APPLICATION OF CHEMICALS IN-SEASON TO AUGMENT PREPLANT FUMIGATION.

James S. Gerik*[1], Susanne Klose[2], and Ian D. Greene[3]

[1]USDA-ARS, Parlier, CA; [2]University of California, Salinas, CA; [3]Golden State Bulb Growers, Moss Landing, CA

Hybrid calla lily (*Zantedeschia* spp.) is grown on the central coast of California for cut flowers for the wholesale flower market and rhizomes for propagators of potted flowering plants. The crop is direct seeded in the spring and the rhizomes are harvested after approximately 18 months. The crop is severely affected by soilborne plant pathogens including *Pythium* spp. which cause root rot, particularly during the second summer of the cropping cycle. Pre-plant soil fumigation with methyl bromide:chloropicrin (MB:Pic) is used in an effort to control these pathogens. Even with soil fumigation, fungicides are typically used during the second summer to attempt to control disease. Chemicals such as mefenoxam and azoxystrobin are applied through the drip irrigation system. These chemicals are known to select for resistance in the pathogens and such large molecules may not move sufficiently in the soil to control diseases in the root zone. Methyl bromide alternatives are typically small molecules which readily move through the soil profile. We report here the results of using low dosages of methyl bromide alternatives during the cropping season in an attempt to improve disease control and rhizome yield.

A field trial was established in May 2005 in Moss Landing, California on a ranch with an extensive history of calla lily production. The experimental design was a split-split plot with six replications. The main plots consisted of 500' long and 52" wide beds. The main plots were fumigated with either MB:Pic (50:50, 400 lb/acre), or Midas (50:50, 400 lb/acre) or water (control). The fumigants were applied in 1.5" of water using 5 irrigation tapes equally spaced over the bed width. The subplots were two plastic mulches with one half of each bed covered with high density polyethylene (HDPE) or a virtually impermeable film (VIF). The area under each half bed was further divided into five 50' sub-sub plots. Each of these plots received two in-season treatments during each summer of the cropping cycle. These treatments consisted of either 2-bromoethanol (2-BE), dimethyl disulfide (DMDS), furfural, each at 25 lb/acre or iodomethane at 12 lb/acre, or water (control). Two weeks following the initial soil fumigation, soil samples were collected from each subplot and populations of *Pythium* spp. and *Fusarium oxysporum* were determined on selected media. The crop was harvested in November of 2006. The rhizomes were graded according to salability (not soft, rotten, or cut) and size. The size of the salable rhizomes was used to determine total value for each plot. The values were compared to the

mean of the MB:PIC, HDPE, control plots (standard grower treatment) and relative values are reported.

The results of the soil sample analysis show very good control of *Pythium* spp. with both fumigants compared to the control (Fig. 1). Control of *Fusarium oxysporum* was less complete, but both fumigation treatments had lower populations compared to the untreated control (Fig. 2). Generally, populations of both fungi in soils were greater under VIF than HDPE mulch. These results do not support the common findings of improved fumigant efficacy under VIF relative to HDPE mulch.

In November of 2005, after the first in-season treatment, stand counts were taken. The stand numbers in the center one meter of each plot were 113, 110, and 27 for the combined main plot treatments of MB:Pic, Midas, and control respectively (data not shown). At the same time the number of dead plants in the center 1 meter of each sub-sub plot was counted. The mean number of dead plants were 7.3, 5.4 and 35.2 for the combined main plot treatments of MB:Pic, Midas, and control respectively. The differences between the film treatment and the five in-season treatments were not significant for either count.

The yield data is presented here as relative crop value of the plot mean. The film type had no significant influence on the yield and had no significant interactions so the sub-sub plot means were combined and analyzed as a split plot design. The main plot treatments had significant influence on crop value, both chemicals doubling the crop value compared to the control (Fig. 3). The in-season treatments had no significant influence on crop value although the control plots tended to have a higher value than treated plots (Figure 4). There were no significant interactions between fumigant and in-season treatments.

