THE ECONOMIC IMPACTS OF BANNING METHYL BROMIDE: WHERE DO WE NEED MORE RESEARCH?

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Using two different approaches, we have investigated the impacts of phasing out methyl bromide for the United States. First, we calculated the value of each pound of methyl bromide based on anticipated yield and cost changes assuming constant prices. We found that California Strawberries and Strawberry Nurseries, California Wine Grapes, California Almonds, California Sod, California Carnations, Florida Central Strawberries, California Perennial Nurseries, and Florida States Double-crop systems (such as Tomatoes/Cucumbers, Pepper/Watermelon, Tomato/Watermelon and Tomato/Squash), lose more value when forced to stop using methyl bromide and switch to the lowest per unit cost alternative. The actual values per pound of methyl bromide relative to the next best alternative are presented in Table 1. The higher degree of loss could support additional research dollars being directed toward these crops and production systems.

Our second approach examines the annual crops that use methyl bromide extensively and allows both acreage and prices adjustments. Methyl bromide use on tomatoes, strawberries, peppers, watermelon, cucumber, squash and eggplant account for over 60% of the total U.S. pre-plant use, either directly or in a double crop rotation production system. These crops are grown with methyl bromide primarily by horticulturists in California and Florida with production in South Carolina, North Carolina and Georgia. Their primary competition are producers in three Mexican states: Baja California, Sinaloa, and Sonora, in Texas, and in non-methyl bromide using regions in the United States. The phase-out of methyl bromide will force many U.S. growers to change their production technology.

The annual horticultural market includes those regions that are methyl bromide users as well as their direct competitors and is modeled as a spatial partial equilibrium problem. California, Florida and Mexico are divided into regions due to differences in production practices and harvest dates. Production areas included in this model are four regions in California: South Coast, Central Coast, Imperial Valley and San Joaquin Valley. The five regions in Florida are West and North, Central, Southeast, Southwest and Dade County. The two regions in Mexico are Sinaloa and Baja California/Sonora. North Carolina, South Carolina, Georgia and Texas are included as individual regions. The calculations include baseline equilibrium production, monthly shipments between production areas and markets, and monthly consumption in each representative market (Atlanta, Chicago, New York and Los Angeles) in each month given current technology. Equilibrium crop prices for each market for each month are also computed. The phase out of methyl bromide will result in all methyl bromide user shifting to another production technology which changes the cost of growing the crop and the expected monthly yield. Literature reviews, workshops and personal interviews have resulted in

the identification of the alternatives (Telone C-17 with an herbicides (such as Tillam or Devrinol) for most crops except California Strawberries which use Chloropicrin, Vapam and hand weeding) and the assumed cost and yield changes which are presented in Table 2. The alternatives take into account the restrictions on 1,3-Dichloropropene use in California and the recent actions in certain California Counties to restrict the high rates of Chloropicrin as an alternative. The yield losses for strawberries include a 7.5 percent effect of having strawberry transplants from nurseries that were not able to use methyl bromide.

Our results show that consumers of these annual crops will suffer the largest losses from the proposed phase-out in the form of higher prices and less quantity of produce available. The overall consumer surplus loss will be $159 million of which strawberry consumers bear the largest loss at $116 million or 10 percent of preban consumer surplus. Tomato consumers' surplus decreases $26 million. While a smaller absolute number than tomatoes, eggplant consumers will see a 5 percent drop in their consumer surplus. Table 3 lists the predicted consumer losses. These results indicate that if research is directed based on consumers' welfare that strawberries and tomatoes should be the highest funded of the annual crops (with some focus on eggplant as well). This is not surprising as producers of these two crops use the most methyl bromide as well as the fact these are the highest valued crops.

For the annual crop producers, the results are mixed. Some growers benefit as growers in other regions decrease production or exit the market entirely, opening up market windows. The results indicate significant shifts between regions as pre-harvest costs per acre increase and yields per acre decrease. Regions see decreases in acreage or acreage shifts to other regions of the state which may have a slightly different harvest schedule and may retain their comparative advantage even with the increased costs. For example, eggplant production disappears in Florida from the Southeast Region and moves entirely to Baja and Sinaloa, Mexico. Specific regions such as the North and West of Florida go out of production of tomatoes and watermelon entirely. This opens up a market window for Florida Central which expands watermelon acreage. For strawberry growers, gross revenues increase with acreage increases and price increases given the lower levels of production. Costs also increase significantly though, and only Baja California exhibits any return on their increased production with the value of an additional acre equal to $3889. Table 4 contains the changes in revenue experienced in each region by crop. Again, eggplant producers are predicted to lose 12 million in revenues as the entire industry leaves the state. Tomato producers are expected to lose almost 50 million in revenue. California tomato producers, especially in the South Coast or San Diego area, are also predicted to lose almost 50 million in revenues. These numbers of course do not show cost savings that occur as fewer acres are planted, i.e. these are not net revenue changes.

