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# METHYL BROMIDE CRITICAL USE RENOMINATION FOR PREPLANT SOIL USE (OPEN FIELD OR PROTECTED ENVIRONMENT)

## STRAWBERRY FRUIT

### 1. SUMMARY OF THE NEED FOR METHYL BROMIDE AS A CRITICAL USE

This nomination is for methyl bromide for the production of strawberries in California, Florida, and several other states in the eastern U.S. (Alabama, Arkansas, Georgia, Illinois, Kentucky, Louisiana, Maryland, Mississippi, Missouri, New Jersey, North Carolina, Ohio, South Carolina, Tennessee, and Virginia). Strawberry growers have been replacing methyl bromide and reducing its use rates in all production areas.

**California.** California growers have a critical need for methyl bromide, for 2011, to treat fields where alternatives are not available due to regulations or to complete a fumigation program that includes a once per three year treatment with methyl bromide to manage two new diseases. Iodomethane is unlikely to be registered for use in California in the near future and, therefore, cannot reduce methyl bromide critical needs. Although use of methyl bromide has been reduced over the years (approximately one-third of strawberry land was treated with methyl bromide in 2006 (NASS, 2007; Table 1) this trend is in danger of being slowed if the incidences of two new diseases continue to increase in strawberry fields. *Macrophomina* and *Fusarium oxysporum* have emerged in some fields that have been treated annually with alternatives (Legard, personal communication, 2008). These pathogens have not been found in any of the fields that have been treated annually with methyl bromide (Legard, personal communication, 2008).

The lowest formulation of methyl bromide that is likely to be allowed in California is 57:43 (methyl bromide:chloropicrin) due to severe restrictions on the use of chloropicrin. High rates of chloropicrin (greater than 225 kg/ha) are restricted by regulation and lower rates may not be optimally effective against plant pathogens. Township caps restricting the use of 1,3-D may affect between 5,700 and 9,000 hectares by 2011 (California Strawberry Commission, 2008—Appendix JJ.11).

**Florida.** Iodomethane is now registered in Florida. Fumigant trials indicate comparable results to methyl bromide. A transition from methyl bromide to iodomethane is likely to occur quickly if first-users of iodomethane report successes in the 2008 and 2009 seasons. However, use rates, formulation and differences in application techniques require development of protocols for effective use of the new product. Until sufficient experience is gained with iodomethane, methyl bromide is considered critical for a portion of land for the 2011 use season.

Some production areas in Florida are located above karst geological formations. For these areas, there are restrictions on the use of 1,3-D to prevent contamination of ground water. Fields with key disease problems have achieved good control with chloropicrin, but those with sting nematode problems require either methyl bromide or 1,3-D. Results of several years of research trials in Florida with high barrier films indicate that an effective rate of methyl bromide with these films may be as much as 50% less than the historical use rate for some Florida strawberry

production land (Noling and Botts, 2007a; Noling and Botts, 2007b). Rates that are 25-50% lower than historical methyl bromide rates are being used in Florida as the use of VIF-type films has increased. This has allowed a reduced rate of methyl bromide while maintaining efficacy.

**Eastern Region.** Growers in the eastern U.S. have reduced their use of methyl bromide from previous years. Continuing research and extension (e.g., Welker et al., 2008) suggests that growers will transition to alternatives as rates and application methodologies are optimized. For 2011, this consortium requested on average a rate of 70 kg methyl bromide/ha to be used with a 50:50 (methyl bromide: chloropicrin) formulation. Diverse climatic areas even within a single state (e.g., coastal, mountain, piedmont) prevent a uniform description of an “eastern strawberry production” region. This strawberry industry is de-centralized and outside of North Carolina consists of small family farms that directly market strawberries through “U-pick”, “ready-pick”, roadside stands, and farmers markets (Sydorovych et al., 2006). In the eastern U.S, many of the farms contend with yellow and purple nutsedges, which are significant problems in some areas more than others. Farmers with a low incidence of nutsedge use other chemicals, such as chloropicrin, 1,3-D, and metam-sodium to manage diseases such as black root rot, nematodes, and other weeds (Sydorovych et al., 2006). Iodomethane will likely have increased use as growers gain experience with its application.

