

Methyl Bromide Alternatives

As the deadline approaches for complete Methyl Bromide phase-out, more research is proving the efficacy of replacements.

By A.R. Chase

Methyl bromide is an important part of ornamental production. The combination of methyl bromide and chloropicrin has long been used to control weeds, nematodes and plant pathogens like Pythium. The majority of this fumigant is used for strawberries, fruit trees and vegetables in Florida and California, but there is a substantial amount of the product used in floriculture production. Some industries have found acceptable alternatives over the past five years and no longer use methyl bromide. Floriculture has been struggling to find an acceptable alternative.

The production of field-grown cut flowers, some in-ground shade house flowers and caladiums rely on availability of methyl bromide (MBr) for economically acceptable crops. I have even met a few greenhouse growers who still use soil as a part of their potting medium and fumigate the resulting blend with MBr before use.

The California Cut Flower Commission (CCFC) took the lead in funding research on MBr alternatives in ornamental production in the early 1990s. Research has involved everything from alternative fumigants; solarization; treatment of soil with steam, microwaves or UV rays; soil fertility; and amendment with green manures and biological agents. Current alternative fumigants are 1, 3-D (Telone), chloropicrin and metam sodium (Vapam), which can be applied alone and in combination. In some cases, application through drip irrigation systems has been developed with excellent results. In addition, the use of granular Basamid has been researched extensively, often in conjunction with Telone or chloropicrin.

Much of the new research sponsored by the California Cut Flower industry has concentrated on weed control. Research on Fusarium wilt fungi (on mini-carnations and bulbs such as Dutch iris) and nematodes is also ongoing. Some of the key crops in these trials have been ranun-

culus, gladiolus, callas lilies, delphiniums and stock. Although MBr is used in saran houses in both California and Florida, the bulk of the product is used in field production, and therefore, much of the research has been done in the field.

POSSIBLE REPLACEMENTS

In the early 1990s, a group of scientists at the University of California, led by Dr. Jim Sims (UC-Riverside) started extensive research into the use of methyl iodide (MI) as a replacement for MBr. Their results were very encouraging, but it was not until 1999 that Arvesta (formerly Tomen-Agro) began to develop MI as a new product. Arvesta has continued research into MI (trade name will be Midas), and a label was submitted to the EPA a little over a year ago. The initial label will include bulbs and ornamentals, as well as tomatoes, peppers and strawberries.

Midas is a liquid at room temperature, making it a little safer to handle than MBr (gaseous at room temperature). It also has a much shorter



Left: Pythium root rot in a control plot of ranunculus at The Flower Fields in Carlsbad, Calif.; Right: Excellent ranunculus stand following fumigation with Midas/chloropicrin at 300 lbs. per acre.



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half-life than MBr and is unlikely to damage the ozone layer since it falls apart before it can reach the ozone. Midas can be applied through a drip irrigation system, making it more flexible in use patterns than MBr. It has much the same spectrum of activity — works on weeds, nematodes and fungal pathogens and appears to remain in the soil longer than MBr, again because it is a liquid at room temperature. When fields are planted too quickly after pulling the plastic used in Midas application, some toxicity has been reported.

Many other alternatives are being researched at this time, including sodium azide. This poison has been around for at least 50 years but has no agricultural uses at this time. In fact, development of sodium azide was probably curtailed when MBr became widely available in the 1970s. Under some conditions, sodium azide explodes, which can obviously be a problem with its usage. Presently, there are two companies developing a liquid sodium azide. The first is American Pacific, which is working with Auburn University. The second is Cal-Agri Products. Trials with these newer experimental formulations have had mixed results in both California and Florida, but research continues.

An annual MBr alternatives meeting provides a forum for the many USDA, university and private researchers to exchange ideas, report results and learn the latest in the political arena. For 2003, the meeting will be held in San Diego in November and will rotate to Orlando the following year.