The change in acreage by region and crop are shown in Table 5. Florida sees over 28 thousand acres go out of production following the ban of methyl bromide. The majority of this acreage is the loss of watermelon acreage even after the shifts in regional

production occurs. Much of this lost watermelon acreage shifts to other regions of the U.S. such as Georgia and South Carolina. In addition, both Florida and California see decreases of over 6,000 acres of tomatoes each while Mexico increases its tomato acreage by 11.5 thousand. Regions were permitted to increase acreage up to 50 percent more than they planted on average between 1994-1996. If regions have more severe land constraints, in the short run these results may have to be interpreted differently. We may find smaller shifts between regions or less production and higher prices following the ban.

The results for producers indicate a significant loss can be expected by Florida producers such as eggplant and watermelon and in the double cropping production system. Some areas of Florida bear most of the cost of the ban such as Florida North and West. California South Coast Tomatoes also decrease production following the ban. These results can help target some of the on-going research efforts to particular crops and regions and their problems.

Table 1. Crop Value Per Pound of Methyl Bromide

Region and Crop	Value ($/lb.)
California Strawberry	47.56-95.77
California Premium Wine Grapes	54.36
California Almonds	32.85-47.03
California Sod	36.42
Florida Central Strawberry	34.27
California Perennial Nurseries	33.59
California Carnations	32.85
Florida Double Crops	12.93-30.98

Table 2. Percent Yield Loss and Cost Change

	Eggplant		Peppers		Strawberries		Tomatoes	
	Yield Loss	Cost Change	Yield Loss	Cost Change	Yield Loss	Cost Change	Yield Loss	Cost Change
Cal. Central Coast					21.5	$698		
Cal. South Coast					21.5	$598	10	$0
Fl. Central	15	$23	12.5	$23	21.5	$449	10	$13
Fl. Dade	20	-$51					17.5	-$60
Fl. Southeast	15	$23	12.5	$23			10	$13
Fl. Southwest	15	$23	12.5	$23			10	$13
Fl. West & North							10	$13
Georgia							10	$13
North Carolina			12.5	$23				
South Carolina							10	$13

	Watermelon		Cucumbers	Squash
	Yield Loss	Cost Change	Yield Loss	Yield Loss
Fl. Central	17.5	$96	17.5	17.5
Fl. Dade				22
Fl. Southeast			17.5	17.5
Fl. Southwest			17.5	17.5
Fl. West & North	17.5	$96		
Georgia	17.5	$96		

Note: Cucumber and Squash Loss are for second crop production systems.

Table 3. Change in Consumer Surplus

	PRE-BAN	POST-BAN	CHANGE	% CHANGE
Cucumber	$163,861,100	$161,959,700	-$1,901,460	-1.2%
Eggplant	$7,561,736	$7,179,469	-$382,268	-5.1%
Pepper	$413,274,500	$407,974,700	-$5,299,840	-1.3%
Squash	$194,717,100	$190,756,100	-$3,960,940	-2.0%
Strawberry	$1,127,755,000	$1,011,759,000	-$115,996,000	-10.3%
Tomato	$1,500,686,000	$1,474,756,000	-$25,930,000	-1.7%
Watermelon	$671,445,000	$666,357,300	-$5,087,790	-0.8%
TOTAL	**$4,079,300,436**	**$3,920,742,269**	**-$158,558,298**	**-3.9%**

Table 4. Change in Revenues

	Cucumber	Eggplant	Pepper	Squash	Strawberry	Tomato	Watermelon
California	0	0	0	0	38,791,700	-49,354,010	-2,639,059
Florida	-3,940,398	-11,925,193	-12,503,654	-145,537	6,600,295	-48,073,698	-36,963,176
Mexico	3,533,198	9,910,265	15,089,505	1,921,258	22,162,942	112,209,700	10,173,764
Other US	800,365	0	1,060,209	0	0	-5,597,963	34,041,264

Table 5. Change in Acreage

	Florida	California	Other	Mexico
Cucumber	-4,434	0	0	542
Eggplant	-1,519	0	0	1,232
Pepper	1,989	0	325	6,770
Squash	-744	0	0	484
Strawberry	961	3,695	0	604
Tomato	-6,146	-6,045	-952	11,494
Watermelon	-18,379	-1,161	19,979	5,358
TOTAL	**-28,272**	**-3,510**	**19,352**	**26,484**