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OFFICE OF
PREVENTION, PESTICIDES
AND
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Memorandum

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SUBJECT: Benefits assessment for diazinon use in peaches and nectarines

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Summary of Analysis

Diazinon is used in both peaches and nectarines to control a variety of insects that can significantly damage developing shoots and fruit. In California, effective alternatives exist for control of scale insects (a key pest) on dormant trees. Production costs will increase with the use of these alternatives resulting in losses of net revenues of between 0.4 and 1.4%, which BEAD characterizes as negligible. For post-bloom use of diazinon on the west coast, alternatives also exist for control of moth pests. For these insects also, higher chemical costs will result in negligible losses of net revenue of between 0.4 and 1.0%. However, diazinon also targets scale pests at this time and effective alternatives do not exist for this use. Infested acres will likely suffer losses in terms of fruit quality that may significantly reduce grower revenues, perhaps by 50%. Quality losses in California could be around $2.5 million, but this figure is subject to considerable uncertainty. Finally, in eastern US growing regions, diazinon's main use is as a post-harvest treatment to control scale and moth pests. If this is eliminated, growers will have only spinosad available to use against moth pests, increasing costs and reducing net revenues by over 3%. Again, scale insect damage may increase as there are no effective substitutes for their control with diazinon. This damage may reduce the productive life of the tree, reducing overall profitability of an orchard by as much as 30%, which could deter some growers from remaining in the industry. Losses to the entire peach and nectarine industry from increased chemical costs alone are estimated at about $176,000 annually, out of gross revenues of $593 million.

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 peaches and nectarines. 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 scenario is also applicable for areas where high risk to migrating salmon have been identified by the Environmental Fate and Effects Divison, primarily growing regions on the west coast. 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 other environmental risks (e.g., risk mitigation for risks to terrestrial plants and organisms).

The impacts estimated by this analysis only represent potential short-term – 1 to 5 years – impacts on the peach production system. Impacts of scale damage on overall orchard life go beyond this time frame by necessity, since a typical orchard has a productive life span of 10-12 years. However, assumptions such as which pesticide alternatives will continue to be available, could only be made reliably with the next 1 to 5 years in mind. 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 and grower impacts assume that there is no shift from peaches or nectarines to another crop. Estimates of yield and quality losses associated with the various scenarios are based on the best professional judgement of BEAD analysts when 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 peach production, and other sources listed.

Background of US peach and nectarine production

Peaches and nectarines (both *Prunus persica*) are in the family Rosaceae and originated in China. The only important difference between the peach and the nectarine is that nectarines have smooth skins and peaches are fuzzy. They come from identical trees. Nectarines often originate from peach seeds, and peaches may come from nectarine seeds. Botanists are unsure of which originated first. It is impossible to tell which seeds from nectarine trees will produce nectarine bearing trees, so commercial growers graft nectarine producing branches onto peach trees. The branches will continue to produce nectarines. In appearance, nectarine trees are virtually indistinguishable from peach trees. Tree size and shape, leaves, and even buds look the same. Nectarine fruit, however, is smaller than the peach and smooth skinned (looking more like plums), a golden yellow with large blushes of red. There are over 100 varieties of nectarine, both freestone and clingstone varieties, the same as for peaches. Freestone flesh separates from the pit easily, while clingstone flesh clings to the pit. Nectarines are hand harvested, as the fruit need more delicate handling than peaches because they are bruised more easily.

Peaches are grown commercially throughout the United States, but the majority of production originates in California, with over 70 % of production by weight. Another 17 % is produced along the eastern seaboard, while the mid-west, southern and a few western states contribute the rest (Table 1). After California, the major producing states are South Carolina, Georgia, Pennsylvania, New Jersey, Washington and Michigan.

Table 1. U.S. Peach production, by state, 1998-2000 averages.

Region	Bearing Acres	Production million lbs	% of Total Production	Value $1,000	% of Total Value
Pacific [1]	70,900	1834	75.7	262,900	56.4
Eastern Sea Board [2]	56,100	420	17.3	136,900	29.4
Midwest [3]	9,600	74	3.1	24,700	5.3
South [4]	17,200	64	2.6	28,900	6.2
West [5]	4,000	30	1.3	12,800	2.7
Total	157,800	2423		466,200	

1 California, Oregon and Washington.
2 Connecticut, Georgia, Maryland, Massachusetts, New Jersey, New York, North Carolina, Pennsylvania, South Carolina, Virginia and West Virginia.
3 Illinois, Indiana, Michigan, Missouri and Ohio.
4 Alabama, Arkansas, Kentucky, Louisiana, Oklahoma, Tennessee and Texas.
5 Colorado, Idaho and Utah.
Source: USDA/NASS, Agricultural Statistics 2001 and Noncitrus Fruits and Nuts 2000 Summary.