## **2. SUMMARIZE WHY KEY ALTERNATIVES ARE NOT FEASIBLE**

Alternatives are considered not feasible where 1) they have not been sufficiently tested or protocols have not been sufficiently developed for their use, 2) costs are excessive, 3) application difficulties exist due to such factors as hilly terrain or equipment requirements, 4) areas of environmental sensitivity or characteristics reduce their efficacy, 5) regulatory restrictions prevent their use, 6) pest pressure is to such an extent that alternatives are not effective.

Approximately two-thirds of strawberry land in California use alternatives to methyl bromide (Table 2). In California, township caps currently restrict the use of 1,3-D on approximately 40-62% of total strawberry land (California Strawberry Commission, 2008). High rates of chloropicrin (greater than 225 kg/ha) are restricted by regulation and lower rates are not optimally effective against plant pathogens. One alternative, iodomethane, is not registered for use in California.

In Florida, based on the 2010 nomination, approximately one-third of strawberry production land has been considered critical for methyl bromide (Table 1). In eastern U.S. production areas, based on the 2010 nomination, approximately 18% of strawberry production land has been considered critical for methyl bromide (Table 1). Iodomethane has recently been registered in all of the strawberry production states, except California. Its use will likely replace a significant portion of the critical use area for methyl bromide. However, because its registration is new it is not known how rapidly a transition to iodomethane will take place by commercial operations (Toth, 2008). High-percent iodomethane formulations (98:2) have not been tested rigorously to support research findings. Identifying effective use rates and effective formulation ratios are only beginning to be addressed after the 2008 registration. Equipment adaptation and product availability are concerns for growers who have no experience with the product. Consequently,

while iodomethane may be a promising soil treatment, there remains a critical need for methyl bromide until issues of concern are satisfactorily resolved for iodomethane.

As previously stated, some production areas in Florida are located above karst geological formations and there are restrictions on the use of 1,3-D. Sting nematode problems require either methyl bromide or 1,3-D. Some fields with key disease problems have achieved good control with chloropicrin, although there may be regulatory restrictions on its use at high rates.

Alternative strategies for pest management where weed pressure is strong include additional herbicides to provide acceptable weed management. However, this may require a 30-day period prior to planting (Noling and Botts, 2007a). Additional technical problems may be encountered, such as proper distribution of low rates of methyl bromide, which relies on back pressure measured at the flow divider (Noling and Botts, 2007a; Gilreath et al., 2005c). Noling and Botts (2007a) pointed out that taller and narrower beds required significantly more hand labor to lay VIF film due to slippage during the laying operation. Newer formulations of VIF films may help adjust for this problem.

### 3. IS THE USE COVERED BY A CERTIFICATION STANDARD?

Methyl bromide is not used to meet a certification standard for strawberry fruit production.

### 4. PROPORTION OF CROP USING METHYL BROMIDE

TABLE 2. PROPORTION OF CROP USING METHYL BROMIDE

| REGION WHERE METHYL BROMIDE USE IS REQUESTED | TOTAL CROP AREA (HA) | AREA NOMINATED FOR METHYL BROMIDE USE IN 2010 (HA) | PROPORTION <sup>1</sup> OF TOTAL CROP AREA TO BE TREATED WITH METHYL BROMIDE (%) |
|--|----------------------|--|--|
| California                                   | 14,500 <sup>2</sup>  | 4,856  | 33   |
| Eastern U.S. (15 states)                     | 2,600 <sup>3</sup>   | 474  | 18   |
| Florida                                      | 3,000 <sup>2</sup>   | 1,022  | 34   |

<sup>1</sup> Based on the amount of methyl bromide nominated for the 2010 use season for strawberry fruit production.

<sup>2</sup> NASS, 2007. 2006-season data.

<sup>3</sup> Based on estimates from various recent extension publications of states associated with the requesting consortium.

### 5. IF PART OF THE CROP AREA IS TREATED WITH METHYL BROMIDE, INDICATE THE REASON WHY METHYL BROMIDE IS NOT USED IN THE OTHER AREA, AND IDENTIFY WHAT ALTERNATIVE STRATEGIES ARE USED TO CONTROL THE TARGET PATHOGENS AND WEEDS WITHOUT METHYL BROMIDE THERE.

