The Organic Center
for Education & Promotion

Minimizing Pesticide Dietary Exposure Through the Consumption of Organic Food

An Organic Center
State of Science Review

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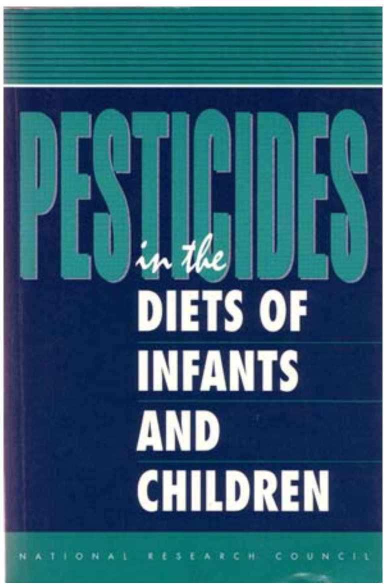


In the United States alone, more than one billion pounds of pesticides are deliberately released into the environment each year. Among these are some of the most dangerous synthetic chemicals manufactured today. Humans are exposed to these pesticides daily through several different routes, including food, drinking water and beverages, air and dust, surfaces inside homes and workplaces, and in public places.

Pesticides are intended to kill or control pests, but they sometimes do more. Many are extremely toxic to non-target organisms ranging from pollinating bees and beneficial insects to birds, fish and earthworms. In mammals, including humans, several widely used pesticides can alter fetal development, impair immune function, and trigger health problems that can take many years, even decades, to develop.

From conception through the first years of life, children are much less able than adults to detoxify most pesticides, and they are highly vulnerable to endocrine disruptors and developmental neurotoxins. During pregnancy, pesticides are transferred to the developing fetus via umbilical fluids. The risk of neurological or behavioral problems following pesticide exposure in the young extends through puberty, as the reproductive and nervous systems, including the brain, continue to grow.

The National Academy of Sciences (NAS) convened a committee of nationally recognized scientists charged with the assessment of the science supporting pesticide regulation in the United States. Its 1993 report *Pesticides in the Diets of Infants and Children* included several sobering conclusions:

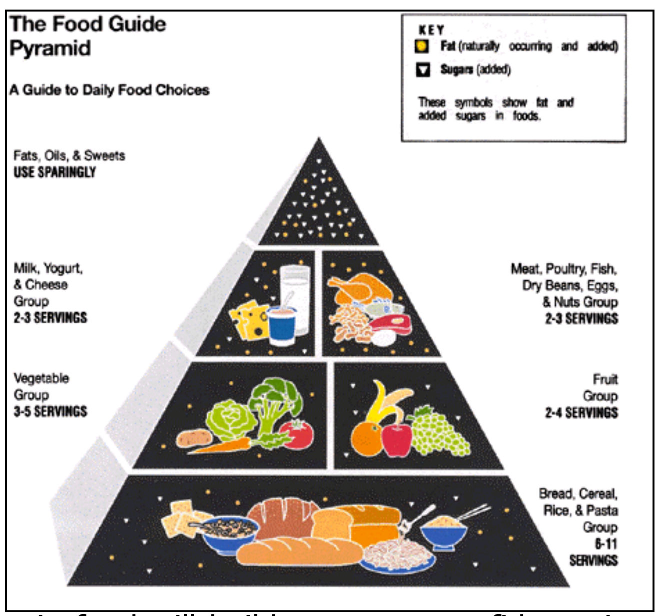
- The most vulnerable segments of the population — pregnant women, infants, and children — face unique and possibly significant developmental and endocrine-system risks from low-level pesticide exposures during critical windows of development, and some exposures may have serious life-long consequences.

- Government pesticide risk assessment models are either too insensitive or were not designed to address many of these unique risks in the course of setting acceptable levels of pesticide exposure through food.
- Pesticide residue data and dietary risk estimates fail to reflect real-world exposures and do not take into account the fact that people are often exposed to multiple pesticides on a given day, sometimes leading to synergistic effects.

