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OFFICE OF
PREVENTION, PESTICIDES
AND
TOXIC SUBSTANCES

Memorandum

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SUBJECT: Benefits assessment for diazinon use in melons: watermelon, honeydew, and cantaloupe

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Summary of Analysis

Diazinon is used against a variety of foliar and soil insect pests in all melons. Effective alternatives exist for all of the foliar pests targeted, though some are relatively new and growers may not yet have efficiently incorporated their use, particularly for late season aphid control in California. However, no effective substitutes appear to exist for its use against soil insects. Different components of the soil insect complex have primary importance in different parts of melon-growing regions that use the most diazinon. In California, seedcorn maggots and cucumber beetle larvae, in particular, can migrate into even carefully managed fields and destroy newly planted crops. Cutworms and grubs may be particularly severe soil pests in southeastern growing regions, where these species may survive better

due to the warm climate and moist soil conditions. Yield losses in these regions to soil pests may be high in some years. In general, areas where grubs and wireworms are both abundant may be particularly vulnerable, as there are no other registered alternatives with efficacy comparable to that of diazinon. If diazinon is not available and if farmers make no cultural adjustments (and if no alternative insecticides become available) then yield losses in these regions to these soil pests could be severe in some fields in some years. Areas where grubs and wireworms are abundant - again, primarily in the south - may be particularly vulnerable. Losses due to such soil insects in Texas and adjacent southern US areas could be as high as $2,000 per acre out of an expected gross revenue per acre of $5,000 on some fields. Total losses could be several million dollars out of a total crop value for the three crops in the three states of about $600,000,000. However, insecticides that provide control of these pests are registered on other crops and we would expect that requests for registration of one or more of these alternatives would occur. In sum, BEAD believes that the negative impact of diazinon loss in melons is unlikely to be severe in areas where foliar pests are the main target, but may be higher in the near future, in regions facing serious soil pest problems.

Scope and limitations of this assessment

The scope of this analysis comprises an examination of potential regional-level and industry-wide impacts associated with elimination (through a phase-out) of the use of diazinon in melon production. This mitigation scenario reflects the high health risks to mixers, loaders and applicators as identified by the Health Effects Division of the Office of Pesticide Programs. This analysis does not attempt to address impacts associated with mitigation efforts targeted at workers reentering fields treated with diazinon, or potential mitigation for various environmental risks (e.g., risk mitigation for risks to terrestrial plants and organisms or water contamination). This document addresses diazinon use only in the three economically significant melon crops produced in the US: watermelon (*Citrullus lanatas*), cantaloupe and honeydew (both varieties of the same species, *Cucumis melo*). Other melons (e.g., Crenshaw and Persian melons) are grown in the same areas and in the same ways as the major types, and but are not considered specifically here. Impacts on these other melons would probably be comparable to impacts on the melons discussed here.

This assessment considers the pest management and economic implications of a loss of diazinon. Economic impacts are assessed only for California, Arizona, and Texas, which are major melon growing states. These states are also the only states in which any significant diazinon use on melons was observed. They are also those with highest proportion of diazinon usage (in these crops). Differences that might occur in other growing regions have not been considered. Since the pest complex affecting different melons are virtually identical, these scenarios have been assumed to be equally likely for each crop. Biological aspects of the implications of diazinon loss are expected to be similar across all scenarios and therefore are discussed in general terms.

The impacts estimated by this analysis only represent potential short-term-1 to 5 years - impacts on the melon production system. Impacts to the industry are calculated by simply scaling up the estimated per-acre impacts. We ignore potential price changes that could result from production changes. Further, our analysis of grower-level impacts assume that there is no shift from melons to another crop.

A major constraint on this analysis is the lack of information on possible losses if soil insects are not controlled. For western production areas, for example, the only information available was a single expert opinion that “fields could be impacted with anywhere from 10 % to 50 % of yields on average, taken out.” (LeBoeuf, personal communication). In general, estimates of yield and quality losses associated with the various scenarios are based on the best professional judgement of BEAD analysts because they were not available from other sources. These estimates were derived from reviewing available USDA crop profiles, state crop production guides, discussions with university extension and research entomologists knowledgeable in melon production, and other sources listed.

Background of US melon production

A number of different melons are grown in the United States. The three most important are cantaloupe, honeydew and watermelon. Appendix tables 1 through 3 provide production and value for these melons for the years 1999 to 2000.

Acreage of watermelons varies from year to year but is normally above 150,000 acres. The southern states of Florida, Georgia and Texas account for approximately half of the total acreage. On average, across years, approximately 10 % of planted acres are not harvested. Harvesting costs account for about 1/3 of total production costs and it is probable that some fields are not harvested because the price has fallen below the harvesting cost. Average gross revenue from an acre of watermelons for these three states has varied from about $ 1,750 an acre to $ 2,000 over the past three years. Per acre gross revenues vary significantly depending on yield and time of harvest. Texas watermelon growers grossed an average of $ 550 per acre in 2000 while in the same year watermelon growers in California grossed an average of $ 6,250 per acre. Texas growers had low yields and sold their watermelons at low prices while California farmers faced the opposite situation.

Cantaloupes are grown on fewer acres (about 100,000) than watermelon. More than one-half are grown in California. Arizona and Texas also have significant acreage. The yield per acre is similar but cantaloupes sell for approximately three times as much as watermelons. Gross revenue from an acre of cantaloupe is expected to be around $5,000. The state and year per acre variation in gross revenue appears to be much less for cantaloupe than it is for watermelon. Over the nine state and year combinations the lowest average gross revenue per acre was for California in 1999 ($ 3,630) while the highest was for Texas in 2001 ($ 6,225).