Pest problems vary, and therefore, no one strategy is appropriate for the variety of pests and growing conditions in strawberry production. Alternatives are used on two-thirds of strawberry production land in California. For example, *“Methyl bromide is often being used in rotation with alternative fumigants. Many growers will use alternative fumigants for 2-3 years then rotate back to methyl bromide to clean up emerging weed and disease problems. While, in some locations, local permit conditions may not allow the use of methyl bromide due to the proximity of sensitive sites such as schools or housing, thus alternative fumigants such as s Inline are used.*

*In these locations, growers may accept lower returns over time due to higher weeding costs and reduced yields or they will cease growing strawberries in those fields if soil borne disease losses and weed density gets too high” (California Strawberry Commission, 2008).*

Furthermore, in California, the choice of fumigant “*is influenced by a number of factors including the regulatory situation for a particular ranch, their financial situation—can they afford methyl bromide, the type of crop they are producing (summer plantings typically do not use methyl bromide because they have a short production season while growers in the northern district are more likely to use methyl bromide since they have a very long season), the prevalence of disease or weed problems, etc...*” (Legard, personal communication, 2008).

In the Florida and the eastern U.S., an area-wide research program (Welker et al., 2008; Welker et al., 2007) has highlighted successes with alternatives (e.g., InLine<sup>®</sup>, chloropicrin) and reduced rates of methyl bromide (150 kg ai/ha). Based on the 2010 U.S. nomination for methyl bromide, alternatives are used on two-thirds of strawberry land in Florida and approximately 82% of strawberry land in the eastern U.S. (Table 2). Preliminary research conducted on a commercial farm in North Carolina where black root rot and winter weeds were the key pests (with low nutsedge pressure) indicated that in some situations the efficacy of alternative treatments with a high barrier films was similar to a treatment of 300 kg methyl bromide/ha with a standard film. The nomination for 2011 is for areas where pest pressure is moderate to high and alternatives have not been sufficiently adapted to the areas of concern.

## **6. WOULD IT BE FEASIBLE TO EXPAND THE USE OF THESE METHODS TO COVER AT LEAST PART OF THE CROP THAT HAS REQUESTED USE OF METHYL BROMIDE? WHAT CHANGES WOULD BE NECESSARY TO ENABLE THIS?**

In California, expansion of alternative methods to critical areas “does not appear to be likely due to the emergence of two new soil borne disease problems and the persistence of the yellow nutsedge weed problem. An alarming number of fields in Santa Maria, Oxnard and Orange County, that have not been fumigated with methyl bromide for more than two years, are experiencing increasing losses to charcoal rot (*Macrophominia phaseolina*) and Fusarium wilt (*F. oxysporum*)” (California Strawberry Commission, 2008). In addition restrictions on the use of 1,3-D in California and Florida limit its expansion to other areas. If use rates, formulation, and availability issues are resolved iodomethane could expand in Florida and eastern U.S. strawberry growing areas where it is registered.

Nevertheless, the California Strawberry Commission has funded Farming Without Fumigants Initiative whose goal is to develop strawberry fruit production methods that can avoid the complexities of highly regulated fumigants. This research includes collaboration with the University of California and USDA.

In Florida, iodomethane may be used in 2008 for the first time and could be a replacement for methyl bromide if use this season proves to be acceptable. A transition period is likely to be necessary to allow protocols for iodomethane to be developed for commercial production of

strawberries in Florida. The adoption of VIF over the past two years has increased the efficacy of fumigants such that lower use rates are effective.

In the eastern U.S. adoption of VIF-type films is also occurring and alternatives are being used. However, for some areas methyl bromide has allowed production on marginal land or in the case of the many small farms, land that is not able to be rotated out of strawberries due to the economic situation of the farmer. Iodomethane will likely present a feasible alternative with excellent efficacy (SE Regional Strawberry Integrated Management Guide, 2008), but as is the case in Florida, a transition period for adoption of iodomethane is necessary for production areas in the eastern U.S. to allow protocols for iodomethane to be developed for commercial strawberry production (Toth, 2008).