The conclusion from this study is that the main fumigants applied by drip irrigation were sufficient in achieving a healthy calla lily stand, controlling *Pythium* spp. and *Fusarium oxysporum* and producing a crop value twice as high as in untreated soils. In this study and year, the type of film used made little difference, probably due to the high rates of the primary fumigants. The application of the low rate in-season fumigant treatments was not beneficial for the production of calla lilies. In the contrary, in-season pesticide treatments caused phytotoxicity on the calla crop with plants showing chlorosis and necrosis. However, even with the drip application of high rates of the primary fumigants MB/Pic and Midas, disease still adversely effected production of this crop. More work will be needed to find a method to curtail these losses.

This work was funded in part from a grant from the California Cut flower Commission with funds contributed by the USDA IR-4 program.

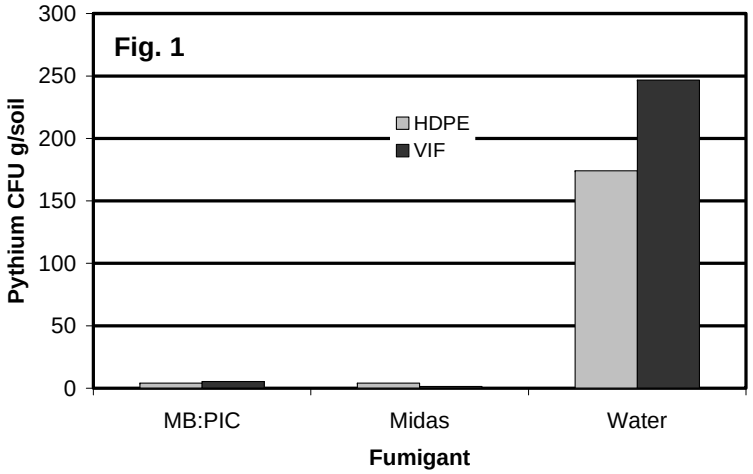
Fig. 1
Pythium CFU g/soil
300
250
200
150
100
50
0
HDPE
VIF
MB:PIC
Midas
Water
Fumigant

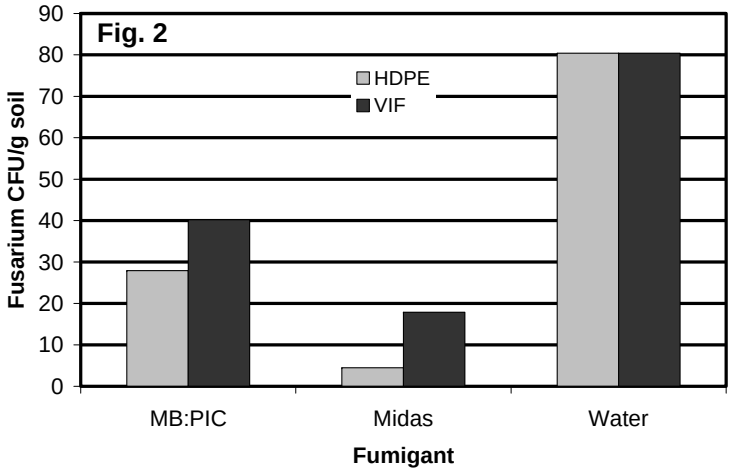
Fig. 2
Fusarium CFU/g soil
90
80
70
60
50
40
30
20
10
0
HDPE
VIF
MB:PIC
Midas
Water
Fumigant

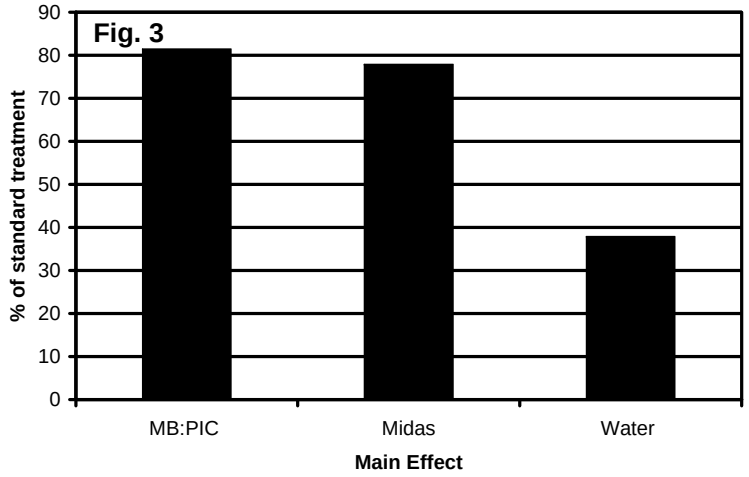
Fig. 3
% of standard treatment
90
80
70
60
50
40
30
20
10
0
MB:PIC
Midas
Water
Main Effect