RESEARCH RESULTS

Over the past two years, Chase Research Gardens has been helping out with some MBr

alternative trials for cut flower production. Many of the trials we visited in 2001 and 2002 were conducted by Dr. Clyde Elmore, a recently retired weed scientist from the University of California-Davis. Clyde has been conducting trials at The Flower Fields (Carlsbad, Calif.) in cooperation with Mellano and Company. One of the trials was designed to evaluate Iodomethane (Midas) in a 50:50 combination with chloropicrin. Treatments were shank applied and tarped. Two rates were compared to a MBr/chloropicrin standard at 350 lbs per acre and an untreated control. We have also rated the trials periodically, and some of the results from this year’s trials are presented in Figure 1, left.

Compared to the tarped-only control, plant vigor (rated on a scale from 1 [dead] to 5 [excellent]) was better for all fumigated plots on both the March 18 and the April 4 evaluations. The degree of flowering was also evaluated and looked identical to vigor for the April 4 rating. All fumigant treatments were very effective in killing last year’s white flower seed, compared to the tarped-only control. Those that did grow were on bed ends where the fumigant concentration was apparently too low for 100-percent kill.

On April 22, 2003, the Pythium severity of each plot was rated using the following scale: 1 = none, 2 = few plants with wilting or stunting, 3 = up to 25 percent of plants dead and/or showing wilting and stunting, 4 = 26-50 percent of plants showing wilting and stunting or dead and missing, and 5 = more than 75 percent of plants in plots missing or showing wilting and stunting. Disease was moderate in the control plot, but both Midas/chloropicrin (300 lbs.) and MBr/chloropicrin (350 lbs.) had little if any dis-

ease apparent. However, the higher rate of Midas/chloropicrin showed slight disease or at least what appears to be disease. It is possible that the wilting and yellowing typical of Pythium are due to some other factor in this treatment.

Dr. Elmore has been working with Glad-A-Way (one of the world’s largest producers of gladiolus) in Santa Maria, Calif., as well. Last fall a trial was run using Midas and chloropicrin (33:67, 50:50 and 67:33) applied at 300 lbs. per acre compared to MBr and chloropicrin in a 50:50 mix applied at 350 lbs. per acre and an untreated control. Dr. Elmore’s weed data showed excellent results with Midas when it was used at 50 or 67 percent of the fumigant mix but slightly reduced control when used at only 33 percent. The ability of these mixtures to kill cormlets from previous crops was also shown. The image above shows an untreated area with many cormlets (new gladiolus propagules) growing between the rows. The other image above shows the ability of Midas and chloropicrin to kill these weed cormlets when used at 50 or 67 percent of the fumigant mix.

A second gladiolus trial at the same site, compared Vapam and Basamid combined with Inline (a mixture of 1, 3-D and chloropicrin) to an untreated control and to an experimental formulation of sodium azide. Sodium azide was very effective in killing many of the weeds that were present but not as effective in killing the cormlets (40-percent kill). All three of the commercial alternatives were very effective in weed control, as well as cormlet eradication. Other similar trials showed the benefit of adding Inline treatments to either Vapam or Basamid to reduce weeds.

One final set of trials has recently been completed by Dr. Elmore working with Ano Nuevo Flowers (located just north of Santa Cruz, Calif.). One of his trials at this site evaluated a 50:50

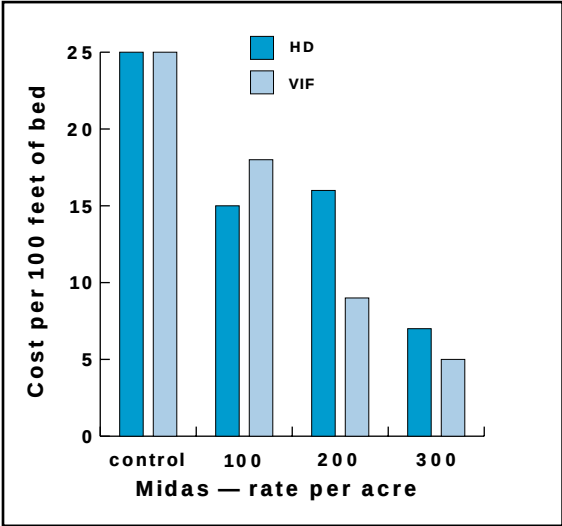
Figure 1. Effect of Midas on ranunculus vigor, volunteer seed from previous crops and Pythium severity.