Honeydew melons are grown on about 25,000 acres, but have yields and prices similar to cantaloupes so also have gross revenues of about $ 4,000 acre. Most production is in California. Arizona and Texas are the only other states with significant acreage. Honeydew melon gross revenue variation for honeydew melons is similar to that for cantaloupes.

Use of diazinon for insect control on melons

Most reported use of diazinon on these three crops is in Arizona, California and Texas. Appendix Tables 4, 5 and 6 summarize available public-domain data on the usage of diazinon on melons. The NASS data indicate that somewhat less than 5% of watermelons in Texas are treated with diazinon. Use of diazinon on cantaloupe varies from very low up to 25 % depending on the year. Use of honeydew melons was around 20% in the early 1990's but in recent years has been much lower.

We also have an estimate of diazinon use on melons in Texas from an extension specialist (Holloway) He states that 95 % of the melons grown in South Texas are treated with diazinon. He also states that 35 % to 40 % of state acreage is in South Texas. This would imply a state-wide usage percentage of about 35 %. This percentage is almost an order of magnitude higher than the NASS estimate for watermelons and two to three times the NASS estimate for diazinon use on cantaloupes and honeydews.

Insect pests targeted by diazinon, and potential alternatives

While the pest complex targeted by diazinon applications is similar across the major production regions, there are some important differences in the role of diazinon in various growing areas. Therefore, we describe this role on the basis of the main melon production areas in the US.

Texas and adjacent southeastern regions

In watermelon production in these areas, diazinon is used against a variety of foliar pests, some of which are disease vectors. Those considered most important are the melon (= cotton) aphid (*Aphis gossypii*), and cucumber beetles (*Diabrotica* spp.). In cantaloupe and honeydew melons also, diazinon is used against these insects, as well as to control occasionally serious infestations of flea beetles (*Epitrix* spp.), spider mites (*Tetranychus* spp), and thrips (*Frankliniella* spp.) (USDA 1999b). Effective alternatives are currently registered for use against most of these pests (Table 1). It should be noted that the synthetic pyrethroids esfenvalerate and permethrin are suspected to cause flareups of mites as secondary pests. Thus, BEAD believes that these chemicals, while recommended by some state extension guides (e.g. Mississippi 2000), may not be frequently used as alternatives.

In all melon crops in these regions, the most critical benefit of diazinon appears to be the control of soil insects. Important ones among these are: cutworms (*Agrotis* spp.), grubs (larvae of cucumber beetles, white-fringed beetles, *Graphognathus leucoloma*, and June beetles, *Cotinus nitida*), and wireworms (larvae of click beetles in the genus *Limonius*). There are no alternatives to diazinon except 1,3 dichloropropene (brand name "telone"), which is only labeled for wireworms, and bifenthrin, which is labeled for wireworms, cutworms, and grubs. However, their efficacy against these insects, relative to that of diazinon, is unclear. BEAD was unable to find comparative product performance data in this regard. It should also be noted that the main use of telone is as a nematicide (Holloway and Edelson, personal communication), and that it is much more expensive than diazinon. The soil insect complex described above appears to be at its worst in south Texas, where warm, relatively moist conditions year-round may foster better survival (Holloway, personal communication).

Table 1. Alternative chemical control options for foliar and fruit-feeding insect pests occurring in **all** melon-producing areas, including Texas and the southeast.

Insect	**Likely alternatives to diazinon**
aphids	bifenthrin, dimethoate *, endosulfan *, esfenvalerate, imidacloprid, oxamyl *, pymetrozine, thiamethoxam
cucumber and flea beetles	azinphos-methyl *, bifenthrin, carbaryl, endosulfan *, esfenvalerate, imidacloprid, methomyl, permethrin, thiamethoxam (flea beetles only)
mites	avermectin, dicofol, fenpropathrin
thrips	dimethoate *, imidacloprid, fenpropathrin, spinosad

Notes: (1) *Sources:* Mississippi State University Extension Service (Mississippi 2000); USDA Crop Profiles (USDA 1999b); UC Pest Management Guidelines (Godfrey et al. 2000)

(2) * = undergoing reregistration and use on melons may be restricted in the near future.

Arizona and California

Cucumber and flea beetle adults do not appear to be a problem of major concern in Arizona. However, in California, cucumber beetle adults are listed as an occasional pest of foliage, flowers, young fruit, and roots, particularly in honeydew melons (Godfrey et al. 2000). In addition to the foliar feeders listed for Texas (above), beet armyworm (*Spodoptera exigua*), leafhoppers (*Empoasca* spp.)

and leafminers (*Liriomyzia* spp.) are also occasional pests that are targeted by diazinon applications. For all these insects, effective alternatives exist (Table 2). Only those insecticides with residual activity and/or efficacy comparable to that of diazinon's are listed. Note that a range of chemistries (synthetic pyrethroids, neonicotinoids, carbamates, etc.) and some reduced-risk pesticides are available for all the insects listed.

Table 2. Alternative chemical control options for foliar and fruit-feeding insect pests occurring primarily in Arizona and California.

Insect	**Likely alternatives to diazinon**
Beet armyworm	bifenthrin, fenpropathrin, methomyl, permethrin, spinosad
Leafminers	avermectin, cryomazine, dimethoate *, permethrin, spinosad
Leafhoppers	bifenthrin, dimethoate, esfenvalerate, imidacloprid , naled, permethrin

Notes: (1) The same alternatives as those listed for Texas (see Table 1) are available for cucumber and flea beetles.
(2) *Sources*: UC Pest Management Guidelines (Godfrey et al. 2000); USDA Crop Profiles (USDA 1999a, 2000a)
(3) * = undergoing reregistration and use on melons may be restricted in the near future.