The value of production is approximately $467 million annually. Nationally, bearing acreage has been declining. In 2000, there were about 156,000 acres of producing peach trees, 67,200 of which were in California (NASS, 2001). This is down from 178,000 in 1991. Utilization is shown in Table 2. Just under half the production is destined for the fresh market, while the rest is processed in one form or another. State-level data is not available for all states. California is relatively more concentrated on processing, especially the clingstone varieties, with 72.2 % of production going to that market. Over 95 % of clingstone varieties go to processing, while over two-thirds of freestone varieties go to the fresh market. In contrast, 86.1 % of South Carolina production goes to the fresh market. This partially explains the higher price received in the east, which averaged 32.6 ¢/lb over all states, compared to 13.4 ¢/lb in California. Even in the fresh market, the

Eastern Sea Board enjoys a price advantage. Fresh peaches in South Carolina averaged 23.2 ¢ / lb, the lowest in the region, while in California fresh peaches averaged only 19.5 ¢/lb.

Table 2. Utilization of peaches.

End Use	Utilization *(million pounds)*				% of Production
	1998	1999	2000	average	
fresh	1,001	1,000	1,184	1,095	45.1%
canned	985	996	1,035	1,005	41.4
dried	25	31	25	27	1.1
frozen	186	204	220	203	8.4
other	129	102	56	96	3.9

Source: USDA/NASS, Agricultural Statistics 2001.

In 2000, the U.S. exported over 115,000 metric tons (MT) of fresh peaches, about 10% of total utilized production (FATUS 2001). Canada and China were the main trading partners, together accounting for about 80% of U.S. exports by volume. The U.S. also imported 44,000 MT of peaches during the off-season, over 97% of which came from Chile. The value of net exports (exports less imports) for the year was over $65 million, up about 20% from 1999.

By far the largest production area in the U.S. for nectarines is California (Markle et al. 1998). Approximately 96% of U.S. nectarine production is in CA with bearing acreage in 2001 of 36,500 acres (Noncitrus Fruits and Nuts Preliminary Summary USDA/NASS 2001). California Environmental Protection Agency data suggest that acreage is around 40,000. Total production of nectarines in CA in 2001 was 275,000 tons, of which 265,400 tons were fresh market. Total crop value for U.S. nectarines in 2001 was $127,392,000. This data source does not cover the production of nectarines outside of California.

Diazinon usage on peaches and nectarines

BEAD (2000) estimated that diazinon use on peaches totaled about 61,000 lbs active ingredient (a.i.) annually, between 1987 and 1997. While insecticide use varies from year to year depending on pest pressure, an estimated 26,000 acres were treated annually, representing about 12% of the acreage. The most recent USDA report (2000) indicates that about 10% of peach acreage was treated in 1999, or about 15,000 acres, and about 32,500 lbs a.i. were used nationally. These data are from only selected states and may underestimate total usage. They may also reflect the decline in total acres devoted to peaches in recent years.

USDA (2000) reports that 19% of the California acres were treated, or almost 13,000 acres, with 32,300 lbs a.i. used. The California Environmental Protection Agency (2001) reports about 30,300 lbs used in 1999, slightly less than the three-year (1998-2000) average of 34,100 lbs, on 14,400 acres or 18.4% of the acreage. USDA reports minor usage of diazinon on peaches in a number of other states, including Georgia, North Carolina, Texas and Michigan, but does not estimate acreage or amount used. Imputation of USDA data, however, indicate that these states average less than 2% of the crop treated. Extrapolating from reporting states and given bearing acres from Table 1 suggest about 15,200 acres treated nationally with about 34,500 lbs a.i. (Table 3).

Table 3. Diazinon usage on peaches, 1999, extrapolated from reporting states.

