Costs of Methyl Iodide Non-Registration

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The California Department of Pesticide Regulation has proposed to register methyl iodide, a fumigant that may be a technically feasible alternative to methyl bromide in some uses. To the extent that currently registered alternatives cannot substitute perfectly for methyl bromide, methyl iodide has the potential to offer a better option for growers, so that non-registration could generate costs for California agriculture.

On April 30, 2010 the California Department of Pesticide Regulation (CDPR) proposed to register five pesticide products containing the fumigant methyl iodide (MeI) previously registered by the U.S. EPA in 2008. MeI was registered by the EPA in part because unlike the fumigant methyl bromide (MBr), MeI does not damage the ozone layer in the upper atmosphere. The use of MBr in pre-plant soil fumigation was an important pest and pathogen management tool for growers of many crops for decades. Due to its negative effect on the atmosphere, however, its use is being phased out.

At this point in time, all MBr used in the United States must either come from existing stocks or qualify for a critical use exemption (CUE) approved by national and international authorities. Available stocks are anticipated to be negligible from 2011 on, and it is very unlikely that the United States will apply for any CUEs for use in 2015 or later.

Consequently, it's a matter of great importance to identify technically and economically feasible alternatives to MBr for uses that are permitted currently under CUEs. There is considerable interest in MeI as a potential replacement for MBr in some uses.

We examine the potential value of MeI to California agriculture when MBr is no longer available. MeI has been characterized as the alternative that is the closest to being a "drop-in" replacement for MBr, due to its broad control spectrum, high vapor pressure relative to other alternatives, and the ability to apply it using the same equipment as MBr. Overall, MeI performs comparably to MBr for nematode, weed, and fungi control, based on results of laboratory and field trials. Of course, the efficacy of MeI is not constant, but depends on field conditions, soil type, application method, application rate, crop, and use regulations. Some use regulations, such as limits on application rates, may limit the efficacy of MeI products directly. Others, such as buffer zones, limit the land to which it can be applied.

Revenue Loss Analysis

Because MeI has the ability to act against a broad spectrum of pests, it may be able to manage pest and/or disease pressures that are not managed effectively by other MBr alternatives. Information contained in MBr critical use exemption (CUE) requests for specific crops provides one measure of the potential costs to California agriculture of the non-registration of MeI. To the extent that currently registered alternatives cannot substitute perfectly for MBr, there is the potential for MeI to offer a better option for growers.

We use the data prepared for four CUE applications approved by the EPA and forwarded to the international Methyl Bromide Technical Options Committee for approval for 2011, along with acreage and price information for ten associated crops. In 2007, the crops considered here accounted for almost a quarter of California's total cash farm receipts.

We use 2011 CUE nominations in order to provide a forward-looking analysis. As existing stocks of MBr are exhausted, the pattern of its use will change so that 2009 values are of relatively limited use even for short-term projections. By 2011, less than 10% of the MBr used in the United States is predicted to come from existing stocks.

Our approach to estimating the cost of MeI non-registration assumes that the loss of gross revenues from the unavailability of MBr could not be mitigated through other alternatives. Thus, the loss in gross revenues from MBr unavailability represents an estimate of the economic cost from non-registration of MeI. One definition of the losses that would occur is obtained from CUE applications, which are required to include an estimate of the yield loss that would occur if the application was denied. This estimate applies only to the acreage for which the CUE is requested; the presumption is that registered alternatives to MBr are technically and economically feasible on other acreage.