The soil pests targeted by diazinon in these regions are somewhat different than those in the southeastern US areas. Grubs do not appear to be insect problems in either Arizona or California (Godfrey et al. 2000, USDA 1999a, 2000a). Wireworms, cutworms (many species), seedcorn maggots (*Delia platura*), and cucumber beetle larvae are all occasionally the focus of diazinon use. All are pest problems in newly planted fields, where young plants can easily be completely destroyed. Cutworms can also damage mature plants and fruit (Leboeuf, personal communication). Field crickets (*Gryllus* spp.), mole crickets (*Gryllotalpa* spp.), and darkling beetles (*Blapstinus* spp.) can damage flowers, ripening fruit and irrigation equipment occasionally and are also targeted with diazinon (Palumbo, personal communication, USDA 1999a, 2000a). As in the southeast, no alternatives to diazinon are available for wireworms other than telone and isotox (a mixture of lindane and captan), neither of which can be applied after planting and have unknown efficacy relative to diazinon. It should also be noted here that lindane is undergoing reregistration and may be restricted in the near future. For seedcorn maggots, isotox is the only alternative currently available.

For cutworms, carbaryl, methomyl, or esfenvalerate may be used with efficacy comparable to that of diazinon (Godfrey et al. 2000). Note here that esfenvalerate is available for all melons except casaba, Crenshaw and Persian varieties. For crickets and darkling beetles, carbaryl and permethrin are alternatives that should provide adequate control; malathion is also recommended for beetles by some authorities (USDA 1999a, Godfrey et al. 2000). For cucumber beetle larvae, carbaryl and imidacloprid are the only insecticide alternatives to diazinon that are available as soil treatments. For the soil insect complex in general, no effective natural enemies appear to exist (Godfrey et al. 2000, USDA 2000a). In these western growing regions, cultural practices such as elimination of weeds in and around fields and removal of organic debris from previously harvested crops often prevents many of these insects from building up to economically injurious levels (Godfrey et al. 2000). However, seedcorn maggots and cucumber beetle larvae, in particular, may become soil pests more frequently. This is because females of these species can migrate into even carefully managed fields and oviposit rapidly (LeBoeuf, personal communication).

Biological impacts of eliminating diazinon in melon production

BEAD believes that the loss of diazinon as a foliar insecticide should not have a dramatic immediate (1 to 2 year) impact on pest management, in all melon producing regions, due to the availability of alternative chemical controls. However, diazinon sometimes fills an important niche, in that it can be rotated into pest management programs to help delay resistance development in the foliar pests it targets. Thus, removal of diazinon will make resistance management more difficult, particularly in melon aphids (which have developed resistance to many insecticides in other crops). Other limitations also exist for some of the foliar alternatives. Methomyl is thought to sometimes cause leafminer outbreaks while esfenvalerate may have the same effect on thrips and mites, possibly due to high toxicity of these materials to natural enemies (LeBoeuf, personal communication, Walgenbach et al. 2001). However, BEAD was unable to find any specific assessments of the extent to which these phenomena occur in melons. Thus, the long term impact of the absence of diazinon is unpredictable in terms of resistance development and epidemics of previously minor pests.

An additional factor that must be considered regarding the foliar use of diazinon is that some of the alternative insecticides are relatively new and growers and researchers are still testing ways in which to incorporate them into pest control programs in such a way as to effectively substitute them, particularly for late-season use of diazinon against aphids in California (LeBouef, personal communication). BEAD believes that this aspect of the impact of diazinon risk mitigation may be adequately addressed by allowing time for a phaseout if elimination of this insecticide is to be considered.

Texas extension service crop experts estimate a minimum 10 % loss of yield to occur if diazinon use against soil pests is eliminated in their region (Anciso and Smith 2000, Holloway, personal communication). In California and Arizona, BEAD believes that some losses to soil insects - particularly seedcorn maggots and cucumber beetle larvae - would also occur if diazinon is lost. Level of loss to the soil insect complex is difficult to estimate reliably. One crop expert commented that it may be as high as 50 % in as much as 30 % of production fields, at least in California cantaloupes and honeydews (LeBoeuf, personal communication). Even if growers are able to successfully use the few available soil insecticide alternatives, the lack of chemistries with different modes of action makes it more likely that resistance will develop in the targeted insects. In California, soil insects are apparently historically minor pests that are now increasing in impact, because melon seed prices have increased and growers are forced to plant fewer seeds per acre, and so cannot tolerate high losses as much nowadays (LeBoeuf, personal communication).

Economic impacts of eliminating diazinon in melon production

Estimates of economic impacts of eliminating diazinon in melon production will be limited to a consideration of the use of diazinon to control soil insects in Arizona, California and Texas. Ranges of estimates will be presented for both per acre and aggregate effects. All estimates below are presented in round numbers both because of the imprecision of loss estimates and because of the range of growing costs, selling prices and yields.

LeBoeuf estimates that some fields in California could suffer a 50 % yield loss due to uncontrolled damage by soil insects. Since harvesting costs are about one-half of total production costs for cantaloupe and honeydew melon producers this could amount to a per acre loss of $ 1,000. Total revenue would fall by about $ 2,000 per acre but this would be partially offset by a reduction in harvest costs of about $1,000 per acre because of the need to handle fewer melons.

For watermelons, harvesting costs appear to be about one-third of total growing costs. If we assume total costs (and revenue) of $ 1,500 per acre, revenue would fall to about $ 750 but costs would fall about $ 135 leading to a net loss of about $ 615 per acre. Growers with this level of damage are almost certainly going to suffer net losses.

It is possible that fields with 50 % damage to soil insects would be abandoned early in season soon after the damage had occurred.