State/Region	Bearing Acres	% Acres Treated	Acres Treated	lbs a.i. Applied	Rate (lbs a.i./acre/year)
Pacific	70,900	19.0	13,500	32,300	2.40
Eastern Sea Board	56,100	2.0	1,100	1,400	1.25
Midwest	9,600	2.0	200	250	1.25
South	17,200	2.0	300	450	1.25
West	4,000	2.0	80	100	1.25
Total	157,800	9.6	15,200	34,500	2.27

Source: USDA, BEAD calculations.

According to the both USDA and California Environmental Protection Agency, diazinon has been used to treat about 21-25% of nectarine acres in California, or about 8,800 acres. About 20,000 lbs a.i. of diazinon are used annually.

Insect Pests targeted by diazinon, and potential alternatives

California

In western growing regions, three widespread and often serious insect pests of both peaches and nectarines are controlled effectively by diazinon. These are the San Jose scale (SJS), *Quadraspidiotus perniciosus*, the peach twig borer (PTB), *Anarsia lineatella*, (a moth) and the oriental fruit moth (OFM), *Grapholitha molesta*. Scale insects cause injury by feeding on twigs, branches, and fruit. They may also inject salivary toxins while feeding. Heavy populations on the bark can cause gumming and kill twigs, branches, and even entire trees, if left uncontrolled. A red discoloration often forms around the insect on small twigs or infested fruit. This often results in the fruit being culled because of unsightly appearance (Bentley et al. 2000a).

Feeding of OFM larvae on developing shoots causes the tip of the shoot to die, causing “shoot strikes” or flagging. The most severe damage occurs where larvae feed on fruit, causing it to be rated off grade. Larvae bore to the center of the fruit and feed around the pit. Feeding damage may also increase the incidence of fruit decay. There are generally five generations of OFM per year in California, though a sixth generation has been observed in years with warm weather in early spring (Bentley et al. 2000b). PTB larvae also damage stone fruits by feeding in shoots and causing shoot strike, or by feeding directly on the fruit. Unlike OFM, PTB larvae enter fruit at the stem or suture and feed just under the skin. Feeding damage, however, can increase the incidence of fruit decay. There are four generations per year in California. First generation larvae usually develop in twigs during May and June and give rise to the next flight of moths in late June or early July. Larvae from this and subsequent generations may attack either twigs or fruit (Bentley et al. 2000c).

Sprays of horticultural oil mixed with diazinon are applied during peach and nectarine dormancy to control SJS adult and PTB larval populations. Additional sprays of diazinon alone are often also used during the growing season (post-bloom only, as diazinon is toxic to pollinating insects such as bees). These applications target mainly immature, mobile populations of SJS (“crawlers”) and moth larvae that might damage fruit. In addition to controlling these key pests, diazinon also appears to provide good control of other insects that could become significant pests of California peaches. These include stink bugs (various species) and other insects of the same order (Heteroptera), all of which feed by piercing fruit with syringe-like mouthparts. This results in “catfacing” or disfigurement of fruit which in turn lowers the marketable value of the crop (Bentley et al. 1998, USDA1999). Katydid populations (of various species) are also kept low at least in part by post-bloom applications of diazinon. These insects also act to lower the quality of fruit by their feeding damage (USDA 1999).

Recommended alternatives to diazinon for use against SJS (listed in order of usefulness in IPM programs) during the dormant period include chlorpyrifos, methadithion, and carbaryl. As with diazinon these products must be mixed with horticultural oil for greatest efficacy. The oil itself can also be used, but has the lowest efficacy (at least 10% less than diazinon) of all these options (Bentley et al. 2000a). These alternatives also target PTB larvae, and growers also have spinosad as an option against this insect. California has also recently received an emergency exemption (section 18) registration to use pyriproxyfen (an insect growth regulator) against SJS during dormancy, though only one application is allowed.

Available alternatives to diazinon use against SJS during the post-bloom period include carbaryl, phosmet and oil. However, carbaryl can cause mite outbreaks and phosmet and oil are so ineffective that pest control advisors do not recommend it (Bentley et al. 2000a). Thus in practical terms there do not appear to be substitutes for this use of diazinon. For the other key pests targeted by post-bloom diazinon use - OFM and PTB - effective alternatives include spinosad and phosmet. While other options exist - mating disruptants, *Bt*, esfenvalerate and permethrin, to name some - their use as diazinon substitutes is unlikely, due either to very short effectiveness or very high cost.