This analysis assumes that the technical efficacy is identical for MeI and MBr, yields are identical, the cost per acre of applying the two fumigants is identical, and that the applicable regulations are identical. If MeI is less efficacious, more expensive, or is subject

Table 1. Effect of Denial of MeI Registration on Gross Crop Revenues: CUE Acres Only, Yield Loss Estimates from 2011 Critical Use Exemption (CUE) Applications*

	Yield loss (%)	2007 Planted acreage	2007 Harvested acreage	2011 CUE acreage	Gross revenues MeI available $millions	Gross revenues MeI not available $millions	Change (%)
Almond[a]	-4	21,080	615,000	217	2,154	2,155	0.01
Cut flower[b]	-20	8,126	8,126	716	182	166	-8.81
Table Grape[a]	-10	2,977	82,000	0	–	–	0
Raisin Grape[a]	-10	906	227,000	106	602	608	1.19
Wine Grape[a]	-10	9,112	480,000	254	1,854	1,860	0.28
Nursery (fruit&nuts)[c]	-100	N/A	N/A	N/A	86	165	161.19
Nursery (roses)[d]	-100	N/A	N/A	12	36	35	-1.32
Stonefruit[a]	-4	8,913	302,000	1,662	865	869	0.41
Strawberry[e]	-15	35,500	35,500	13,444	1,339	1,305	-2.49
Walnuts[a]	-4	3,185	218,000	274	754	761	0.95
TOTAL					7,951	7,920	-0.39

Legend

a. Assumes all acres in full production and affected proportionately

b. Acreage from 2007 U.S. Census of Agriculture.

c. 2006 gross revenues from NASS, 2007.

d. 2008 gross revenues nursery, rose category from CDFA CAC data 2009.

e. Assumes the same shares of revenues from fresh strawberries for all strawberry acreage.

* *This analysis does not address the regulatory scenario of fumigants other than MBr being further restricted, or the possibility that new pest and/or disease problems may emerge.*

to more regulations, then the costs of non-registration would decrease.

In order to compute revenue changes, we use own-price elasticities of demand from the existing literature when available. California is an important supplier of many of the crops we consider; consequently, a decrease in California production may result in an increase in price. The own-price elasticity of demand captures this effect. Results are reported in Table 1.

The decline in production if MeI is not available is computed by multiplying the estimated percentage yield loss in the second column by the 2011 CUE acreage in the fifth column. Multiplying this number by the 2007 California price per unit of the commodity in question provides the reduction in gross revenues due to the non-availability of MeI. For example, the reduction in gross revenues for almonds is computed by multiplying 4% yield loss by the 217 requested CUE acres by the base yield of almonds by the price of almonds per ton. This results in estimated revenue losses of $1 million.

Gross revenues if MeI is available is computed by multiplying 2007 harvested acreage by base yields and prices and assuming zero yield losses.

Gross revenues if MeI is not available is computed by subtracting the loss due to the non-availability of MeI. Planted acreage is included in the table in order to provide a measure of how large CUE acres are as a share of planted acres; for perennial crops, harvested acres are not a reasonable proxy for planted acres. In the case of almonds, the 2011 requested CUE acreage was equal to about 1% of the 2007 almond acreage planted (21,080), but a negligible share of the 615,000 acres harvested.

Cut flowers sustain the largest percentage revenue loss: 9%. This is due to the relatively large (20%) yield decrease reported in the CUE application and the relatively large share of planted acreage for which a CUE is requested, as well as to the very elastic demand assumed for cut flowers. While losses to nursery crops are assumed to be 100% on affected acres, the share of acreage requested in the CUE relative to total acreage is quite small, leading to small percentage losses. Yield losses for other crops are mostly or completely offset by price increases received for the remaining production. In the case of strawberries, our loss estimates reflect the success that the industry has had in identifying alternatives to MBr, which serve as alternatives to MeI and mitigate the costs of the denial of registration.

In addition to direct effects on agriculture, changes in agricultural revenues affect other economic activity. Based on a multiplier of 1.77 from the IMPLAN model of the California economy, there would be a $55 million reduction in total economic activity in California. Total employment would decline by 820.

An important caveat to this analysis is the use of CUE acres; to the extent that users rely on using MBr from existing stocks, CUE acreage requests will understate the use of MBr. Table 2 addresses this concern. It assumes that the yield losses reported in the 2011 CUE nominations apply to all harvested acreage. Because some acreage in each

of these crops is using MBr alternatives, these estimates will exceed the cost of MeI non-registration under current regulations. Consequently, we are able to place an upper bound on the potential cost of MeI non-registration due to additional acreage of these crops using MBr from existing stocks.