The above are worst case estimates. It is not known how many acres/farmers would be affected to this extent. Planted watermelon acreage in Texas has declined by about one-third over the past decade which suggests that watermelons are not a particularly profitable crop for many Texas growers. Texas farmers have had low yields over most of this time compared to Arizona and California but in the early 1990s received prices much higher than they have seen in the past few years.

The lack of available pest damage data makes it difficult to choose a reasonable average yield loss for determining aggregate impacts of soil pests. We will use 10% (Anciso and Smith, 2000; Holloway, personal communication) as a basis for our calculations. A range will be used for the number of affected acres. The low end of the range will be the average percent of crop treated estimated by NASS. For cantaloupes and honeydew melons, the high end will be the figure provided by Holloway. Based on the NASS data which estimated usage of diazinon on watermelons varying from less than one percent of crop treated in Texas to a maximum of less than 5 percent we think that treatment of more than 10 % of Texas watermelons with diazinon for control of soil insects is very unlikely.

Aggregate impacts are likely to be less than 5 % of total production of honeydews and cantaloupes in the three states. If there are no price effects, total gross revenues to farmers could fall $ 15,000,000 out of a total crop value of about $350,000,000 for cantaloupes and about $5,000,000 out of a total crop value of $100,000,000 for honeydew melons. Watermelon impacts will proportionally less - about $ 2,000,000 out of a $100,000,000 crop for the three states. Appendix Tables 7, 8 and 9 provide hypothetical impacts for the years 1999 to 2001 assuming a 10% yield loss and low, medium and high percentages of the crop affected.

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Appendix Table 1

Cantaloups for Fresh Market: Area Planted and Harvested, Yield, and Production by State and United States, 1999-2001

State	Area Planted 1999	Area Planted 2000	Area Planted 2001	Area Harvested 1999	Area Harvested 2000	Area Harvested 2001
	Acres					
AZ	19,700	14,900	14,600	19,700	14,900	14,600
CA	61,000	58,500	57,800	61,000	57,500	56,800
CO	2,100	1,800	1,800	1,900	1,500	1,700
DE 1/		430	430		420	430
GA	6,800	6,800	5,900	6,500	5,500	5,300
IN	3,500	3,200	3,000	3,200	3,000	2,900
MD	1,700	1,500	1,700	1,600	1,400	1,600
MI	800	800	800	700	750	700
OH 2/	720			650		
PA	1,100	1,200	1,300	1,000	1,100	1,200
SC 1/		1,300	1,600		1,000	1,500
TX	11,700	11,800	12,200	11,100	10,800	11,200
VA 1/		900	800		800	700
US	109,120	103,130	101,930	107,350	98,670	98,630

State	Yield per Acre 1999	Yield per Acre 2000	Yield per Acre 2001	Production 1999	Production 2000	Production 2001
	Cwt			1,000 Cwt		
AZ	270	225	270	5,319	3,353	3,942
CA	210	230	235	12,810	13,225	13,348
CO	180	240	230	342	360	391
DE 1/		110	105		46	45
GA	170	165	160	1,105	908	848
IN	180	215	250	576	645	725
MD	80	94	110	128	132	176
MI	140	140	150	98	105	105
OH 2/	125			81		
PA	120	130	93	120	143	112
SC 1/		100	100		100	150
TX	180	170	250	1,998	1,836	2,800
VA 1/		140	175		112	123
US	210	212	231	22,577	20,965	22,765

State	Value Per Cwt 1999	Value Per Cwt 2000	Value Per Cwt 2001	Value Total 1999	Value Total 2000	Value Total 2001
	Dollars			1,000 Dollars		
AZ	13.80	19.60	14.90	73,402	65,719	58,736
CA	17.30	17.10	18.90	221,613	226,148	252,277
CO	13.60	13.30	15.30	4,651	4,788	5,982
DE 1/		17.00	20.00		782	900
GA	13.40	8.50	12.00	14,807	7,718	10,176
IN	15.50	15.50	16.30	8,928	9,998	11,818
MD	26.00	21.00	20.00	3,328	2,772	3,520
MI	17.30	15.30	17.90	1,695	1,607	1,879
OH 2/	21.30			1,725		
PA	16.00	16.30	15.60	1,920	2,331	1,747
SC 1/		13.50	13.30		1,350	1,995
TX	28.40	23.10	24.90	56,743	42,412	69,720
VA 1/		14.00	12.00		1,568	1,476
US	17.20	17.50	18.50	388,812	367,193	420,226

1/ Added to vegetable program in 2000.
2/ Estimates discontinued in 2000.

Appendix Table 2

Honeydews for Fresh Market: Area Planted and Harvested, Yield, Production, and Value by State and United States, 1999-2001

State	Area Planted			Area Harvested		
	1999	2000	2001	1999	2000	2001
	Acres					
AZ	4,200	3,600	2,400	4,200	3,600	2,400
CA	20,500	20,000	21,000	20,500	20,000	21,000
TX	2,900	2,600	2,000	2,800	2,400	1,800
US	27,600	26,200	25,400	27,500	26,000	25,200

State	Yield per Acre			Production		
	1999	2000	2001	1999	2000	2001
	Cwt			1,000 Cwt		
AZ	245	210	215	1,029	756	516
CA	180	185	185	3,690	3,700	3,885
TX	210	230	200	588	552	360
US	193	193	189	5,307	5,008	4,761

State	Value					
	Per Cwt			Total		
	1999	2000	2001	1999	2000	2001
	Dollars			1,000 Dollars		
AZ	19.20	17.50	16.20	19,757	13,230	8,359
CA	21.10	18.60	19.60	77,859	68,820	76,146
TX	29.10	25.60	37.80	17,111	14,131	13,608
US	21.60	19.20	20.60	114,727	96,181	98,113