## 7. SUMMARY OF RECENT RESEARCH

**California.** According to Legard (personal communication, 2008) with regard to *Macrophomina* and *Fusarium oxysporum*, “...neither disease was a problem before growers started using alternative fumigants, although we have not seen these disease problems in fields that have been strip/bed fumigated with methyl bromide (this method is used about 20% of the time in Santa Maria). The key consideration may be the shift from broadcast fumigation to drip fumigation. We are conducting studies this fall to see if high rates of fumigants applied through the drip tape can control these diseases. We have seen *Macrophomina* occur in fields that were drip fumigated with 100% Pic. However, growers are restricted from applying rates above 200 lbs/a, so we are testing higher rates to see if they are efficacious. If so, we would then need to find a way to convince local regulators to allow drip applications at those rates. Another reason for the increase in disease problems on fields not treated with methyl bromide may be related to the fact that MB disperses better and has a longer half-life than Pic. Straight MB does have fungicidal properties. Broadcast applications of straight Pic are strictly regulated and many counties either prohibit them or restrict their rates (in Ventura County they will allow only 125 lbs/a) to levels that are not efficacious.”

In an attempt to address the problem, some growers have returned to using a methyl bromide treatment after two years treatment with alternatives in order to “clean-up” the soil contaminated with both emerging pathogens and weeds. Norton (2008) reported that excellent weed and disease control have been achieved with drip-applied 1,3-D/chloropicrin (InLine) followed 5-8 days later by metam-sodium. However, weed control was highly dependent on optimal fumigant placement, which has not always been applied.

Fennimore et al. (2008) reported:

- High barrier tarps improve efficacy at reduced rates of drip-applied 1,3-D, iodomethane, and methyl bromide. This effect did not appear to occur with chloropicrin used alone.
- Drip applied 1,3-D/chloropicrin (InLine), iodomethane/chloropicrin, and methyl bromide/chloropicrin resulted in comparable yields in two locations.
- Totally impermeable films glued well and enhanced retention of 1,3-D, iodomethane, and methyl bromide compared to standard films.
- Test plots that were treated with steam and Brassica meal provided good yields in two locations.

- Test plots treated with steam also provided good weed control.

**Florida and the Eastern Region.** Iodomethane may offer an effective alternative to methyl bromide, although 2008 is the first year where it can be used commercially. Consequently, certain uncertainties must be resolved and necessitate a critical need for methyl bromide for a portion of strawberry land until a transition can be complete. According to the Florida request for the critical use of methyl bromide, *"Iodomethane has been trialed extensively in replicated small plot research across the crop needs and soil types currently treated with methyl bromide in Florida. We have been working with Arysta LifeSciences in evaluating various cropping and efficacy components of iodomethane. Midas received a registration in the state of Florida on July 7, 2008. We anticipate additional grower use and trial work this fall with further acreage of Florida strawberries, tomatoes and peppers receiving treatment. A major impediment to adoption of this alternative is the extensive risk mitigation and management requirements associated with its use. The expense of the product and complexity of implementing these requirements have significantly reduced the enthusiasm of growers for this alternative."*

In Florida, trials were conducted that assessed iodomethane (either drip- or chisel-applied). Iodomethane (and various 1,3-D/chloropicrin treatments) resulted in yields that were comparable to methyl bromide treated plots (Noling, 2008). However, variability between test sites were said to be a result of application problems. These will have to be resolved prior to optimal commercial use of these alternatives.