Eastern US

The pest complex in eastern growing regions is virtually identical to that in the west. The same key pests occur, though SJS is a relatively recent problem. Its populations in the east have only begun to rise since the early 1990s (D. Horton, P. Shearer, personal communication; Horton et al. 2000). In addition to the insects mentioned above, growers in the southeast also occasionally use diazinon to target white peach scale, *Pseudaulacaspis pentagona*, and the peach tree borer, *Sanninoidea exitiesa* (NRAES 1995). Damage caused by these insects is very similar to that incurred from the SJS and PTB, respectively. BEAD has not been able to locate quantifications of the yield losses attritutable to each of these insects, but it is reasonable to assume that, if left uncontrolled, they may cause losses similar to the SJS and PTB.

Diazinon is used in most eastern growing areas after harvest, as insecticides applied prior to harvest must be mixed with sulfur-containing scab fungicides. Diazinon used with these compounds damages fruit finish, so most growers reserve it for post-harvest insect control (Horton et al. 2000). Applications of diazinon at this time are modest, covering only about 5 to 10 % of acreage in the southeast (D. Horton, personal communication). Lacking information to indicate otherwise, BEAD assumes a similar area is treated in other eastern regions also. Diazinon is also rarely used as a dormant period spray (similar to the west coast practice), mixed with oil. Acreage to which this is applied is very low, estimated at 0.05 % in the southeast. Its main purpose is to “clean up” heavy infestations of overwintering insects (D. Horton, personal communication).

There are presently no alternatives to the post-harvest use of diazinon against scale insects in the eastern US. Spinosad is an alternative that could be used against moth pests at this time. While other insecticides with efficacy similar to diazinon are registered for peaches and nectarines in these regions, all are already used to the maximum allowable extent during other parts of the growing season, primarily to target incipient moth populations, Japanese beetle (*Popillia japonica*), plum curculio (*Conotrachelus nenuphar*), and the green peach aphid (*Myzus persicae*). Alternatives to the dormant season use of diazinon are horticultural oil and methidathion. Of these, only the latter is equivalent in efficacy to diazinon (D. Horton, personal communication).

Biological impacts of eliminating diazinon in peach and nectarine production

Loss of diazinon as a dormant period treatment in California is likely to result in growers using either chlorpyrifos or methadithion as substitutes. Both provide levels of control similar to that of diazinon, so yield losses would be unlikely due to this change. If more growers rely exclusively on pyriproxyfen, the likelihood of resistance developing in SJS populations may increase. Problems caused by PTB might also increase. However, BEAD believes that this scenario is unlikely because of the high cost of pyriproxyfen (see the economic analysis below for details on cost).

If diazinon use in the post-bloom period in California is eliminated, growers would likely substitute either phosmet or spinosad in its place. Phosmet currently has a five year time-limited registration for both peaches and nectarines. As long as it is available, it will provide growers with good control of moth pests and the other insects mentioned above that are incidentally controlled by diazinon (USDA 1999). Spinosad, however, will only control moth populations effectively. If reliance on spinosad becomes exclusive, a longer term result of diazinon cancellation may be the development of resistance to spinosad, particularly in the widespread populations of OFM and PTB. Loss of post-bloom control of SJS may also result in a reduction in the quality of fruits harvested, which would also lower farmers’ revenue. If phosmet is also removed from use without an equivalent substitute, quality loss due to the other secondary pests mentioned above may also increase. However, BEAD has been unable to find a reliable estimate of such quality losses; therefore, it is impossible to estimate the extent of this impact accurately. As long as dormant season control of the key pest - SJS - remains available, BEAD believes quality losses of this kind should be rare. Indeed, diazinon use as a post-bloom control appears to have been declining in recent years (Mr. R. Coviello, pers. comm.).

Loss of diazinon use as a post-harvest treatment in the eastern U.S. will leave growers with no equivalent chemical control options for scale insects. As in the west, growers will likely turn to spinosad to control moth pests. Eastern growers anticipate registration of pyriproxyfen and the closely related material buprofezin (D. Horton, personal communication). If this occurs, diazinon would have value in that it would provide a way to delay resistance to these newer, reduced risk alternatives. Loss of post-harvest scale control is unlikely to result in significant quality losses in Eastern US crops, but it could allow scale feeding to more rapidly weaken overwintering trees and their fruiting capacity in subsequent seasons. This effect of scales should be mitigated by dormant season control of scales. Nevertheless, we examine the economic impact of long-term scale damage to trees in the sections below.