Appendix Table 3

Watermelons for Fresh Market: Area Planted and Harvested, Yield, and Production by State and United States, 1999-2001

State	Area Planted			Area Harvested		
	1999	2000	2001	1999	2000	2001
	Acres					
AL	6,800	5,600	3,400	4,700	3,900	2,400
AZ	7,200	7,100	6,800	7,100	7,100	6,500
AR	2,600	2,900	3,100	2,400	2,700	2,900
CA	14,700	12,300	12,500	14,700	12,300	12,500
DE	2,500	2,700	2,800	2,500	2,600	2,700
FL	45,000	30,000	26,000	35,000	27,000	24,000
GA	28,000	28,000	24,000	25,000	24,000	22,000
IN	7,000	7,000	6,900	6,500	6,100	6,400
LA 1/	2,800	2,600		2,300	2,200	
MD	2,800	3,000	3,200	2,700	2,900	3,100
MS	3,600	3,000	3,000	3,200	2,800	2,500
MO	5,900	6,000	5,500	5,300	5,800	5,000
NC	10,400	10,900	10,600	8,900	10,000	9,500
OK	10,000	8,500	7,000	7,500	6,000	6,000
SC	11,000	9,600	9,500	9,500	7,500	7,700
TX	39,700	47,000	45,000	37,200	40,000	40,000
VA 2/		1,800	1,600		1,500	1,400
Total	200,000	188,000	170,900	174,500	164,400	154,600
HI 1/	560	560		560	560	
Oth Sts 3/			2,800			2,300
US	200,560	188,560	173,700	175,060	164,960	156,900

State	Yield per Acre			Production		
	1999	2000	2001	1999	2000	2001
	Cwt			1,000 Cwt		
AL	71	130	180	334	507	432
AZ	426	375	430	3,025	2,663	2,795
AR	115	150	170	276	405	493
CA	430	535	530	6,321	6,581	6,625
DE	430	300	430	1,075	780	1,161
FL	300	320	310	10,500	8,640	7,440
GA	195	195	265	4,875	4,680	5,830
IN	260	260	400	1,690	1,586	2,560
LA 1/	100	110		230	242	
MD	220	195	280	594	566	868
MS	65	66	170	208	185	425
MO	240	210	230	1,272	1,218	1,150
NC	145	160	155	1,291	1,600	1,473
OK	90	70	125	675	420	750
SC	130	200	180	1,235	1,500	1,386
TX	200	140	160	7,440	5,600	6,400
VA 2/		220	210		330	294
Total	235	228	258	41,041	37,503	40,269
HI 1/	200	225		112	126	
Oth Sts 3/			127			292
US	235	228	257	41,153	37,629	40,374

1/ 2001 data not published to avoid disclosure of individual operations. Data have been included in the Other States total.
2/ Added to vegetable program in 2000.
3/ 2001 - HI and LA.

Watermelons for Fresh Market: Value by State
and United States, 1999-2001

Appendix Table 3 (contined)

State	Value Per Cwt 1999	Per Cwt 2000	Per Cwt 2001	Total 1999	Total 2000	Total 2001
	Dollars			1,000 Dollars		
AL	5.60	5.60	6.60	1,870	2,839	2,851
AZ	5.60	6.80	10.10	16,940	18,108	28,230
AR	7.50	4.20	4.90	2,070	1,701	2,416
CA	9.80	11.70	10.90	61,946	76,998	72,213
DE	9.00	7.00	8.00	9,675	5,460	9,288
FL	6.90	5.25	5.70	72,450	45,360	42,408
GA	5.00	4.60	5.00	24,375	21,528	29,150
IN	6.60	6.40	7.80	11,154	10,150	19,968
LA 1/	6.70	6.90		1,541	1,670	
MD	11.00	9.00	8.00	6,534	5,094	6,944
MS	5.80	6.32	5.50	1,206	1,169	2,338
MO	3.50	3.65	4.25	4,452	4,446	4,888
NC	5.20	6.00	5.70	6,713	9,600	8,396
OK	7.30	7.00	7.00	4,928	2,940	5,250
SC	6.70	5.10	5.70	8,275	7,650	7,900
TX	3.98	3.90	4.50	29,611	21,840	28,800
VA 2/		5.00	7.00		1,650	2,058
Total	6.43	6.35	6.81	263,740	238,203	274,351
HI 1/	21.00	23.00		2,352	2,898	
Oth Sts 3/			12.90			3,773
US	6.47	6.41	6.86	266,092	241,101	276,871

1/ 2001 data not published to avoid disclosure of individual operations. Data have been included in the Other States total.
2/ Added to vegetable program in 2000.
3/ 2001 - HI and LA.

Appendix Table 4

Reported Use of Diazinon on Cantaloupes (Various Sources)

