceptibilities to pests or residual pesticides are unknown. While significant progress has been made

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in demonstrating feasibility of alternatives for vegetable crops including tomato and pepper, in-field feasibility of alternatives for major ornamental species remains to be demonstrated.

Cooperative research projects between University of Florida research and extension scientists in Gainesville and Ft. Pierce, and USDA, ARS scientists at the U.S. Horticultural Research Lab in Ft. Pierce have yielded new, practical information on the application of alternative fumigants in Florida field-grown ornamentals. Much of this information is general in nature and may be applied to use of these alternatives in other crops. Data were generated in field trials located on commercial and experimental farms across south Florida. The primary alternative fumigants tested were Midas® (methyl iodide:chloropicrin 50:50, Arysta LifeScience North America LLC, Cary, NC) and Paladin™ (dimethyl disulfide (DMDS):chloropicrin 79:21, United Phosphorous, Inc, King of Prussia, PA), both compared with methyl bromide:chloropicrin 98:2 at 400 lb/A (Rosskopf et al. 2008). These alternative products were selected due to their potential to be commercially available to growers in the immediate future. In 2008, Midas® was granted a conditional registration for Florida and Paladin™ is currently available for limited use in Florida under an experimental use permit (EUP), with full registrations pending.

Crops in which alternatives were tested included celosia, snapdragon followed by sunflower, a double crop of sunflower, delphinium, and caladium. Treatments were applied in the fall and spring for celosia, in the fall only for double-cropped sunflower, in the fall only for delphinium, and in the spring for caladium. All experiments were replicated and included a methyl bromide standard. When possible, an untreated control was included, and all tests were performed under naturally occurring weed, nematode, and disease pressures.

Logistical Issues

Many ornamental growers use broadcast fumigation applied to flat (not bedded) land, and employ commercial fumigators for the application. The use of broadcast fumigation is, in part, due to the infrastructure used for production of many cut-flower crops (Figure 1). Broadcast fumigation requires wide plastic (up to 13 ft wide) sheets (Figure 2), which must be glued together to cover large areas and accommodate shadecloth infrastructure such as posts (Figures. 3, 4, and 5). Currently, the use of virtually impermeable films (VIF) is being recommended with all fumigants in order to reduce use rates and airborne emissions from soil, and for reducing buffer zone size requirements. New requirements for buffer zones around fumigated fields have recently been established by the US Environmental Protection Agency (http://www.epa.gov/pesticides/reregistration/soil_fumigants/buffer-zones-fs.htm). The use of VIF films is problematic for broadcast fumigation used by many ornamental (and turf) producers because the nature of VIF films, which makes them impermeable to gases, also does not allow oxygen to penetrate the film, which is necessary for the glue to set quickly during field installation. Fortunately, the ability to glue VIF plastics is anticipated in the near future. Availability of wide VIF films has also been a problem in the past, but is improving.

Figure 1. Infrastructure commonly used in ornamental crop production.

The different chemical and physical properties of alternative chemicals result in different behavior in soil compared to methyl bromide. Successful pest control with alternatives will be highly dependent on understanding soil fumigant behavior and application requirements. Methyl bromide's high vapor pressure has allowed for rapid and thorough distribution through soil, enhancing its versatility and effectiveness as a fumigant. During its previous usage, methyl bromide was typically observed to be less susceptible to application errors, such as upward venting through chisel traces or kerfs (Figure 6), than the alternative chemicals that don't move or diffuse as effectively through soil. This requires that applicators modify existing standard methyl bromide application equipment with orifice plates, flow meters, delivery line changes to better regulate and distribute gas or liquid flow among chisels, and press wheels or rollers to provide better soil sealing capability (Figure 7). These modifications are discussed in more detail by Gilreath et al. (2005), and specific recommendations for these modifications for the application of Midas® are provided by the manufacturer (http://www.arystalifescience.com/usa/files/documents/MID-094TechBulletin.pdf). Commercial applicators have now adopted rollers or drag bars on most broadcast application equipment to eliminate chisel traces by sealing and compressing surface soil. The lower vapor pressure of the alternatives also requires longer waiting periods after treatment for soil residues to dissipate, so that the soil will be safe for planting of the crop. In addition, the lower vapor pressures limit their usefulness for application around permanent posts, which have traditionally been treated with methyl bromide using the “hot gas” method. Industry cooperators have indicated that it is possible to use Midas® for the treatment of post rows using a directed spot application under tarps. The relatively short plant-back interval and the ability to remove plastic mulch covers quickly after application of methyl bromide gave growers a great deal of flexibility in their planting window, and these intervals will need to be adjusted for alternatives. When winds are strong and moving large amounts of airborne soil, additional costs are incurred if plastic cannot be removed in a short period of time and treated soil is exposed during a long aeration period. Soil moisture and other physical properties of soil are also more critical to successful application of alternatives than for methyl bromide.

Figure 2. Wide plastic is needed (13 ft wide) for broadcast flat fumigation.

