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Yield and Cost Impacts of Reduced Pesticide use on Onion Production

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ABSTRACT

This study determines the impacts of reduced chemical use on onions. Specifically, the yield and per unit cost impacts of eliminating the use of insecticides, fungicides, and herbicides was evaluated, as well as the impacts of a 50 percent reduction in the number of applications. The impacts generally were substantial but highly variable among regions studied. Sweeping pesticide use reduction involving more than one pesticide category would have more adverse (synergistic) impacts on yield than strategies targeted toward particular pesticides.

RESUMEN

Este estudio determina los efectos del uso reducido de productos químicos sobre cebolla. Se evaluaron las consecuencias sobre el rendimiento y los costos por unidad ocasionadas por la eliminación del uso de insecticidas, fungicidas y herbicidas así como por la reducción del 50 por ciento del número de aplicaciones. Los efectos generalmente fueron sustanciales pero altamente variables entre las regiones estudiadas. La reducción extensiva en el uso de pesticidas, que incluyera más de una categoría de estos, tendría impactos más adversos (sinergísticos) sobre el rendimiento, que el que tendrían las estrategias dirigidas contra pesticidas específicos.

The 1990s represent a crossroads on the issue of pesticide use in agriculture. Congress amended the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) in 1988 to require that all pesticides and their uses registered before November 1984 be reregistered to comply with current standards by the end of 1997. It is widely believed that this reregistration requirement could impact the availability of certain pesticides and thus have serious consequences in terms of potential reductions in yields, production levels, and unit cost of production for fruit and vegetable crops. A major concern is that the costs of reregistration may be sufficiently large that pesticide production and marketing would be prohibitively unprofitable and thus unavailable as a crop protectant. Further challenges to the use of agricultural chemicals will come in the debate over the Delaney Clause of the Federal Food, Drug, Cosmetic Act, reauthorization of the Clean Water Act and FIFRA, as well as the debate over the 1995 farm bill. The judicially mandated clarification and/or modification of the zero tolerance provisions of the Delaney Clause are a central concern to the future availability of pesticides as are state regulations that are even more stringent than federal policy.

Prior to the writing of the 1990 farm bill, many people were concerned that provisions could be included mandating reductions in pesticide use through instruments such as cross-compliance. In balancing concerns about the environmental impacts of the use of agricultural chemicals against the potential adverse economic consequences of nonuse, Congress opted to seek more information through research and extension programs, including substantially increased funding for sustainable agriculture activities, frequently involving reduced levels of pesticide use. While the battle over environmental issues in the 1990 farm bill might have been loosely considered a victory for agricultural interests, some fear that the earlier reregistration decision may already have lost the battle for agricultural interests in minor use pesticides.

In the reregistration process, consideration has been given to the impact of losing specific individual chemicals and the resulting effect on productivity, yield, and output levels for proposed uses on specified crops. However, few studies have been completed on the impact of eliminating a large number of pesticides, a scenario that might occur as a result of the reregistration process. Likewise, little is known about the potential impact of reducing the level of pesticide use from current practices to perhaps 50 percent of current practices, a change that has been suggested as a possible environmental policy goal.

MATERIALS AND METHODS

A study was undertaken to quantify the supply, availability, and cost consequences of reduced pesticide use on fruit and vegetable crops. The nine crops analyzed include potatoes, oranges, tomatoes, grapes, apples, lettuce, onions, sweet corn, and peaches. These crops represent more than 82 percent of the 1992 value of U.S. production for major fruit and vegetable crops. This article focuses on the impacts on onion production in three regions including Idaho, California and Texas.

The yields estimated in this analysis were provided by leading university horticultural scientists in the major production areas associated with each crop. Each horticultural scientist also specified changes in cultural practices designed to minimize the yield losses of each individual pesticide use reduction option. These cultural practices could, for example, include increased use of labor to control weeds or the sorting out of unacceptable market quality products.