Source	Year	Acres Planted	Acres Treated	Percent of Acres Treated	Number of Applications	Total Active Ingredient	Total Pounds/ Acre
Arizona							
NASS	1990	9,000		*	.		.
NASS	1992	14,000		*	.		.
NASS	1994	14,000	3,000	24	1.0	1,000	0.2
1/ NASS	1996	18,000		*	.		.
NCFAP	(1997)			5	.	2,000	2.2
NASS	1998	19,000		*	.		.
NASS	2000	15,000		*	.		.
California							
NCFAP	(1992)			19	.	6,000	0.5
NASS	1992	86,000		*	.		.
NASS	1994	59,000	10,000	17	1.0	6,000	0.6
CDPR	1996			.	.	8,000	.
1/ NASS	1996	79,000	8,000	10	1.2	6,000	0.8
NCFAP	(1997)			27	.	15,000	1.0
CDPR	1998			.	.	6,000	.
NASS	1998	63,000	5,000	8	1.0	2,000	0.5
CDPR	1999			.	.	6,000	.
NASS	2000	59,000	9,000	15	1.3	8,000	0.9
Delaware							
NASS	1998	<500		*	.		.
Georgia							
NASS	1992	9,000		*	.		.
NASS	1994	9,000		*	.		.
NASS	1998	6,000		*	.		.
NASS	2000	7,000		*	.		.
Indiana							
NASS	1998	3,000		*	.		.
Michigan							
NASS	1992	1,000		*	.		.
NASS	1994	1,000		*	.		.
NASS	1998	1,000		*	.		.
NASS	2000	1,000		*	.		.
Tennessee							
NCFAP	(1997)			35	.	<500	2.2
Texas							
NASS	1990	19,000	1,000	7	1.1	1,000	0.8
NCFAP	(1992)			11	.	1,000	0.5
NASS	1992	13,000	1,000	11	1.1	1,000	0.5
NASS	1994	14,000	2,000	11	1.0	1,000	0.8
1/ NASS	1996	16,000	1,000	8	1.0	1,000	0.7
NCFAP	(1997)			10	.	1,000	0.7
NASS	1998	11,000		*	.		.
NASS	2000	12,000	3,000	26	1.6	6,000	2.0
Holloway	(2001)			35	.		.
Virginia							
NCFAP	(1997)			9	.	<500	0.7
States Surveyed							
NASS	1992	123,000	6,000	5	1.1	4,000	0.6
NASS	1994	98,000	15,000	15	1.0	8,000	0.5
1/ NASS	1996	113,000	9,000	8	1.1	7,000	0.8
NASS	1998	102,000	8,000	8	1.2	6,000	0.7
NASS	2000	93,000	14,000	15	1.3	15,000	1.1

1/ NASS surveyd "Other" melons in 1996. Includes cantaloupes and honeydews.
All data from NASS unless indicated.
'*' indicates that NASS had insufficient reports to publish a number.
. Indicates low levels of usage
Years in parentheses indicate estimates made for that gneral time period but not necessarily for that specific year

Appendix Table 5

Reported Use of Diazinon on Honeydew Melons (Various Sources)

Source	Year	Acres Planted	Acres Treated	Percent of Acres Treated	Number of Applications	Total Active Ingredient	Total Pounds/ Acre
Arizona							
NASS	1990	3,000		*	.		.
NASS	1992	3,000		*	.		.
NASS	1994	3,000		*	.		.
NCFAP	(1997)			1	.	<500	0.4
NASS	1998	4,000		*	.		.
NASS	2000	4,000		*	.		.
California							
NCFAP	(1992)			46	.	5,000	0.6
NASS	1992	17,000		*	.		.
NASS	1994	18,000	1,000	5	1.0	1,000	0.5
NCFAP	(1997)			15	.	4,000	0.9
NASS	1998	21,000		*	.		.
NASS	2000	22,000		*	.		.
Texas							
NASS	1990	5,000	1,000	16	1.0	1,000	0.9
NCFAP	(1992)			20	.	1,000	1.3
NASS	1992	5,000	1,000	20	1.4	1,000	1.3
NASS	1994	5,000		*	.		.
NCFAP	(1997)			10	.	<500	1.3
NASS	1998	3,000		*	.		.
NASS	2000	3,000		*	.		.
Holloway	(2001)			35	.		.
States Surveyed							
NASS	1992	25,000	2,000	10	1.7	3,000	1.2
NASS	1994	26,000	4,000	14	1.3	3,000	0.7
NASS	1998	27,000	4,000	16	1.5	5,000	1.0
NASS	2000	29,000	2,000	6	1.0	2,000	1.1

1/ NASS surveyd "Other" melons in 1996. Includes cantaloupes and honeydews.
All data from NASS unless indicated.
'*' indicates that NASS had insufficient reports to publish a number.
. Indicates low levels of usage
Years in parentheses indicate estimates made for that gneral time period but not necessarily for that specific year

Appendix Table 6

Reported Use of Diazinon on Watermelons (Various Sources)

Source	Year	Acres Planted	Acres Treated	Percent of Acres Treated	Number of Applications	Total Active Ingredient	Total Pounds/ Acre
Alabama							
NCFAP	(1997)			15	.	<500	0.5
NASS	2000	6,000		*	.		.
Arizona							
NASS	1990	4,000		*	.		.
NASS	1992	7,000	2,000	26	1.5	1,000	0.6
NCFAP	(1992)			26	.	1,000	0.6
NASS	1994	7,000		*	.		.
NASS	1996	7,000		*	.		.
NCFAP	(1997)			25	.	1,000	0.5
NASS	1998	7,000		*	.		.
NASS	2000	7,000		*	.		.
Arkansas							
NCFAP	(1992)			8	.	<500	0.5
NCFAP	(1997)			4	.	<500	0.5
California							
NASS	1992	15,000	2,000	10	1.7	3,000	1.8
NCFAP	(1992)			10	.	3,000	1.8
NASS	1994	17,000	4,000	22	1.9	7,000	2.0
NASS	1996	17,000	3,000	16	1.7	4,000	1.6
CDPR	1996			.	.	3,000	.
NCFAP	(1997)			17	.	3,000	1.1
NASS	1998	17,000		*	.		.
CDPR	1998			.	.	3,000	.
CDPR	1999			.	.	3,000	.
NASS	2000	12,000		*	.		.
Delaware							
NCFAP	(1997)			30	.	<500	0.4
NASS	1998	2,000		*	.		.
Florida							
NASS	1990	53,000	1,000	1	1.0	1,000	0.7
NASS	1992	53,000		*	.		.
NCFAP	(1992)			1	.	<500	0.7
NASS	1994	40,000		*	.		.
NASS	1996	40,000		*	.		.
NASS	1998	35,000		*	.		.
NASS	2000	30,000		*	.		.
Georgia							
NASS	1992	42,000		*	.		.
NASS	1994	37,000		*	.		.
NASS	1996	42,000		*	.		.
NASS	1998	27,000		*	.		.
NASS	2000	28,000		*	.		.
Indiana							
NCFAP	(1992)			3	.	<500	0.6
NCFAP	(1997)			5	.	<500	0.4
NASS	1998	7,000		*	.		.
Maryland							
NCFAP	(1997)			30	.	<500	0.4
Mississippi							
NCFAP	(1992)			8	.	<500	0.5
NCFAP	(1997)			15	.	<500	0.5
North Carolina							
NASS	1992	11,000		*	.		.
NASS	1994	10,000		*	.		.
NASS	1996	10,000		*	.		.
NASS	1998	10,000		*	.		.
NASS	2000	11,000		*	.		.