Figure 3. Use of LDPE has been standard practice for methyl bromide fumigation but VIF films will be standard for all fumigants in the future.

Evaluation of Midas® and Paladin™ under high weed, nematode and disease pressure

Four seasons of field trials were conducted under high weed, nematode, and disease pressure, to evaluate Midas® (iodomethane:chloropicrin 50:50 at 200 lb/A) under gas impermeable metalized film (Canslit Inc., Milton, ON) for production of ornamental cockscomb (*Celosia argentea* var. *cristata*). Disease incidence and weed density were significantly lower in Midas® and methyl bromide (methyl bromide:chloropicrin 98:2 at 200 lb/A) treated plots, when compared to an untreated check. Number of marketable stems was highest and there were no volunteers from the previous crop in both the Midas® and methyl bromide fumigated plots compared to the untreated control. Nematodes isolated from roots at harvest were significantly

Figure 4. Gluing LDPE is currently standard for broadcast fumigation. Gluing VIF is problematic because of the need for plastic to be permeable to oxygen for the glue to cure.

Figure 5. Overview of structure showing need to glue plastic for application to wide areas and to accommodate post rows.

reduced in Midas® and methyl bromide fumigated soil, which was reflected in lower galling and higher root weights for both fumigants compared to the untreated control. This reduction in galling occurred even though populations of root-knot nematode in soil had rebounded to similar levels in all treatments by the end of the season. This illustrates the importance of early-season nematode control to reduce galling severity and to maintain acceptable yields of celosia. Limited movement of Midas® in soil, as well as application issues were identified in these trials, which included slow start to fumigant movement through lines (Figures 8 and 9A) and lack of lateral movement in fumigated areas with clogged chisel lines, as well as higher concentrations of

Figure 6. Closing shoes and/or compaction rollers to close kerfs are more critical with alternatives because of lower vapor pressure of alternatives resulting in reduced movement in soil.

Figure 7. Modified rig for closing chisel marks.

fumigant in the lines that were not clogged. This resulted in some phytotoxicity from soil residues early in the season.

Hard-seeded leguminous weeds such as clover have been difficult to control with increased chloropicrin content (33% or higher) in methyl bromide formulations. Methyl iodide:chloropicrin (50:50) combinations or soil solarization for 6 weeks were found to be better control options for clover in snapdragons than was a 67:33 methyl bromide:chloropicrin formulation.

Cut flower trials with dimethyl disulfide and dimethyl disulfide:chloropicrin (79:21) combinations conducted over multiple cropping seasons since 2004 have yielded similar results. Optimized application will require changes in application technology. Placing shutoff devices for fumigant flow as close as

Figure 8. The white card indicates where fumigant application actually began, which is readily evident from the weed infestation at the beginning of the row. Even using orifice plates and having a delayed take-off did not allow enough time for the lines to fill on the first bed, and approximately 40 ft. at the beginning of the bed did not get treated.

possible to chisel orifices will minimize problems of line filling and dripage during turns at the ends of rows. Avoiding delays in line filling is critical for pest and weed control at edges of fields and has been a problem with this material (Figure 9B), but in areas treated with the target application rates, reductions in nematode, weed, and disease pressure have been comparable to methyl bromide treated areas.

Summary

Both Midas® and Paladin™ can provide good weed, nematode, and disease control in field-grown ornamental crops in Florida. Pest control can be similar to methyl bromide if care is taken with application. Even with the use of orifice plates, and delaying tractor take-off, a delay in fumigant application was noted on several occasions. It is critical to allow enough time for the lines to fill on the pass, and the use of sight glasses increases application uniformity and accuracy among individual chisels delivering fumigant to soil. With validation of these results, growers will have a

Figure 9. (Top) Weed populations are evident in another trial at the beginning of the bed in the first methyl iodide treated plot by a commercial applicator; (Bottom) weeds at the start of the first DMDS treated plot were more abundant than in the methyl bromide treatment as well.

greater number of options when weeds and nematodes are the principal pest problems. The development of new highly retentive plastics that can be joined for use in broadcast fumigation, will allow for the use of lower rates of fumigant while maintaining efficacy.

References

Gilreath, J., B. Santos, J. Mirusso, J. Noling, and P. Gilreath. 2005. Application considerations for successful use of VIF and metalized mulches with reduced fumigant rates in tomato. HS287, IFAS, University of Florida, Gainesville, FL. http://edis.ifas.ufl.edu/HS270.

Rosskopf, E.N., N. Kokalis-Burelle, E. Nissen, O. Nissen, R. Hartman, E. Skvarch, R. McSorley, R.

Kreger, T. Estes, and C. Owens. 2008. Area-wide demonstration of chemical alternatives to methyl bromide for Florida ornamentals. Pp. 28.1-28.2 in G.L. Obenauf (ed.), 2008 Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reductions. Methyl Bromide Alternatives Outreach, Fresno, CA.