Pesticide residues are a part of most meals. More than 80 percent of the 12,600 samples of conventionally grown fresh fruits tested by USDA's "Pesticide Data Program" (PDP) from 1994-1999 contained one or more pesticide residues. Nearly 75 percent of conventional fresh vegetable samples tested positive for pesticides during this same period.

Many consumers are surprised to learn how frequently fresh produce contains pesticide residues. Some examples follow:

- About 45 percent of conventional fruit and vegetable samples contain residues from two or more pesticides.
- The average conventional apple tested in the PDP from 1994-1999 contained residues from three different pesticides.
- USDA tested 530 apple samples in 1996 and found that the odds of buying a bag of apples with nine or more different pesticide residues was as great as selecting a bag with no residues.



Anyone eating more than one serving of fruits and vegetables a day is likely to consume one or more pesticide residues. Those who follow USDA's dietary guidelines — consuming at least "five-a-day" servings of fruit and vegetables — are ingesting six or more pesticides on most days. Public and private sector efforts to substantially increase fresh fruit and vegetable consumption are definitely among the best investments possible to improve public health in America. Reducing the frequency and levels of pesticides in food will build consumer confidence in the safety of fresh produce and is a solid step in the right direction in promoting healthier dietary consumption patterns.

Widely accepted organic farming principles, and the certification rules governing organic farming in most countries, prohibit the use of nearly all synthetic pesticides, including chemical weed killers, insecticides and most fungicides used to control plant diseases. For this reason, many people are turning to organic food as a practical, commonsense way to reduce pesticide health risks. This State of Science Review (SSR) assesses the extent to which consumption of organic food reduces pesticide dietary exposures. Other State of Science Reviews address the developmental, neurological, immunological, and reproductive risks stemming from pesticide exposure, but in general, reducing exposures in food will translate into proportional reductions in risk levels.

One point deserves emphasis. Pesticide risk assessment can rarely prove definitively a direct, causal relationship between pesticide exposure and a specific adverse health outcome that some individual has suffered. But across the population, scientists have concluded that pesticide exposure is a risk factor that increases the chances that certain health problems will occur with greater frequency and/or lead to more serious consequences.

The public will continue to hear conflicting claims about whether there is any reason to worry about pesticide residues in the diet. While scientists work toward more complete and accurate pesticide dietary risk assessments, reducing pesticide exposures across the population remains a sure way to reduce pesticide risks, whatever those risks ultimately prove to be.

Controversies and Conflicting Claims

Three claims often appear in media stories that present contrasting views on the public health benefits stemming from reducing pesticide exposures through consumption of organic food.

1. Because organic farmers are not supposed to spray their crops with synthetic pesticides, the presence of residues in some samples of organic food must mean that at least a portion of organic farmers are not following the rules.

2. Natural pesticides approved for use on organic farms may actually pose dietary risks comparable to the synthetic pesticides used on conventional foods.

3. Pesticide residues found in conventional foods pose essentially no risk, so it should not matter to consumers that organic foods contain relatively fewer residues.

In Section IV below, these claims are repeated and analyzed in light of the data on pesticide residues in food discussed in the body of this State of Science Review.

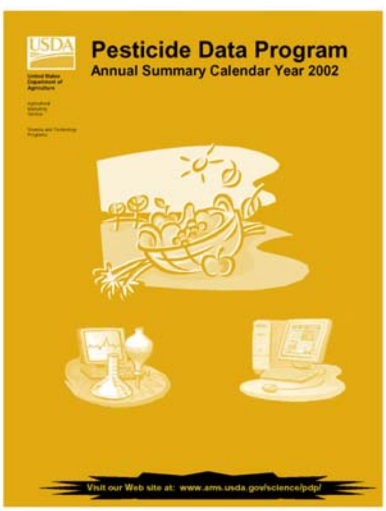
METHODS AND SOURCES OF DATA ON PESTICIDE RESIDUES IN FOOD

More than 100,000 samples of food are tested for pesticide residues annually in the United States. Both state and federal government agencies conduct testing programs, as do many private companies.

Some government residue testing is done to enforce compliance with published tolerance levels. Pesticide tolerances establish the maximum amount of a given pesticide that legally can be present in food. The Food and Drug Administration (FDA) tracks pesticides in food over time through a market-basket-based Total Diet Study.