Due to inelastic demand, revenues from almonds, raisin grapes, wine-grapes, stonefruit, and walnuts are not impacted adversely. Losses for strawberries increase to 7%. Because of the assumed perfectly elastic demand, cut flower losses are 20%. Because a 100% yield loss is assumed for nursery crops due to the nematode-free certification requirement, losses are also 100%.

It is important to note that the estimates in Table 2 should not be interpreted as estimates of the cost to these commodities of eliminating all fumigant use. The yield losses in the 2011 CUE nominations do not represent this elimination scenario. In the absence of any fumigant use, higher yield losses would be predicted.

Total revenues for these ten crops decline by $38 million. Again, applying multipliers from the IMPLAN model of the California economy, total economic activity would decrease by $67 mission and employment would decrease by approximately 1,005.

Table 2. Effect of Denial of MeI Registration on Gross Crop Revenues: Yield Loss Estimate from 2011 Critical Use Exemption (CUE) Applications

	Yield loss (%)	2007 Harvested acreage	Gross revenues MI available $millions	Gross revenues MI not available $millions	Change (%)
Almond[a]	-4	615,000	2,154	2,168	0.62
Cut flower[b]	-20	8,126	182	146	-19.99
Table Grape[a]	-10	82,000	623	617	-0.99
Raisin Grape[a]	-10	227,000	602	648	7.65
Wine Grape[a]	-10	480,000	1,854	2,003	8.00
Nursery (fruit and nuts)[c]	-100	N/A	165	N/A	-100
Nursery (roses)[d]	-100	N/A	36	N/A	-100
Stonefruit[a]	-4	302,000	865	882	1.98
Strawberry[e]	-15	35,500	1,339	1,239	-7.41
Walnuts[a]	-4	218,000	754	833	10.49
TOTAL			8,573	8,535	0.45

* *This analysis does not address the regulatory scenario of fumigants other than MBr being further restricted, or the possibility that new pest and/or disease problems may emerge.*

[a-e] *See the legend in Table 1.*

1,3-D Township Caps

Current restrictions on the use of other fumigants increase the costs of the denial of MeI registration for California agriculture. For example, one important fumigant-specific regulation limits the amount of 1,3-dichloropropene (1,3-D) that can be applied within a township in a given year. Even if MeI is not the most efficacious alternative to MBr, it could serve as an alternative for growers affected by township caps on 1,3-D. Strawberries and sweet potatoes are two crops that utilize pre-plant soil fumigation relatively intensively and have production concentrated in specific townships. Thus they may be disproportionately affected in those areas by the non-registration of MeI, because it would deny them an alternative to 1,3-D.

However, even if perennial crops are not heavy users of pre-plant soil fumigation using 1,3-D in any individual year, they are subject to special dynamic considerations that may cause them to be affected by the caps. Pre-plant fumigation use is governed by replant rates, which vary over time. Because application rates are relatively high for a perennial replant, demand in specific years could exceed the township cap, even if average annual demand does not. Another potential concern regarding perennials is that the loss of MBr may alter the effective lifetime of a planting by reducing plant vigor and productivity. If the economic life of an orchard, grove, or vineyard is reduced when pre-plant fumigation with currently registered MBr alternatives is used, but pre-plant fumigation with MeI would eliminate this reduction, then reduced life spans for perennials would be an additional cost of the denial of the registration of MeI.

Specific Pest and Disease Considerations

MeI has the potential to perform better for a number of specific pests and diseases than currently available MBr alternatives. We discuss only a few. For example, pre-plant soil fumigation with MBr combined with chloropicrin has been a means of protecting the vigor of perennial crops replanted on ground previously in those crops. MeI may be an effective management tool in the absence of MBr, although its potential is dependent on soil type and other considerations, as noted earlier. For almonds and stonefruit, MeI could be a tool for managing peach replant disorder. Studies suggest that its efficacy may be limited by the maximum application rate permitted. Similarly, grapes are subject to vineyard replant disorder. Vineyard replant disorder, loosely speaking, refers to a loss of vigor in vines planted to fields previously in vineyards, compared to

vines planted in fields with a different previous crop. While the precise cause (or causes) of vineyard replant disorder are unknown, growers have used MBr successfully to control it.