The cost impacts generally were provided by a separate horticultural economist utilizing the information regarding yields and cultural practices provided by the horticultural scientist. The economist was responsible for developing the

Table 1. Per Hectare and per Kilogram Costs of Growing and Harvesting Onions in Idaho, 1991-92.

Crop: onions Region: ID All Scenarios	Normal	No Herb/ Grow.Reg	50% Herb/ Grow.Reg	No Fung/ Fumigant	50% Fung/ Fumigant	No Insect	50% Insect	No Pest	50% Pest
Expected Yield (kg/ha)	56,000.00	30,240.00	47,600.00	44,800.00	NA	49,280.00	51,520.00	22,400.00	30,800.00
Yield reduction (% change)		46%	15%	20%	NA	12%	8%	60%	45%
Cash operating expenses									
Land & bed preparation									
Seed or transplants	271.70	271.70	271.70	271.70	NA	271.70	271.70	271.70	271.70
Fertilizer/lime	389.99	389.99	389.99	389.99	NA	389.99	389.99	389.99	389.99
Chemicals:									
Pre-emerg Herbicides	39.03	0.00	4.37	39.03	NA	39.03	39.03	0.00	39.03
Post- emerg Herbicides	69.11	0.00	69.11	69.11	NA	69.11	69.11	0.00	32.33
Fungicides (not needed in Idaho)	0.00	0.00	0.00	0.00	NA	0.00	0.00	0.00	0.00
Insecticides	44.66	89.32	66.99	44.66	NA	0.00	22.33	0.00	22.33
Fumigants	580.45	580.45	580.45	0.00	NA	580.45	580.45	0.00	0.00
Growth regulators	54.09	0.00	54.09	54.09	NA	54.09	54.09	0.00	0.00
Fuel, lube, & repairs	178.48	156.94	167.47	178.48	NA	178.48	178.48	156.94	167.47
Cultivation	13.04	13.04	13.04	13.04	NA	13.04	13.04	19.56	13.04
Hired labor:									
Machinery operation	142.84	121.23	132.02	142.84	NA	142.84	142.84	121.23	132.02
Hand weed	370.50	741.00	691.60	370.50	NA	370.50	370.50	741.00	494.00
Irrigation labor	118.86	118.86	118.86	118.86	NA	118.86	118.86	118.86	118.86
Other:	20.53	20.53	20.53	20.53	NA	20.53	20.53	20.53	20.53
Custom work:									
Custom Fertilize	53.72	53.72	53.72	53.72	NA	53.72	53.72	53.72	53.72
Custom Bed Prep & Fert	24.70	24.70	24.70	24.70	NA	24.70	24.70	24.70	24.70
Irrigation	72.82	72.82	72.82	72.82	NA	72.82	72.82	72.82	72.82
Miscellaneous:									
Soil/petiole test	6.18	6.18	6.18	6.18	NA	6.18	6.18	6.18	6.18
Custom air spray	34.58	69.16	51.87	34.58	NA	0.00	17.29	0.00	17.29
TOTAL PREHARVEST	2, 485.26	2,729.62	2,789.49	1,904.81	NA	2,406.03	2,445.65	1,997.22	1, 875.99
Harvest expenses:									
Harvest/haul	1,079.34	726.92	1,007.76	948.48	NA	1043.33	1045.30	538.46	679.25
Clean/grade/pack	1235.00	766.94	1049.75	1086.80	NA	1195.48	1136.20	568.10	747.18
OTHER:	329.99	177.84	279.93	263.45	NA	288.50	302.33	131.73	181.79
TOTAL HARVEST:	2644.33	1671.70	2337.44	2298.73	NA	2527.30	2483.83	1238.29	1608.22
TOTAL PREHARVEST & HARVEST	5129.60	4401.32	5126.93	4203.54	NA	4933.33	4929.48	3235.50	3484.21
PREHARVEST COST/KG	$0.0443	$0.0902	$0.0585	$0.0425		$0.0488	$0.0474	$0.0891	$0.0608
HARVEST COST/KG	$0.0472	$0.0552	$0.0491	$0.0513		$0.0512	$0.0482	$0.0552	$0.0522
TOTAL COST/KG	$0.0915	$0.1454	$0.1076	$0.0937		$0.1000	$0.0956	$0.1443	$0.1130
Percent change		58.89%	17.59%	2.43%		9.29%	4.46%	57.69%	23.50%

baseline budget reflecting cultural practices currently used in commercial production of the crop.