Economic impacts of eliminating diazinon in peach production

The basis for the economic analysis are crop budgets for peach production, prepared by the University of California Cooperative Extension and the University of Georgia Cooperative Extension. The former is for clingstone peach, a mainly processing peach, while the latter is for a fresh-market freestone variety. Freestone varieties are also cultivated in California, as are nectarines, but the associated crop budgets imply that net returns are negative. Since consistent negative returns are not sustainable and would lead growers to cultivate a different crop, BEAD assumes that returns per acre of clingstone peaches are representative of returns to freestone and nectarines. Further we assume that production costs in Georgia are largely representative of production throughout the Eastern Seaboard and the South. This analysis focuses on net cash returns to peach production, which does not include establishment costs nor land costs and so understates actual payments to the grower.

Per-acre losses, California

Based on the biological assessment, we examined three implications for the cancellation of diazinon for use on peaches. First is the impact for SJS control during the dormant season in California. BEAD believes that growers will replace diazinon with chlorpyrifos, a similar organophosphate that is already widely used and that is cheaper than other alternatives. Second, we examined the impact of diazinon cancellation for post-bloom applications in California, where growers will be obligated to use an alternative pesticide for control of OFM and PTB. Our third scenario is the likely impact on the eastern production region, where diazinon is used for post harvest control of scale and moths. BEAD believes that growers would switch to spinosad for control of the oriental fruit moth; however it will not control SJS and could reduce long-term profits because weakened trees must be replaced more frequently.

Table 4 provides a summary of sample production costs for peach production in California (Hasey, *et al.*, 2000) assuming a dormant spray targeting SJS. Average yields between 1998 and 2000 are 17.4 tons/acre and the price, $232/ton, for gross revenues of $4037/acre (USDA 2001). Insecticide costs are approximately $68/acre, of which an application of diazinon costs $12.71/acre according to EPA data. Chlorpyrifos, which is equally effective as diazinon, costs approximately $19.11/acre. An increase of $6.40/acre represents a 9.4% increase in insecticide costs and a 0.3% increase in total operating costs, including harvest costs. Such an increase in costs lowers net cash returns by 0.4%, from about $1,540/acre to $1,536/acre. Methadithion costs $34.77/acre, substantially more than chlorpyrifos, and using it increases costs by $22.06/acre or 174% over diazinon. Total operating costs would increase by 0.9% and returns would drop to $1520/acre, that is, a decrease of 1.4% in net cash returns. EPA data suggest that pyriproxyfen costs more than $60/acre. If growers were to use it, costs would increase, and net revenues decrease, by almost $50/acre. This represents a loss of 3.2% of net revenues. BEAD assumes that most growers would use chlorpyrifos, the lowest cost option, but even with methadithion, BEAD would characterize such losses as negligible.

Table 4. Gross returns, production costs and net returns to peach production, California, dormant spray for control of SJS.

	Base Scenario diazinon	Alternative chlorpyrifos	% Change
production (tons/acre)	17.4	17.4	0.0
price ($/ton)	232.00	232.00	
gross returns ($/acre)	4036.80	4036.80	0.0
diazinon ($/acre) chlorpyrifos ($/acre)	12.71	 19.11	 50.4
other insecticide costs ($/acre)	55.29	55.29	
total insecticide costs ($/acre)	68.00	74.40	9.4
other pre-harvest costs ($/acre)	1476.50	1476.50	
harvest costs ($/acre)	950.50	950.50	
total operating costs ($/acre)	2495.00	2501.40	0.3
net cash returns ($/acre)	1541.80	1535.40	-0.4

Sources: University of California Cooperative Extension and BEAD calculations.

In California, diazinon is also applied during the growing season, when it is used to control the OFM as well as the second generation of scale insects. Cancellation would likely cause growers to switch to phosmet, so long as it is still available. Phosmet costs approximately $19.19/acre, an increase of $6.48/acre. This represents an increase of about 9.5% of insecticide costs and 0.3% of total variable costs. This cost increase reduces cash returns to $1535/acre or 0.4%. Spinosad costs $28.22/acre, an increase in $15.50/acre, which results in a decline in cash return of 1.0%. Neither option is particularly effective against SJS, which could result in serious declines in fruit quality and prices received. Net cash returns could, therefore, fall substantially more on infested acres.