Iodomethane is also registered in the eastern strawberry-growing states comprising this consortium. North Carolina State University extension rated iodomethane:chloropicrin (50:50) as providing excellent control of diseases nematodes and good to excellent control of weeds, including nutsedge (Welker, 2008). A formulation of 98:2 (iodomethane:chloropicrin) has been marketed but not well-studied. Poling and Schiavone (2008) found that a 50:50 formulation of iodomethane resulted in the highest numerical total and marketable yield of any treatment, although not significantly different than methyl bromide. According to the researchers, *"Total and marketable yields were significantly greater for fumigated soil than the untreated control treatments. Midas 50:50 at the 180 lb/A broadcast rate with standard plastic, and Midas 50:50 at the 120 lb/A broadcast rate with VIF had the highest yields in the study, but were not significantly different from methyl bromide at 175 lb/A with VIF. It is very interesting that the lower rate of Midas 50:50 (120 lb/A with VIF) was significantly higher in total and marketable yield than Midas 50:50 at the 140 and 160 rates with VIF. Also, the 180 lb/A rate (with VIF) was 7,272 lb/A lower in marketable yield than the 120 lb/A rate of Midas 50:50 (with VIF)."*

Welker et al. (2008) found that in South Carolina trials weed control was achieved under VIF with 1,3-D/chloropicrin (35 gal Telone C35), iodomethane/chloropicrin (168 kg/ha 50:50), and methyl bromide/chloropicrin (146 kg/ha, 50:50). However yield was significantly reduced with the 1,3-D/chloropicrin. Researchers suspected that under VIF, that rate was too high stunted plants. In North Carolina trials, drip applied 1,3-D/chloropicrin (InLine) and PicClor 60 resulted in excellent annual weed control under VIF, where previous data had indicated unacceptable weed control. Extension conducted an on-farm field day, which provided information on methyl bromide alternatives to growers.

Norton (2008) reported that use of 1,3-D/chloropicrin followed by metam-sodium with appropriate water moisture could achieve excellent disease and weed control. A 21-d waiting period was required prior to transplanting. As with the situation in Florida, use experience, availability, and equipment and rate adjustments for the new product may require a period of transition for a portion of strawberry land making some methyl bromide critical for 2011.

## 8. ECONOMIC FEASIBILITY OF ALTERNATIVES

The following economic analysis is organized by methyl bromide critical use application regions.

In this study net revenue is calculated as gross revenue minus operating costs. This is a good measure to describe the direct losses of income that may be suffered by the users. It should be noted that net revenue does not represent net income to the users. Net income, which indicates profitability of an operation of an enterprise, is gross revenue minus the sum of operating and fixed costs. Net income should be smaller than the net revenue measured in this study. Fixed costs were not included because it is often difficult to measure and verify.

### Summary of Economic Feasibility

The economic analysis of the strawberry fruit application compared data on yields, crop prices, revenues and costs using methyl bromide and using alternative pest control regimens in order to estimate the loss of methyl bromide availability. The alternatives identified as technically feasible in cases of low pest infestation for Florida and the eastern U.S. states are: (a) Iodomethane and (b) 1,3-D/chloropicrin followed by metam sodium. For California, the primary alternative is 1,3-D/chloropicrin followed by metam sodium. Iodomethane is not registered for use in California.

The economic factors that drive the feasibility analysis for fresh market strawberry fruit use of methyl bromide are increased production costs which may be due to the higher-cost of using an alternative, additional pest control requirements, and/or resulting shifts in other production or harvesting practices and yield losses.

Crop budgets were analyzed for pre-plant sectors to determine the likely economic impact if methyl bromide were unavailable. Various measures were used to quantify the impacts, including the following:

- (1) **Loss per Hectare.** For crops, this measure is closely tied to income. It is relatively easy to measure, but may be difficult to interpret in isolation.
- (2) **Loss per Kilogram of Methyl Bromide.** This measure indicates the value of methyl bromide to crop production.
- (3) **Loss as a Percentage of Gross Revenue.** This measure has the advantage that gross revenues are usually easy to measure, at least over some unit, *e.g.*, a hectare of land or a storage operation. However, high value commodities or crops may provide high revenues but may also

entail high costs. Losses of even a small percentage of gross revenues could have important impacts on the profitability of the activity.

**(4) Loss as a Percentage of Net Operating Revenue.** We define net cash revenues as gross revenues minus operating costs. This is a very good indicator as to the direct losses of income that may be suffered by the owners or operators of an enterprise. However, operating costs can often be difficult to measure and verify.

**(5) Operating Profit Margin.** We define operating profit margin to be net operating revenue divided by gross revenue per hectare. This measure would provide the best indication of the total impact of the loss of methyl bromide to an enterprise. Again, operating costs may be difficult to measure and fixed costs even more difficult, therefore fixed costs were not included in the analysis.