This baseline budget only included the cash costs involved in producing and harvesting a crop. The baseline budget was then adjusted for each pesticide reduction scenario to account for the changes in cultural practices specified by the horticulturist making the yield estimates. Impacts on a cash cost per pound could then be calculated from the yield and cost per acre information for each reduced chemical use scenario. This cash cost per kilogram of **marketable** production is a conservative estimate of the changes in total cost since it does not recognize any increases in overhead, management, or capital replacement costs that could be associated with reduced pesticide use.

The specific scenarios analyzed for each crop included eight chemical use reduction alternatives in addition to the baseline. Four of these scenarios involved complete elimination of the following:

Pesticides, including the combination of herbicides, insecticides, and fungicides.

Herbicides, including growth regulators.

Fungicides, including fumigants.

Insecticides, including miticides and registered biological methods of control.

Table 2. Per Hectare and Per Kilogram costs of Growing and Harvesting Onions in California, 1991-92.

Crop: Onions **Region: CA** **All Scenarios**	Normal	No Herb	50% Herb	No Fung	50% Fung	No Insect	50% Insect	No Pest	50% Pest
Expected Yield (kg/ha)	44,800.00	29,120.00	33,600.00	31,360.00	40,320.00	40,320.00	NA	17,920.00	24,640.00
Yield reduction (% change)		35%	25%	30%	10%	10%	NA	60%	45%
Cash operating expenses									
Land & bed preparation	421.60	421.60	421.60	421.60	421.60	421.60	NA	421.60	421.60
Seed or transplants	367.90	367.90	367.90	367.90	367.90	367.90	NA	367.90	367.90
Fertilizer/lime	304.44	304.44	304.44	304.44	304.44	304.44	NA	304.44	304.44
Chemicals:									
Pre-emerg Herbicides	76.05	0.00	76.05	76.05	76.05	76.05	NA	0.00	76.05
Post-emerg Herbicides	64.20	0.00	0.00	64.20	64.20	64.20	NA	0.00	0.00
Fungicides	111.11	111.11	111.11	0.00	55.56	111.11	NA	0.00	55.56
Insecticides	22.22	66.67	22.22	22.22	22.22	0.00	NA	0.00	NA
Fuel, lube. & repairs (included elsewhere)									
Cultivation	143.83	196.91	143.83	143.83	143.83	143.83	NA	196.91	196.91
Hired labor:									
Machinery operation (included elsewhere)									
Hand weed	185.19	925.93	555.56	185.19	185.19	185.19	NA	925.93	555.56
Irrigation labor	198.77	246.07	198.77	198.77	198.77	198.77	NA	229.53	229.53
Other: Shred Weeds (2x)	0.00	53.09	0.00	0.00	0.00	0.00	NA	53.09	0.00
Custom work:									
Custom Planting	41.98	46.17	41.98	41.98	41.98	41.98	NA	46.17	41.98
Apply herbicide	51.85	0.00	17.28	51.85	51.85	51.85	NA	0.00	17.28
Apply Fungicide	39.51	39.51	39.51	0.00	19.75	39.51	NA	0.00	19.75
Irrigation	514.20	556.79	514.20	514.20	514.20	514.20	NA	535.51	535.51
Miscellaneous:									
Apply Fertilizer	66.67	66.67	66.67	66.67	66.67	66.67	NA	66.67	66.67
Apply Insecticide	12.35	37.04	12.35	12.35	12.35	0.00	NA	0.00	NA
TOTAL PREHARVEST	2,621.85	3,439.90	2,893.46	2,471.23	2,546.54	2,587.28	NA	3147.75	2888.74
Harvest expenses									
Harvest/haul	1,975.31	1,604.94	1,777.78	1,590.12	1,866.67	1,777.78	NA	987.65	1,358.02
Clean/grade	2,370.37	1,769.38	1,955.56	1,991.11	2,346.67	2,133.33	NA	1,135.80	1,499.26
Other: Pack/sell	2,370.37	1,540.74	1,777.78	1,659.26	2,133.33	2,133.33	NA	948.15	1,303.70
TOTAL HARVEST	6,716.05	4,915.06	5,511.11	5,240.49	6,346.67	6,044.44	NA	3,071.60	4,160.99
TOTAL PREHARVEST & HARVEST	9,337.90	8,354.96	8,404.57	7,711.73	8,893.21	8,631.73	NA	6,219.36	7,049.73
PREHARVEST COST/KG	$0.0585	$0.1180	$0.0860	$0.0787	$0.0631	$0.0641		$0.1755	$0.1171
HARVEST COST/KG	$0.1498	$0.1686	$0.1639	$0.1670	$0.1573	$0.1498		$0.1713	$0.1687
TOTAL COST/KG	$0.2083	$0.2867	$0.2499	$0.2457	$0.2204	$0.2139		$0.3468	$0.2859
Percent change		37.65%	20.01%	17.98%	5.82%	2.71%		66.51%	37.27%