BEAD was unable to find a reliable estimate of quality losses in peaches, however similar losses were reported to be around 20-25% in pears (McClain, personal communication). Assuming that about 4% of peach production is culled for other uses, such as juice, as noted in Table 2, and that such produce brings a very low price, as in pears, provide us with a gross estimate of possible losses. A shift in utilization of 20% from high-valued processed to cull would lead to losses in gross revenues of over $700/acre, or about 18% of the value of the crop. Combined with the higher insecticide costs for control of the OFM, net revenues could decline by almost 50% on infested acres. Because scale is an occasional pest, growers would not necessarily incur these losses every year. Moreover, the risk of these losses could induce growers to take preventative measures, including increased sprays during the dormant season to insure against possible outbreaks in the growing season. Such measures would reduce, but not eliminate, the possibility of heavy losses.

Table 5. Gross returns, production costs and net returns to peach production, California, growing season spray for control of SJS and OFM.

	Base Scenario diazinon	Alternative phosmet for OFM SJS result in quality losses	% Change
production (tons/acre)	17.4	17.4	0.0
processed	16.7	13.4	-20.0
price ($/ton)	240.50	240.50	
cull (juice)	0.7	4.0	471.4
price ($/ton)	20.00	20.00	
gross returns ($/acre)	4035.00	3302.00	-18.3
diazinon ($/acre) phosmet ($/acre)	12.71	 19.19	 51.0
other insecticide costs ($/acre)	55.29	55.29	
total insecticide costs ($/acre)	68.00	74.48	9.5
other pre-harvest costs ($/acre)	1476.50	1476.50	
harvest costs ($/acre)	950.50	950.50	
total operating costs ($/acre)	2495.00	2501.50	0.3
net cash returns ($/acre)	1540.00	800.50	-48.1

Sources: University of California Cooperative Extension and BEAD calculations.

Some growers in California apply diazinon in both the dormant and growing season; that is, some are struck by both scale and moth pests in a given year. Combined cost increases due to the cancellation could range from $12.88/acre to $37.57/acre and result in a decrease in net cash revenues of 0.8% to 2.4%. These losses do not include gross revenue losses stemming from quality reductions due to scale damage on the fruit.

Per-acre losses, Eastern production region

In the eastern production region, diazinon is used as a post harvest control of moths and scale. Without diazinon, BEAD believes growers will use spinosad for moth control. However, scale will be left uncontrolled until the regular dormant season application. Spinosad is not widely used at this time along the eastern seaboard, which means we do not have good data on application costs. BEAD therefore assumes costs equal to that observed in California, $28.22/acre. This is an increase of $15.72/acre, which represents a 0.8% increase in total operating costs. Net revenues are currently estimated at $487/acre (Mizelle and

Westberry, 1986). The increased costs lower net revenues to $471/acre or a 3.2% decline. Details are shown in Table 6.

Table 6. Gross returns, production costs and net returns to peach production, Georgia, post harvest spray for control of moths.

	Base scenario diazinon	Alternative spinosad	% Change
production (lbs/acre)	7400	7400	0.0
price ($/lbs)	0.326	0.326	
gross returns ($/acre)	2412.40	2412.40	0.0
diazinon ($/acre) spinosad ($/acre)	12.50	28.22	125.8
other insecticide costs ($/acre)	178.40	178.40	
total insecticide costs ($/acre)	190.90	206.62	8.2
other pre-harvest costs ($/acre)	424.50	424.50	
harvest costs ($/acre)	1310.40	1310.40	
total operating costs ($/acre)	1925.80	1941.50	0.8
net cash returns ($/acre)	486.60	470.90	-3.2

Sources: University of Georgia Cooperative Extension and BEAD calculations.

Further, uncontrolled scale infestations can weaken trees and shorten their productive life. This is because scales feed on tree sap (phloem), depriving it of nutrients that enhance overwintering ability. They also may inject salivary toxins and kill tree limbs that could bear fruit the following season (Bentley et al. 2000a). A shorter productive lifespan reduces the income stream growers would normally anticipate from peach production. Establishment costs are estimated at $1800/acre for the first three years before production begins (Mizelle and Westberry, 1986). Growers generally expect to pay off this investment during the first eight years of production, with a yearly amortized cost of $331/acre. This leaves net returns to the grower of around $155/acre for the first eight years and almost $487/acre for the remaining four years of productive life. At an interest rate of 9.5% per year, the net present value (NPV) of this stream of income is worth $1598/acre. NPV is a measure of the investment's immediate worth and is calculated as

$$NPV = \sum_t B_t / (1+r)^t$$

where B_t is the net benefits received in year t and r is the rate of interest. Increased insecticide costs reduce net returns to the grower for the first eight years to $140/acre and $471/acre for remaining years. If scale problems reduce the productive life of the orchard by two years, the net present value of establishing an acre of peaches declines to $1156/acre, or a drop of almost 30%. A lower rate of interest increases the NPV, but percentage decline is relatively insensitive to the interest rate. Such a decline could induce farmers to halt replacement of peach trees and cultivate another crop.