These measures represent different ways to assess the economic feasibility of methyl bromide alternatives for strawberry fruit producers. Because producers (suppliers) represent an integral part of any definition of a market, the threshold of significant market disruption is met if there is a significant impact on commodity suppliers using methyl bromide. The economic measures provide the basis for making that determination.

In the case of strawberry fruit production, for the eastern growers that have access to iodomethane, an impact of 1-4% in gross revenue is expected in the first year of use due to increased costs to retrofit application equipment (hoses, nozzles, flow meters) that will allow the use of iodomethane. This cost is estimated to be approximately \$600-\$700 per acre based on USG estimates. Southeastern and Florida strawberry growers that use iodomethane are expected to experience no change in yield or quality. See tables 3 and 4 below.

For California strawberry producers, there is no change in impacts from previous year estimates as iodomethane is under registration review but registration is not expected in the near future. The loss to gross revenue for growers using alternatives to methyl bromide is estimated to remain about 14% as compared to the use of methyl bromide. Table 5 illustrates the 2008 economic impact assessment for California strawberry fruit growers.

**TABLE 3. FLORIDA FRUIT AND VEGETABLE GROWERS ASSOCIATION : ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES**

| FLORIDA FVGA   | METHYL BROMIDE | IODOMETHANE | 1,3 D + PIC |
|--|----------------|-------------|-------------|
| PRODUCTION LOSS (%)                                  | 0%             | 0%          | 14%         |
| PRODUCTION PER HECTARE                               | 2,989          | 2,989       | 2,559       |
| * PRICE PER UNIT (US\$)                              | \$ 32.80       | \$ 32.80    | \$ 32.8     |
| = GROSS REVENUE PER HECTARE (US\$)                   | \$ 98,064      | \$ 98,064   | \$ 83,942   |
| - OPERATING COSTS PER HECTARE (US\$)**               | \$ 52,571      | \$ 56,525   | \$ 51,586   |
| = NET REVENUE PER HECTARE (US\$)                     | \$ 45,493      | \$ 41,538   | \$ 32,086   |
| <b>LOSS MEASURES *</b>                               |                |             |             |
| 1. LOSS PER HECTARE (US\$)                           | \$ 0           | \$ 3,955    | \$ 13,407   |
| 2. LOSS PER KILOGRAM OF METHYL BROMIDE (US\$)        | \$ 0           | \$ 16.8     | \$ 56.96    |
| 3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)         | 0%             | 4%          | 14%         |
| 4. LOSS AS A PERCENTAGE OF NET OPERATING REVENUE (%) | 0%             | 9%          | 29%         |
| 5. OPERATING PROFIT MARGIN (%)                       | 46%            | 42%         | 38%         |

\*\*Note that the measures in the tables below must be interpreted carefully. Operating costs do not include fixed costs and net revenue equals gross revenue minus operating costs.

**TABLE 4. SOUTH EASTERN STRAWBERRY COMMISSION : ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES**

| South Eastern Strawberry Commission                  | METHYL BROMIDE | IODOMETHANE | 1,3 D + PIC |
|--|----------------|-------------|-------------|
| PRODUCTION LOSS (%)                                  | 0%             | 0%          | 0%          |
| PRODUCTION PER HECTARE                               | 14,011         | 14,011      | 12,044      |
| * PRICE PER UNIT (US\$)                              | \$ 2.89        | \$ 2.89     | \$ 2.89     |
| = GROSS REVENUE PER HECTARE (US\$)                   | 40,463         | \$ 40,463   | \$ 34,784   |
| - OPERATING COSTS PER HECTARE (US\$)**               | \$ 33,175      | \$ 33,611   | \$ 32,744   |
| = NET REVENUE PER HECTARE (US\$)                     | \$ 7,288       | \$ 6,853    | \$ 2,039    |
| <b>LOSS MEASURES *</b>                               |                |             |             |
| 1. LOSS PER HECTARE (US\$)                           | \$ 0           | \$ 436      | \$ 5,249    |
| 2. LOSS PER KILOGRAM OF METHYL BROMIDE (US\$)        | \$ 0           | \$ 2.88     | \$ 34.69    |
| 3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)         | 0%             | 1%          | 13%         |
| 4. LOSS AS A PERCENTAGE OF NET OPERATING REVENUE (%) | 0%             | 6%          | 72%         |
| 5. OPERATING PROFIT MARGIN (%)                       | 18%            | 17%         | 6%          |

\*\*Note that the measures in the tables below must be interpreted carefully. Operating costs do not include fixed costs and net revenue equals gross revenue minus operating costs.