Each of these four scenarios was then modified to involve an approximate 50 percent reduction in the **number of pesticide applications.** Because of the choices that had to be made by the lead scientist in accomplishing the 50 percent reduction, the 50 percent target is only an approximation. If only one application was used in the baseline, for example, this option would not be applicable (NA) unless the lead scientist specified an alternative means that would reasonably accomplish a 50 percent reduction.

As mentioned earlier, the major production areas identified for this study are the California Imperial Valley where Imperial Sweet spring onions are produced, South Texas where spring onions are produced, and the Idaho-Oregon Malheur Valley region where storage onions are produced. These three production areas account for about 60 percent

of U.S. production of dry onions. In 1992 dry onion sales totaled $614 million and comprised about 5 percent of fruit and vegetable sales.

DESCRIPTION OF ONION CULTURAL PRACTICES

The time required for onions to mature from seed to bulb stage varies depending on temperature and length of day rather than age or plant size. As a result, most onion varieties are limited in their climatic adaptation and cannot be grown economically in all areas.

Plowing and disking to break clods and land leveling to maintain correct slopes for irrigation and drainage are important in preparing land for onion production. Onions normally are planted on 51 cm (20-inch) beds with two seed rows (one, two or three lines per row) 36-41 cm (14 to 16 inches) apart. Weed control is accomplished by applying pre-emergence herbicides with post-emergence spraying as necessary. Onions are a comparatively shallow-rooted crop with most of the roots in the top foot of soil. All commercial onions require irrigation. The main onion diseases are purple blotch and pink root. In addition to these, damping-off of young seedlings can occasionally by troublesome. These diseases are controlled with fungicides in Texas and California while fumigants are used to control diseases in Idaho. Although insect problems vary within and between regions, insectidcides and miticides are the most critical to controlling cutworms, spider mites, whiteflies, and thrips in

Table 3. Per Hectare and Per Kilogram Costs of Growing and Harvesting Onions in Texas, 1991-92.