These impacts are largely based on pests and practices in the southeast United States. It is assumed to be broadly representative of conditions along the Eastern Seaboard and across the South. Further, Midwestern states, such as Michigan, are thought to be similar due to the commonality of its pest problems and market goals.

Industry Impacts

Losses to California peach growers due to the cancellation of diazinon are estimated to range from $6.40/acre if chlorpyrifos is used during the dormant period to $6.50/acre with phosmet during the growing season, on those acres having pest problems that are currently targeted by diazinon. Costs could increase by as much as $22/acre if growers have to use methadithion during the dormant season. USDA estimates about 12,800 acres of peaches are treated with diazinon in California. California data for 1999 suggests that about 80% of these, 10,240 acres, are treated during the dormant period. Further, around 3,200 acres were treated during the growing period, including over 600 acres that were treated twice. For the state, industry losses could range from $87,400 to $246,100 per year, out of gross revenues of over $236 million dollars for the state. This does not include losses from diminished fruit quality due to scale outbreaks in the growing season. If all peach acres treated during the growing season faced the losses calculated, $740/acre, losses to California would be over $2.5 million. However, scale problems would be unlikely to occur on all acres currently treated at this time.

Table 7 provides a summary of losses to the peach and nectarine industry in the event that diazinon is cancelled. These losses reflect immediate production costs only and do not include quality losses nor losses in profitability due to shortened tree life, both of which would substantially increase the total impact. However, because scale is a sporadic pest, BEAD cannot make reliable estimates of the number of acres that would actually be affected. Quality losses would affect less than the total acres treated during the growing season in the Pacific region, which could be around 5,600 acres of peaches and nectarines in California, Oregon and Washington. Losses in profitability could impact all 1,600 acres outside the Pacific region, although it is probable that the impact would be substantially less.

Table 7. Peach/Nectarine industry losses from cancellation of diazinon, immediate costs only.

Region	Acres Impacted[1]	Losses per acre[2]	Total Impact
Pacific – peaches[3]	14,200	6.50	92,300
nectarines	8,800	6.50	57,200
Eastern Seaboard	1,100	15.70	17,300
Midwest	200	15.70	3,100
South	300	15.70	4,700
West	80	15.70	1,300

U.S.	24,000		175,900

[1] From Table 3.
[2] From analysis above, Tables 4-6.
[3] Assumes about 6% of acres are treated twice.
Source: BEAD estimates.

Conclusion

Diazinon is currently used as a dormant season spray in California mainly for control of SJS, during the growing season in California for control of OFM, PTB and SJS, and after harvest in the south and east for moth and SJS control. Cancellation of diazinon would likely result in negligible losses to California growers facing dormant season outbreak of SJS because equally effective alternatives, that are only moderately more expensive, are available. Estimated losses range from $6.40 to $22.06/acre, representing 0.4 to 1.4% of net revenues. Similar losses are estimated for growers currently using diazinon during the growing season for control of OFM. However, the alternatives do not provide control of SJS at this time in the season. In cases where scale populations are not controlled by dormant season sprays (BEAD expects this to be an unusual scenario), damaged fruit could result in significantly reduced grower revenues, possibly around 50% , because the fruit would have to be culled. In the east, cancellation of diazinon for post-harvest control of moths and scale would result in minor losses due to higher control costs that lower net revenues by about 3%. However, the alternative is again ineffective against SJS. Left uncontrolled, scale damage weakens trees and could shorten their productive lives. A 30% reduction in anticipated profits might result, which would likely discourage some growers from remaining in the industry.

Because relatively few acres of peaches are treated with diazinon nationally, and particularly in the east, industry-wide losses are expected to be around $176,000, not including quality losses or long-term profitability. Quality losses in California alone could be as much as $2.5 million, although this figure is subject to considerable uncertainty.

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