Reported Use of Diazinon on Watermelons (Various Sources) (continued)

Source	Year	Acres Planted	Acres Treated	Percent of Acres Treated	Number of Applications	Total Active Ingredient	Total Pounds/ Acre
South Carolina							
NASS	2000	10,000		*	.		.

Texas							
NASS	1990	55,000	2,000	4	1.2	2,000	0.9
NASS	1992	51,000	1,000	2	1.1	1,000	0.6
NCFAP	(1992)			2	.	1,000	0.6
NASS	1994	56,000	2,000	4	1.7	4,000	1.6
NASS	1996	47,000	<500	1	1.9	<500	0.5
NCFAP	(1997)			1	.	<500	0.5
NASS	1998	41,000		*	.		.
NASS	2000	47,000	1,000	3	1.5	2,000	1.5
Holloway	(2001)			35	.		.
Virginia							
NCFAP	(1997)			10	.	<500	0.4
States Surveyed							
NASS	1992	178,000	5,000	3	1.4	5,000	0.9
NASS	1994	166,000	8,000	5	1.6	13,000	1.5
NASS	1996	164,000	7,000	4	1.5	7,000	1.1
NASS	1998	146,000	7,000	5	1.3	3,000	0.4
NASS	2000	151,000	5,000	3	1.3	6,000	1.6

1/ NASS surveyd "Other" melons in 1996. Includes cantaloupes and honeydews.

All data from NASS unless indicated.

'*' indicates that NASS had insufficient reports to publish a number.

. Indicates low levels of usage

Years in parentheses indicate estimates made for that gneral time period but not necessarily for that specific year

Table 7

Cantaloups for Fresh Market:
Area Planted and Harvested, Yield
and Production by State and United States 1999-2001

State	Area Planted 1999	Area Planted 2000	Area Planted 2001	Area Harvested 1999	Area Harvested 2000	Area Harvested 2001
	Acres					
AZ	19,700	14,900	14,600	19,700	14,900	14,600
CA	61,000	58,500	57,800	61,000	57,500	56,800
TX	11,700	11,800	12,200	11,100	10,800	11,200
3 states	92,400	85,200	84,600	91,800	83,200	82,600

State	Yield per Acre 1999	Yield per Acre 2000	Yield per Acre 2001	Production 1999	Production 2000	Production 2001
	------- Cwt -------			----- 1000 Cwt --------		
AZ	270	225	270	5,319	3,353	3,942
CA	210	230	235	12,810	13,225	13,348
TX	180	170	250	1,998	1,836	2,800

State	Value Per Cwt 1999	Value Per Cwt 2000	Value Per Cwt 2001	Value Total 1999	Value Total 2000	Value Total 2001
	----- Dollars ------			---- 1000 Dollars -----		
AZ	13.8	19.6	14.9	73,402	65,719	58,736
CA	17.3	17.1	18.9	221,613	226,148	252,277
TX	28.4	23.1	24.9	56,743	42,412	69,720
3 states				351,758	334,279	380,733

State	Revenue per harvested acre 1999	2000	2001
	------ Dollars ------		
AZ	3,726	4,410	4,023
CA	3,633	3,933	4,442
TX	5,112	3,927	6,225

Low Estimates of % of acres affected

State	% acres affected	% Yield Loss	Total Dollar Loss For State --- 1000 Dollars --- 1999	2000	2001	% of Total State Revenue Lost 1999	2000	2001
AZ	1%	10%	73	66	59	0%	0%	0%
CA	1%	10%	222	226	252	0%	0%	0%
TX	7%	10%	397	297	488	1%	1%	1%
3 states			692	589	799	0%	0%	0%

Medium Estimates of % of acres affected

State	% acres affected	% Yield Loss	Total Dollar Loss For State --- 1000 Dollars --- 1999	2000	2001	% of Total State Revenue Lost 1999	2000	2001
AZ	6%	10%	411	368	329	1%	1%	1%
CA	12%	10%	2,585	2,638	2,943	1%	1%	1%
TX	11%	10%	605	452	744	1%	1%	1%
3 states			3,602	3,459	4,016	1%	1%	1%

High Estimates of % of acres affected

State	% acres affected	% Yield Loss	Total Dollar Loss For State --- 1000 Dollars --- 1999	2000	2001	% of Total State Revenue Lost 1999	2000	2001
AZ	24%	10%	1,762	1,577	1,410	2%	2%	2%
CA	27%	10%	5,984	6,106	6,811	3%	3%	3%
TX	35%	10%	1,986	1,484	2,440	4%	4%	4%
3 states			9,731	9,168	10,661	3%	3%	3%