Crop: Onions Region: TX All Scenarios	Normal	No Herb	50% Herb	No Fung	50% Fung	No Insect	50% Insect	No Pest	50% Pest
Expected Yield (kg/ha)	25,200.00	18,900.00	22,680.00	10,080.00	15,120.00	15,120.00	21,448.00	5,040.00	10,080.00
Yield reduction (% change)		25%	10%	60%	40%	40%	15%	80%	60%
Cash operating expenses									
Land & bed preparation (included elsewhere)									
Seed or transplants	222.22	222.22	222.22	222.22	222.22	222.22	222.22	222.22	222.22
Fertilizer/lime	359.51	359.51	359.51	359.51	359.51	359.51	359.51	359.51	359.51
Chemicals:									
Pre-emerg Herbicides	160.49	0.00	160.49	160.49	160.49	160.49	160.49	0.00	160.49
Post-emerg Herbicides	24.69	0.00	0.00	24.69	24.69	24.69	24.69	0.00	0.00
Fungicides	271.60	296.30	296.30	0.00	123.46	271.60	271.60	0.00	123.46
Insecticides	98.77	118.52	118.52	98.77	98.77	0.00	39.51	0.00	39.51
Fuel, lube & repairs	45.65	44.20	44.20	45.65	45.65	45.65	45.65	44.20	45.65
Cultivation	11.06	22.12	16.59	11.06	11.06	11.06	11.06	22.12	16.59
Hired Labor									
Machinery operation	46.07	43.48	43.48	46.07	46.07	46.07	46.07	46.07	46.07
Hand weed	197.53	592.59	316.05	197.53	197.53	197.53	197.53	395.06	316.05
Irrigation labor	116.67	136.12	136.12	116.67	116.67	116.67	116.67	116.67	116.67
Other:	246.91	246.91	246.91	246.91	246.91	246.91	246.91	246.91	246.91
Custom Work:									
Apply Pesticides	122.22	133.33	133.33	55.56	55.56	122.22	122.22	0.00	55.56
Irrigation	138.27	158.02	158.02	138.27	138.27	138.27	138.27	158.02	158.02
TOTAL PREHARVEST	2 ,061.68	2,373.33	2,251.75	1,723.41	1,846.86	1,962.91	2,002.42	1,610.79	1,906.72
Harvest expenses:									
Harvest/haul	1,555.56	1,343.65	1,540.00	746.67	1,120.00	1,120.00	1,456.35	622.22	1,057.78
Clean/grade	1500.00	1201.78	1350.00	751.11	1080.00	993.33	1342.86	388.89	718.52
Pack/sell	833.33	625.93	750.00	333.33	500.00	500.00	709.26	166.67	333.33
TOTAL HARVEST	3,888.89	3,171.36	3,640.00	1,831.11	2,700.00	2,613.33	3,508.47	1,177.78	2,109.63
TOTAL PREHARVEST & HARVEST	5,950.57	5,544.69	5,891.75	3,554.52	4,546.86	4,576.25	5,510.89	2,788.57	4,016.35
PREHARVEST COST/KG	$0.0916	$0.1406	$0.1112	$0.1915	$0.1368	$0.1454	$0.1046	$0.3580	$0.2119
HARVEST COST/KG	$0.1728	$0.1879	$0.1798	$0.2035	$0.2000	$0.1936	$0.1832	$0.2617	$0.2344
TOTAL COST/KG	$0.2645	$0.3286	$0.2910	$0.3949	$0.3368	$0.3390	$0.2878	$0.6197	$0.4463
Percent change		24.24%	10.01%	49.34%	27.35%	28.17%	8.81%	134.31%	68.74%