To improve the accuracy of pesticide dietary risk assessments, Congress started the Pesticide Data Program (PDP) in 1991, under the Agricultural Marketing Service (AMS) of USDA. This program produces a highly accurate set of data on the presence of pesticides in foods. By design, PDP focuses on the foods consumed most heavily by infants and children and food is tested, to the extent possible, "as eaten." (Banana or orange samples are tested without the peel; processed foods are tested as they come out of a can, jar or freezer bag.)

Ten years of PDP testing has greatly enhanced understanding of pesticide residues in the United States food supply. Ten to 15 fresh foods and up to a half-dozen processed foods are tested annually. Some 300-800 samples are tested of each fresh or processed food, although as few as 120 samples have been run of some foods. The sample design strives to reflect the actual composition of the food supply in terms of the origin of food. The number of domestic versus imported samples is roughly proportional to their respective share of annual consumption.



USDA also selects food samples associated with certain market claims, including "organic," "IPM-grown," "No Detectable Residues (NDR)" or "pesticide free." The program goal (not yet nearly achieved) is to sample foods with a market claim roughly in proportion to their occurrence in retail market channels. As a result, PDP results make possible comparisons of the distribution and frequency of pesticide residues in domestic versus imported foods, across food groups, and by market claim.

PDP data are used by EPA in carrying out dietary pesticide risk assessments and have greatly enhanced overall knowledge of the distribution and levels of pesticides in conventional and organic foods.

FREQUENCY AND LEVELS OF PESTICIDES IN CONVENTIONAL AND ORGANIC FOODS

Four factors must be taken into account in comparing pesticide dietary risks in conventional versus organic food:

- **frequency** of residues (measured as the percent of samples tested of a given food that were found to contain one or more residues);
- **number** of samples with multiple residues and the average number of distinct residues in samples with two or more residues;
- **levels** of pesticides found in foods (measured as the mean, or average, level of all positive samples);
- **toxicity** of the pesticides present in foods.

This State of Science Review (SSR) addresses the first three of these four factors. Much information in this SSR is from a detailed analysis of pesticide residue patterns that was published in 2002 in the respected peer-reviewed journal *Food Additives and Contaminants*. The Baker et al. article analyzed the distribution and levels of pesticides in conventional, IPM-NDR and organic foods from the late 1980s through 1999. The three datasets included:

- six years of data from USDA Pesticide Data Program, 1993-1999;
- ten years of data from California Department of Pesticide Regulation (DPR), 1989-1998;
- results from a 1998 Consumers Union (CU) report focusing on four crops (apples, peaches, tomatoes and peppers).

Some major food groups — most oils, dairy, meat and poultry products — contain few detectable pesticides and contribute very modestly to dietary exposure and risk. For example, more than 300 samples of beef muscle were tested by PDP in 2002, and only one sample contained a very low residue of a currently used pesticide (diazinon, at three parts per billion). Some 215 out of 300 samples of beef fat tissue had low levels of long-banned organochlorine (OC) insecticides, particularly p,p'-DDE, a breakdown product of DDT (2002 PDP report, Appendix H). Not a single pesticide residue was found in 154 samples of poultry meat and 155 samples of poultry fat (2002 PDP report, Appendix G). In 2001 testing, milk was also nearly free of pesticide residues, again with the exception of residues of the OC breakdown product DDE p.p' (1998 PDP report, Appendix F).

Frequency of Residues

The Baker et al. article found that nearly three-quarters of the fresh fruits and vegetables consumed most frequently by infants and children in the United

States contain residues, based on both USDA and CU testing. The DPR dataset found residues less frequently because markedly less sensitive analytical chemistry methods were used through most of the sampling period.

Since the Baker et al. article was published, USDA has released three more years of PDP data. The additional data have more than doubled the number of organic fruit samples, which increases statistical confidence in comparisons of residues in organic versus conventional samples. Because there are relatively few organic samples of any given single food, it is appropriate to focus only on the frequency of residues in all fruits together, and for the same reason, all vegetables together.