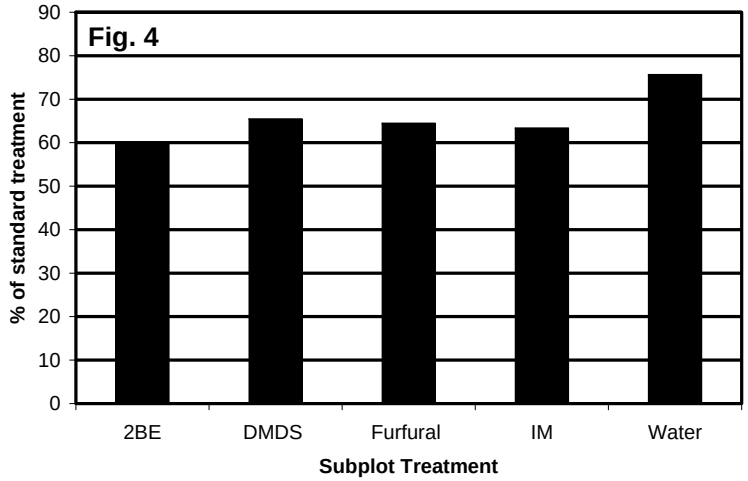
Fig. 4
% of standard treatment
90
80
70
60
50
40
30
20
10
0
2BE
DMDS
Furfural
IM
Water
Subplot Treatment

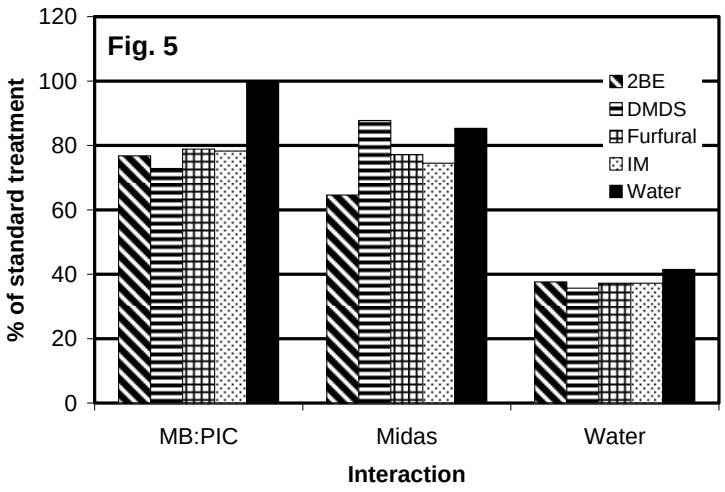

Figure 1. Populations of *Pythium* spp. in soil samples collected from the treated plots 2 week following fumigation. The control is significantly different from the 2 treatments ($P < 0.0001$). The different film types are also significantly different ($P = 0.0311$). The interaction is also significant ($P = 0.0122$).

Figure 2. Populations of *Fusarium oxysporum* in soil samples collected from the treated plots 2 week following fumigation. The control is slightly significantly different from the 2 treatments ($P = 0.0789$). The different film types are also significantly different ($P = 0.0289$). The interaction is not significant ($P = 0.7637$).

Figure 3. Value of the harvested crop relative to standard methyl bromide:chloropicrin fumigation using high density polyethylene film. Data are the combined means of all the split treatments. The control is significantly different from the 2 treatments ($P < 0.0001$).

Figure 4. Value of the harvested crop relative to standard methyl bromide: chloropicrin fumigation using high density polyethylene film. Data are the combined means of all the main plot and film treatments. The data are not significantly different ($P = 0.4302$).

Figure 5. The interaction between the main fumigation treatments and the in-season treatments of crop value. The data are not significantly different.