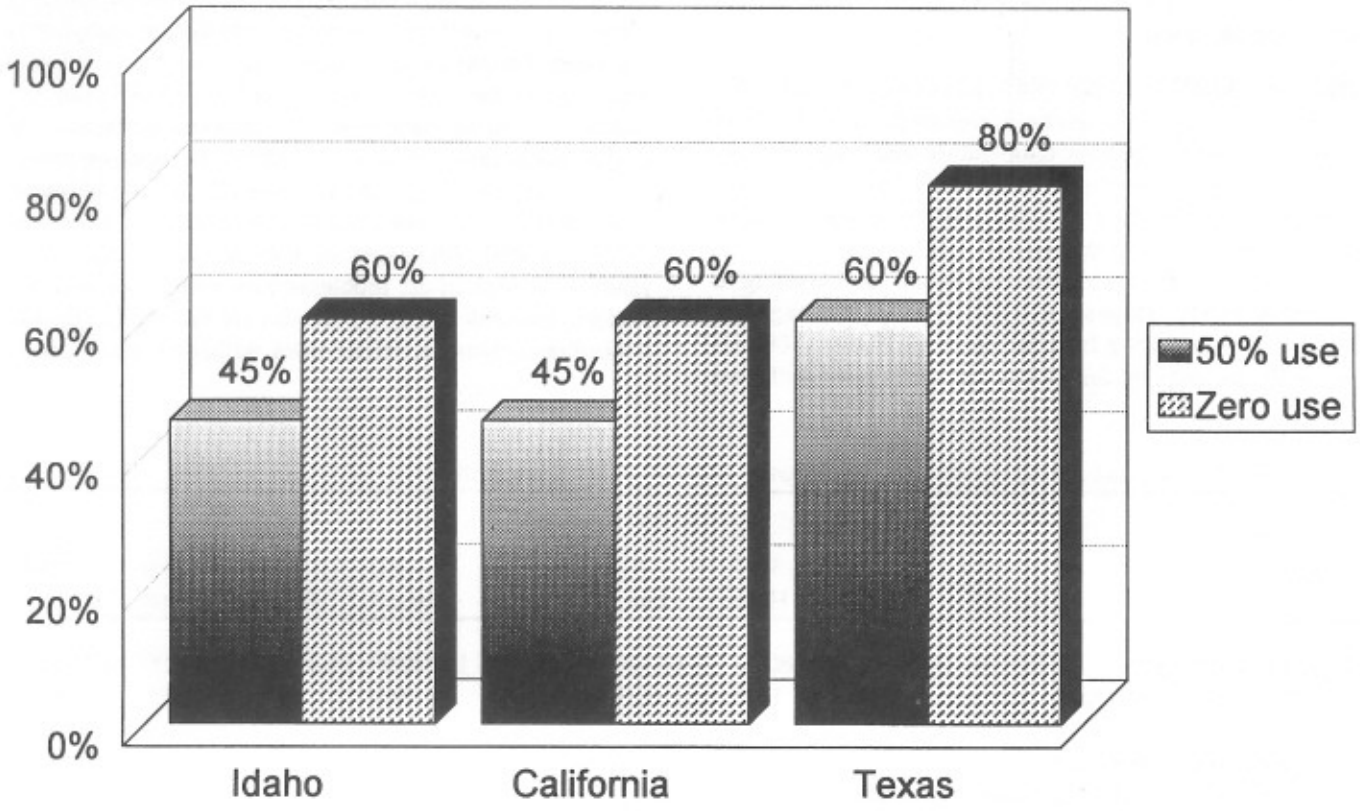

Figure 1. Percent reduction in onion yield per ha from reduced pesticide use.

Texas. Southern climates are more conductive to insect infestations.

When onion bulbs approach maturity, the tops fall to the ground. Some growers begin harvesting when 50 percent of the tops have fallen. Most growers loosen the soil by running a wing-sweep or rod weeder several inches below the bulbs. Onions are pulled, clipped and placed in burlap sacks for up to a week for field curing. Sacks are usually aligned in rows to facilitate loading.

RESULTS AND DISCUSSION

Estimated per ha yield reductions associated with zero pesticide use was estimated to range from 60 percent in Idaho and California to 80 percent in Texas. A 50 percent reduction in the number of applications would result in an estimated 45 percent reduction in yield per ha in California and Idaho and 60 percent in Texas (Tables 1-3).

These results suggest that the greatest proportional reduction in yield would be associated with the first 50 percent reduction in pesticide applications (Figure 1). Using Idaho storage onions as an example, the initial 50 percent reduction in the number of pesticide applications would lead to a 45 percent reduction in the estimated yield per ha, while taking away the remaining 50 percent of the pesticides would reduce the estimated yield by only an additional 15 percent for a total 60 percent lower yield per ha.