One factor often, but not always, associated with replant disorders is high nematode populations. There is evidence that MeI plus chloropicrin (Pic), or 1,3-D plus Pic, are effective tools for nematode management in grapes. For walnuts, 1,3-D does not control nematodes as well as MBr does in finer soils. Application rate restrictions prevent the use of enough 1,3-D to compensate for its lower efficacy. However, as is the case for other perennials, the replant problem is more complex than a nematode infestation, and many walnut trees fail to produce if replanted in non-fumigated soil. Notably, the requested acreage in the 2011 CUE application appears relatively small, given the difficulties of managing nematodes in the finer-textured soils in which a majority of California walnuts are grown. This divergence may be due to the relatively high cost of MBr per acre given current and projected market conditions.

In the cut flower industry, MeI would provide a means of managing weeds in a short production cycle system that includes a large number of diverse species. A broad spectrum preplant control method is very valuable for multiple reasons. These crops are susceptible to a variety of pathogens and differ in their sensitivities to each one. Because so many different crops are grown successively, often on very short production cycles, herbicides may carry over into the next cycle and damage the crop. Studies suggest that MeI may be able to address these needs, although the evidence does not establish that it is likely the best alternative to MBr in all situations.

Nursery stock for on-farm use, such as trees and vines intended for transplanting for commercial fruit and nut production, is required under California law to be free of economically important nematodes. Fumigation with MBr is the conventional nursery treatment specified for nematode-free certification, although in certain cases 1,3-D use is permitted. MeI has not been shown to provide control equivalent to MBr at application rates permitted by U.S. EPA.

Macrophomina phaseolina and *Fusarium oxysporum* are responsible for charcoal rot and Fusarium wilt, respectively, in strawberries. The pathogens have emerged in fields that have been treated with drip-applied bed fumigation, using alternatives to methyl bromide for multiple years. The prevailing hypothesis among researchers is that the bed-only drip applications allow pathogens to persist in the untreated furrows. At the present time, potentially efficacious solutions to the management of these pathogens include long-term rotations of infected ground and flat fumigation. Long-term rotations out of strawberries into non-host crops are generally not economically viable. The use of flat fumigation is limited by township caps for 1,3-D and rate maximum permitted for Pic, which restrict the ability of growers to flat-fumigate at sufficiently high rates for pathogen control in many areas.

Conclusion

The cost of denying registration of MeI products to California agriculture depends on a number of factors. First, MeI may not be as effective as MBr or as other MBr alternatives for specific production systems. For example, MeI does not provide sufficient control of nematodes for fruit and nut nursery stock in heavy soils at permitted application rates. In such cases the cost of non-registration is lower, because the use of MeI provides fewer benefits. In other cases, MeI has the potential to dominate other alternatives to MBr, although in most of these instances more research is needed. Technical efficacy is a prerequisite, but it is not the only consideration. The prices of MeI and its substitutes will matter, as will regulations governing their use.

The analysis focused on the costs of the denial of MeI registration given *current* regulatory conditions. Looking forward, it is clear that the cost of non-registration of MeI would be highly dependent on the effects of the 1,3-D township caps, and on the extent to which crops with CUE applications for 2011 would be able to transition to fumigants other than MeI, or to non-fumigant alternatives, such as steam or substrates, once the MBr ban is complete. Losses would also depend on demand conditions. If new competitors emerge, then for any reduction in the quantity produced, there will be a smaller price response, so revenue losses will increase.

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For additional information, the authors recommend:

"Costs of Methyl Iodide Non-registration: Economic Analysis." Rachael Goodhue, Peter Howard and Richard Howitt. Final report submitted to the California Department of Food and Agriculture, May 2010.