**TABLE 5. CALIFORNIA : ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES**

| CALIFORNIA   | METHYL BROMIDE | PIC + MB   | 1,3 D + PIC |
|--|----------------|------------|-------------|
| PRODUCTION LOSS (%)                                  | 0%             | 15%        | 14%         |
| PRODUCTION PER HECTARE                               | 49,410         | 41,999     | 42,475      |
| * PRICE PER UNIT (US\$)                              | \$ 1.37        | \$ 1.37    | \$ 1.37     |
| = GROSS REVENUE PER HECTARE (US\$)                   | \$ 67,537      | \$ 66,020  | \$ 58,057   |
| - OPERATING COSTS PER HECTARE (US\$)**               | \$ 66,849      | \$ 57,432  | \$ 66,100   |
| = NET REVENUE PER HECTARE (US\$)                     | \$ 688         | (\$ 8,614) | (\$ 8,042)  |
| <b>LOSS MEASURES *</b>                               |                |            |             |
| 1. LOSS PER HECTARE (US\$)                           | \$ 0           | \$ 9,302   | \$ 8730     |
| 2. LOSS PER KILOGRAM OF METHYL BROMIDE (US\$)        | \$ 0           | \$ 46.36   | \$ 43.51    |
| 3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)         | 0%             | 14%        | 13%         |
| 4. LOSS AS A PERCENTAGE OF NET OPERATING REVENUE (%) | 0%             | 1352%      | 1269%       |
| 5. OPERATING PROFIT MARGIN (%)                       | 4%             | -15%       | -14%        |

\*\*Note that the measures in the tables below must be interpreted carefully. Operating costs do not include fixed costs and net revenue equals gross revenue minus operating costs.

## 8. RESULTANT CHANGES TO REQUESTED EXEMPTION QUANTITIES

The USG has applied an aggressive transition rate which is reflected in the nomination amount and detailed in Table 6.

**TABLE 6. NOMINATION AMOUNT: 2011 Methyl Bromide Usage Newer Numerical Index (BUNNI) – Transition Use Reduction Description Spreadsheet.**

| SECTOR  |                | STRAWBERRY FRUIT                 |                    |                    |                        |
|---|----------------|----------------------------------|--------------------|--------------------|------------------------|
|   |                | California Strawberry Commission | Eastern Strawberry | Florida Strawberry | Sector Total / Average |
| Quantity Requested for 2010:                        | Amount (kgs)   | 952,543                          | 47,862             | 103,017            | 1,103,422              |
| Quantity Recommended by MBTOC/TEAP for 2010 :       | Amount (kgs)   | 856,598                          | 47,862             | 103,017            | 1,007,477              |
| Quantity Approved by Parties for 2010:              | Amount (kgs)   | 856,598                          | 47,862             | 103,017            | 1,007,477              |
|   | Area (ha)      | 4,370                            | 299                | 644                | 5,313                  |
|   | Rate           | 196                              | 160                | 160                | 190                    |
| <b>Transition from 2010 Baseline Adjusted Value</b> | Percentage (%) | 0%                               | -52%               | -53%               | -7%                    |
| <b>Quantity Required for 2011 Nomination:</b>       | Amount (kgs)   | <b>952,543</b>                   | <b>22,848</b>      | <b>48,080</b>      | <b>1,023,471</b>       |
|   | Area (ha)      | <b>5443</b>                      | <b>143</b>         | <b>300</b>         | <b>5886</b>            |
|   | Rate           | <b>175</b>                       | <b>160</b>         | <b>160</b>         | <b>174</b>             |

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