In Texas, the initial 50 percent reduction in the number of applications would result in the estimated yield per ha falling 15,100 kg/ha (13,500 pounds/acre) from 25,200 kg/ha to 10,000 kg/ha (22,500 pounds to 9,000 pounds). Eliminating all pesticide use would lead to an additional yield reduction of only 5000 kg/ha (4,500 pounds). In other words, the initial 50 percent reduction in pesticide use would result in an estimated yield reduction three times greater than that produced by the final step of eliminating all pesticides.

While all the reduced pesticide scenarios would generate lower total cash costs per acre than those indicated by the baseline budget using conventional commercial farming practices, the estimated cash cost per kg of onions produced would be greater in all cases for each pesticide use reduction scenario.

Under the no pesticide option, for example, the total cash cost per kg would increase by a projected 67 percent in California, 58 percent in Idaho, and 134 percent in Texas. The total estimated cash cost increase would go from 9.3 to 14.5 cents/kg (4.2 to 6.6 cents per pound) in Idaho, 23.6 to 55.3 cents/kg (10.7 to 25.1 cents per pound) in Texas, and 20.9 to 34.6 cents/kg (9.5 to 15.7 cents per pound) in California.

Idaho was the only region in the study that received a pesticide application for post- harvest quality control. In this case, Idaho farmers applied one pre-harvest application of a sprout inhibitor to prevent the onions from sprouting and spoiling during storage. If the sprout inhibitor had not been used, the marketable yield would have likely declined by about 30 percent.

Herbicides: The zero herbicide use scenario would have the largest adverse impact on yields in Idaho and California, reducing the estimated yields by 46 and 35 per-

cent respectively. Despite a doubling of hand weeding, Idaho farmers would experience a projected decline from 56,000 kg/ha (50,000 pounds per acre) to 30,200 kg (27,000 pounds).

Researchers felt that California farmers would be unable to keep up with the increased weed population despite cultivating two more times, shredding weeds two more times, and hand weeding five more times. As a result , spring onion yields would drop from an estimated 44,800 to 29,100 kg (40,000 to 26,000 pounds). Since hand weeding often disturbs the bulbs and disrupts or even curtails plant growth, hand weeding would be a less than perfect substitute for applying herbicides. under the 50 percent herbicide reduction scenario, the estimated yield reduction would be comparatively less (15 percent) in Idaho where pre-emergence herbicides were retained (post-emergence applications were eliminated) and hand weeding was nearly doubled. On the other hand, Calfornia would experience an estimated 25 percent yield reduction in spite of retaining pre-emergence herbicides and tripling the amount of hand weeding.

The zero use herbicide scenario projected that yields in Texas would drop by 25 percent . Despite twice as much cultivation and three times more hand weeding, yields would fall from 25,200 kg (22,500 pounds) to 18,900 kg (16,875 pounds). Under the 50 percent scenario, however, Texas would retain pre-emergence herbicides, increase cultivation by about 50 percent, and increase hand weeding by 60 percent. This would result in a projected yield reduction of only 10 percent.

Eliminating herbicides would increase the cash cost of growing onions in Idaho by an estimated 59 percent from 9.3 to 14.5 cents/kg (4.2 to 6.6 cents per pound). This compares to estimated increases of 38 percent in California and 24 percent in Texas. A 50 percent reduction in herbicide applications would increase the cash cost per pound by a projected 10 percent in Texas, 18 percent in Idaho, and 20 percent in California.

The yield reductions and unit cash cost increases probably understate the full impact of reduced herbicide use because of the reduction in the marketable size of onions caused by increased competition with weeds for moisture and nutrients. As a consequence, this reduction would affect the market price available to the producer.