Table8

Honeydews for Fresh Market:
Area Planted and Harvested Yield
Production and Value by State and United States 1999-2001

State	Area Planted 1999	Area Planted 2000	Area Planted 2001	Area Harvested 1999	Area Harvested 2000	Area Harvested 2001
	Acres					
AZ	4,200	3,600	2,400	4,200	3,600	2,400
CA	20,500	20,000	21,000	20,500	20,000	21,000
TX	2,900	2,600	2,000	2,800	2,400	1,800
3 states	27,600	26,200	25,400			

State	Yield per Acre 1999	Yield per Acre 2000	Yield per Acre 2001	Production 1999	Production 2000	Production 2001
	------- Cwt -------			----- 1000 Cwt --------		
AZ	245	210	215	1,029	756	516
CA	180	185	185	3,690	3,700	3,885
TX	210	230	200	588	552	360

Value	Per Cwt 1999	Per Cwt 2000	Per Cwt 2001	Total 1999	Total 2000	Total 2001
	----- Dollars ------			----- 1000 Dollars ----		
AZ	19.2	17.5	16.2	19,757	13,230	8,359
CA	21.1	18.6	19.6	77,859	68,820	76,146
TX	29.1	25.6	37.8	17,111	14,131	13,608
				114,727	96,181	98,113

Revenue per harvested acre

	1,999	2,000	2,001
AZ	4,704	3,675	3,483
CA	3,798	3,441	3,626
TX	6,111	5,888	7,560
3 states			

Low Estimates of % of acres affected

State	% acres affected	% Yield Loss	Total Dollar Loss For State (1000 Dollars) 1999	2000	2001	% of Total State Revenue Lost 1999	2000	2001
AZ	1%	10%	20	13	8	0%	0%	0%
CA	1%	10%	78	69	76	0%	0%	0%
TX	7%	10%	120	99	95	1%	1%	1%
3 states			217	181	180	0%	0%	0%

Medium Estimates of % of acres affected

State	% acres affected	% Yield Loss	Total Dollar Loss For State (1000 Dollars) 1999	2000	2001	% of Total State Revenue Lost 1999	2000	2001
AZ	1%	10%	20	13	8	0%	0%	0%
CA	5%	10%	358	317	350	0%	0%	0%
TX	8%	10%	133	110	106	1%	1%	1%
3 states			511	440	465	0%	0%	0%

High Estimates of % of acres affected

State	% acres affected	% Yield Loss	Total Dollar Loss For State (1000 Dollars) 1999	2000	2001	% of Total State Revenue Lost 1999	2000	2001
AZ	5%	10%	99	66	42	1%	1%	1%
CA	35%	10%	2,725	2,409	2,665	4%	4%	4%
TX	35%	10%	599	495	476	4%	4%	4%
			3,423	2,969	3,183	3%	3%	3%

Table 9

Watermelons for Fresh Market:
Area Planted and Harvested Yield
and Production by State and United States 1999-2001

State	Area Planted 1999	Area Planted 2000	Area Planted 2001	Area Harvested 1999	Area Harvested 2000	Area Harvested 2001
	Acres					
AZ	7,200	7,100	6,800	7,100	7,100	6,500
CA	14,700	12,300	12,500	14,700	12,300	12,500
TX	39,700	47,000	45,000	37,200	40,000	40,000
3 states	61,600	66,400	64,300			

	Yield per Acre 1999	Yield per Acre 2000	Yield per Acre 2001	Production 1999	Production 2000	Production 2001
	Cwt			1000 Cwt		
AZ	426	375	430	3,025	2,663	2,795
CA	430	535	530	6,321	6,581	6,625
TX	200	140	160	7,440	5,600	6,400

Watermelons for Fresh Market: Value by State

State	Value Per Cwt 1999	Value Per Cwt 2000	Value Per Cwt 2001	Value Total 1999	Value Total 2000	Value Total 2001
	Dollars			1000 Dollars		
AZ	5.6	6.8	10.1	16,940	18,108	28,230
CA	9.8	11.7	10.9	61,946	76,998	72,213
TX	3.98	3.9	4.5	29,611	21,840	28,800
3 states				108,497	116,946	129,243

Revenue per harvested acre

	1999	2000	2001
AZ	2,386	2,550	4,343
CA	4,214	6,260	5,777
TX	796	546	720
3 states			

Low Estimates of % of acres affected

	% acres affected	% Yield Loss	Total Dollar Loss For State (1000 Dollars) 1999	2000	2001	% of Total State Revenue Lost 1999	2000	2001
AZ	1%	10%	17	18	28	0%	0%	0%
CA	1%	10%	62	77	72	0%	0%	0%
TX	1%	10%	30	22	29	0%	0%	0%
3 states			108	117	129	0%	0%	0%

Medium Estimates of % of acres affected

	% acres affected	% Yield Loss	Total Dollar Loss For State (1000 Dollars) 1999	2000	2001	% of Total State Revenue Lost 1999	2000	2001
AZ	5%	10%	88	94	146	1%	1%	1%
CA	10%	10%	619	770	722	1%	1%	1%
TX	3%	10%	74	55	72	0%	0%	0%
3 states			781	918	940	1%	1%	1%

High Estimates of % of acres affected

	% acres affected	% Yield Loss	Total Dollar Loss For State (1000 Dollars) 1999	2000	2001	% of Total State Revenue Lost 1999	2000	2001
AZ	26%	10%	440	471	734	3%	3%	3%
CA	22%	10%	1,363	1,694	1,589	2%	2%	2%
TX	10%	10%	296	218	288	1%	1%	1%
			2,099	2,383	2,611	2%	2%	2%