Table 1. Frequency of pesticide residues in fresh fruits and vegetables by market claim, excluding the residues of banned organochlorines; PDP 1993-2002

	Organic			IPM/NDR			No Market Claim		
	Number Of Samples	Number Of Positives	Percent Positive	Number Of Samples	Number Of Positives	Percent Positive	Number Of Samples	Number Of Positives	Percent Positive
Total Fruits	76	14	18%	73	37	51%	21,807	16,810	77%
Total Vegetables	233	43	18%	151	66	44%	27,000	16,888	63%
Total F&V All Years	309	57	18%	224	103	46%	48,807	33,698	69%

Table 1 presents the findings of PDP testing, based on annual reports issued from 1993-2002. Results from 1993-1999 are from the Baker et al. article. Results for 2000, 2001 and 2002 are from analyses of annual PDP data files carried out by the Organic Center. Table 1 excludes the small number of samples that tested positive only for a banned organochlorine (OC) residue. Since the banned OCs are no longer used by conventional or organic farmers, excluding them from comparisons of residues on conventional and organic food presents a more accurate picture of what farmers are actually applying today as part of pest management systems.

For fruits, vegetables, and all produce tested, the table reports the number of samples tested, the number of positive samples, and the percent of the samples that were positive for one or more pesticides. The first three columns of results cover organic samples; the next three refer to "IPM-grown" or "NDR" (No Detectable Residues) samples; and, the last three report the results for conventional, or "no market claim," samples.

Over this 10-year period, 21,807 samples of conventional fruit were tested. Seventy-seven percent (16,810 samples) contained one or more residues.

Ninety percent or more of the conventional samples of five fruits had one or more residues: apples, nectarines, peaches, pears, and strawberries.

Only 11 peaches out of 562 conventional samples tested in 2002 contained no residues; just six out of 344 nectarines tested in 2000 had no residues. Pineapples were the only fruit that were largely free of residues.

In this same period, pesticides were found much less frequently in organic fruit. Fourteen of 76 samples tested positive, or 18 percent compared to 77 percent in the conventional samples. Hence, residues appeared in conventional fruit samples on average 4.3 times more often than in organic fruit samples.

Fruit labeled as "IPM-grown" or containing "No Detectable Residues" was less frequently contaminated with pesticides than conventional samples, with 51 percent testing positive, compared to 77 percent of conventional samples, but contained residues much more frequently than organic samples.