Fungicides: The research revealed that reducing fungicide use would likely have the most adverse impact on yields in the more humid Texas climate. Eliminating fungicides would result in Texas spring onion yields declining by an estimated 60 pecent from 25,200 to 10,000 kg/ha (22,500 to 9,000 pounds per acre). With fungicide use cut in half, Texas yields would drop by an estimated 40 percent to 15,100 kg/ha (13,500 pounds per acre).

In Idaho the estimated yield would decline by 20 percent from 56,000 to 44,800 kg/ha (50,000 to 40,000 pounds per acre) under the zero reduction scenario. With only the one application of fumigants, the 50 percent reduction option would not be applicable. In California, the zero fungicide application option would reduce the yield by an estimated 30 percent from 44,800 to 31,400 kg (40,000 to 28,000 pounds), while the 50 percent reduction from two applications to one would result in a 10 percent yield reduction.

The higher cost associated with zero fungicide use would range from an estimated low of 2 percent in Idaho (less humid climate) to 49 percent in Texas. This represented an increase of less than 2.2 cents/kg (1 cent per pound) in Idaho to more than 11 cents/kg (5 cents per pound) in Texas. With fungicide applications cut by half, the cash cost increase would range from a projected 6 percent in California to 27 percent in Texas.

Insecticides: Texas spring onions would be the crop most adversely affected by reduced insecticide use. Estimated yields under the zero insecticide use option would fall by as much as 40 percent from 25,200 to 15,100 kg (22,500 to 13,500 pounds). Reducing the numer of applications from five to two would reduce the yield by an estimated 15 percent to 21,450 kg (19,150 pounds). The Idaho yield reduction with no insecticides would be an estimated 12 percent, while cutting applications from the normal two to one would reduce the estimated yield by 8 percent to 51,500 kg (46,000 pounds). California, with only one insecticide application, would experience a projected 10 percent yield reduction under the zero scenario. Since California used only one application, the 50 percent reduction scenario would not be applicable.

The 40 percent yield reduction experienced by Texas onions in the no insecticide scenario would result in an estimated 28 percent increase in the cash cost of production from 23.6 to 30.2 cents/kg (10.7 to 13.7 cents per pound). This compares with projected increases of only 9 percent in Idaho and 3 percent in California. In contrast, the projected cost per kg would increase by only 4 percent in Idaho and 9 percent in Texas after a 50 percent reduction in normal insecticide applications.

SUMMARY

In all the pesticide reduction cases, the projected yield reductions would be substantial. Under the zero pesticide scenario, the onion yield reduction in all three regions would average an estimated 64 percent. That figure would drop to 48 percent if applications were cut by half.

These estimates indicate substantial regional differences with South Texas consistently being the most adversely affected area, except in the loss of herbicides, and Idaho being the least adversely affected, except in the loss of herbicides. The largest estimated yield reductions would result from the loss of herbicides, except in Texas where the loss of fungicides would cause the largest yield reduction and an associated cash cost increase.

Estimated unit cost increases would be in the range of 20 to 70 percent across the chemical use scenarios. Per unit costs in Texas, however, would probably more than double without pesticides.

Although this study does not analyze the impacts of reduced yields and higher costs on the prices and gross receipts to growers, a yield reduction in some scenarios also would mean a reduction in the marketable size of onions. This reduction would be due primarily to the compounding effects of weeds, diseases, and insects on the size of the onion plant leaf area. The consequence would be an

increase in the price of large onions relative to small onions.

Each scenario eliminating herbicides assumes that labor can be hired at the normal rate to reduce the weed population. Constraints on labor availability could make it impossible to hire these laborers in some areas. To maintain onion production under either the no pesticide option or the 50 percent reduction in applications, onion acreage would have to increase nationwide from 25 to 50 percent. This increase would mean reduced production of other crops.

Alternatively, imports would need to be increased to meet domestic demand. This increase would likely result in higher consumer prices and provide little assurance of the conditions under which the imported onions were grown.

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