Treatments	Rate per acre	Vigor 3-18/4-4	No. white flowers 4-4	Disease 4-22
Methyl bromide/chloropicrin	350 lbs.	4.0 b/4.4 b	6 a	1.2 a
Midas/chloropicrin	300 lbs.	3.8 b/4.2 b	13 a	1.0 a
Midas/chloropicrin	350 lbs.	3.7 b/4.0 b	17 a	1.9 b
Control	—	2.3 a/2.9 a	285 b	3.2 c

Figure 2. Effect of drip applied products on ranunculus vigor, volunteer seed from previous crops and Pythium severity.

Treatments	Rate per acre	Vigor 3-18	Disease 4-4	No. white flowers 4-4
Vapam	325	3.2 a	2.5 c	7 a
Midas/chloropicrin	350	3.8 ab	1.6 ab	10 a
Chloropicrin	150	3.8 ab	1.2 a	20 a
Chloropicrin	300	4.2 b	1.0 a	15 a
Sodium azide	100	3.2 a	2.1 bc	33 a
Inline	150	4.0 b	1.0 a	22 a
Inline	300	4.2 b	1.0 a	35 a
Control	—	2.5 a	3.7 d	243 b

Figure 3. Hand weeding costs for a flower planting after treatment with pre-plant fumigants, Elmore, 2002. Labor for weeding is \$11 per hour at this site.



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Top: Gladiolus cormlets sprouting (look like grass) in a control plot at Glad-A-Way in Santa Maria, Calif.; Bottom: Effective control of gladiolus cormlets in soil treated with Vapam and Inline at Glad-A-Way.

mixture of Midas and chloropicrin used at 100, 200 or 300 lbs. per acre. These treatments were compared to an untreated but tarped control. In addition, a virtually impermeable film (VIF) was compared to the normal high density (HD) plastic. Along with weed count data, Dr. Elmore calculated the costs of hand weeding each treatment. Figure 3, page 45 shows that under the HD plastic 300 lbs. per acre of Midas:chloropicrin was needed to achieve the same level of control as 200 lbs. per acre under the VIF. These data are critical to our success in using Midas once it is legal.

DRIP TRIALS

Dr. Husein Ajwa (chemist, University of California-Davis) has been instrumental in setting up several drip applied trials with Dr. Elmore. This year's trial at The Flower Fields included the same treatments described above and also accounted for occurrence of white flowers and weeds (see Figure 2, page 45). Applications were made late fall 2002. We again rated vigor on March 18 and April 4. All drip applied products significantly reduced the severity of Pythium compared to the control. Chloropicrin (300 lbs.) and both Inline treatments (at 150 and 300 lbs.) showed no signs of Pythium at this rating. The 150-lb. chloropicrin rate and the Midas/chloropicrin treatments had very few diseased plants. Sodium azide had an overall rating of about 2 (slight disease) that was mainly affected by a single replicate with higher than average disease expression (for that treatment). This may have been due to differences in application efficiency, soil conditions or even distribution of the naturally occurring Pythium inoculum. The Vapam treatment was less effective than the others at this rating.

All drip-applied products reduced the number of white flowers that grew from last year's crop. In many treatments, the white flowers were on bed shoulders, indicating that the products had not reached the entire bed as applied. Lowest counts of white flowers occurred in Metam, Midas/chloropicrin and the 300-lb. rate of chloropicrin.

CONCLUSIONS

At this point, it appears that there will be a number of alternatives for MBr for control of weeds and diseases on cut flowers. Products such as Vapam, Basamid, Telone and Inline can each be valuable tools, especially when used in conjunction with each other. Although Midas looks like a very good product, we cannot use it yet, and learning the correct application ratio (with chloropicrin) and rate per acre will be critical to insure a safe and successful fumigation. I have not covered many of the truly experimental products that are being researched at this time. They are in various stages of development, and none look to be as promising yet as Midas. I want to thank the California Cut Flower Commission and the Society of American Florists (on behalf of the Florida growers) for the opportunity to work on this critical topic with them. **GPN**

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