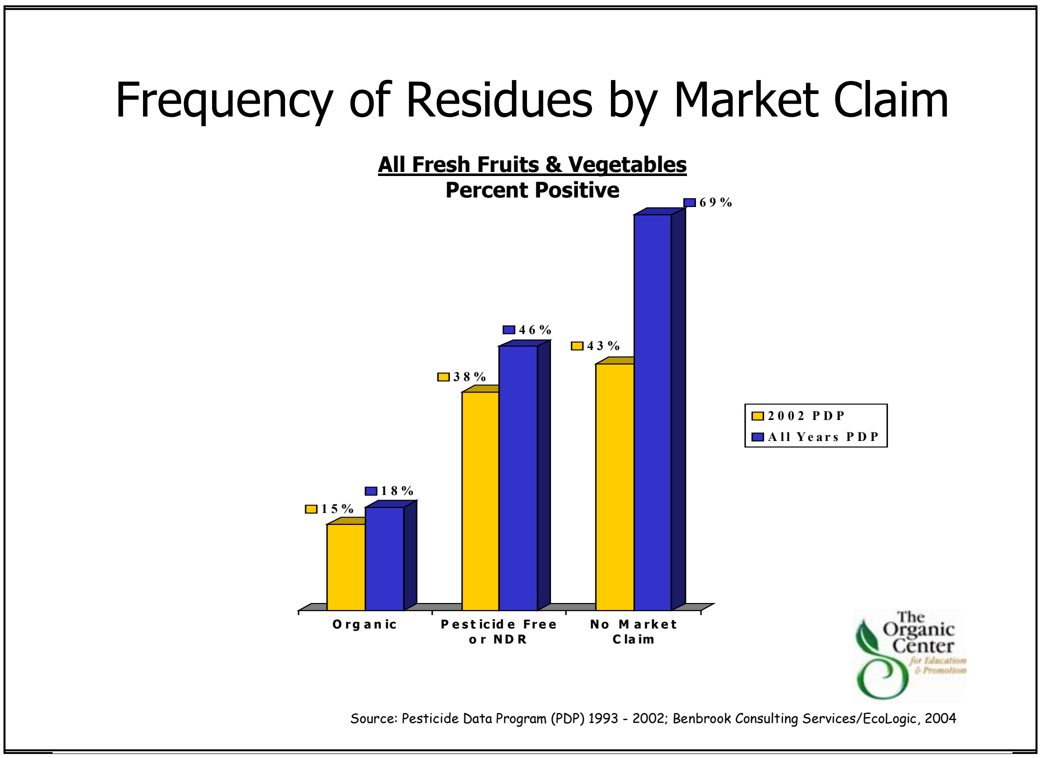


Figure 1. Frequency of Residues by Market Claim

The 1993-2002 PDP dataset contains the results from the testing of 14 organic and conventional vegetable crops. Some 63 percent of the 27,000 samples of conventional vegetables tested positive, while 18 percent of the 233 samples of organic vegetables were positive. Forty-four percent of 151 samples of vegetables labeled IPM-grown or NDR tested positive, significantly less than conventional and significantly more than organic.

Over the 10 years covered by this PDP testing, conventional vegetable samples were 3.5 times more likely to contain one or more residues compared to organic vegetable samples.

Across all fruits and vegetables tested by PDP from 1993-2002, 69 percent of 48,807 conventional samples tested positive for one or more residues, while 18 percent of the 309 organic produce samples had one or more residues. Accordingly, conventional produce contained residues on average 3.8 times more frequently than organic residues.

"IPM-grown" and "NDR" labeled produce contained residues 46 percent of the time, or about 2.6 times more frequently than organic produce. These summary results appear in Figure 1.

In 2002, USDA tested a total of 88 samples of organic foods: eight fruit samples, nine processed food samples, and 71 vegetable samples. Overall, 15 percent of the organic samples tested positive, compared to 43 percent of conventional samples, as shown in Table 2. This table excludes the small number of samples of foods that were found to contain residues of organochlorine insecticides. Among the organic samples, one potato and one celery sample contained an OC residue. Three conventional samples had only OC residues. Appendix Table 1 provides further details on the food-specific results for the categories of food included in Table 2.

Table 2. Frequency of pesticide residues in fruits, vegetables and processed foods by market claim, excluding the residues of banned organochlorines; PDP 2002

	Organic			IPM/NDR			No Market Claim		
	Number Of Samples	Number Of Positives	Percent Positive	Number Of Samples	Number Of Positives	Percent Positive	Number Of Samples	Number Of Positives	Percent Positive
Total Fruits	8	2	25%	0			1,642	869	53%
Total Processed Foods	9	0		1	1	100%	2,533	559	22%
Total Vegetables	71	11	15%	7	2	29%	4,860	2,456	51%
All Foods	88	13	15%	8	3	38%	9,035	3,884	43%

The percent of conventional samples testing positive in 2002 declined compared to earlier years because:

- Only one fruit was tested that typically contains residues (peaches);

- four processed foods were tested, which also tend to contain residues much less frequently than fresh foods; and,
- two vegetables were included that contained very few residues (onions and asparagus).

Seventy percent or more of the conventional samples of peaches, spinach, potatoes, celery, and carrots tested positive for one or more pesticides in 2002 PDP testing. The percent of each of these foods testing positive in 2002 is similar to earlier years when PDP tested the same foods, confirming that the selection of foods in 2002 led to the drop in the overall percent of samples that were positive, rather than a reduction in pesticide use.

Multiple Residues

Many samples of produce tested by USDA contain two or more residues, and remarkably, a few contain 10 or more. The PDP testing protocol calls for the testing of three to five pounds of produce mixed together in a composite sample of individual pieces of fruit or vegetables. Accordingly, when a composite sample is found to contain five residues, this does not necessarily mean that each of the individual pieces of fruit or vegetable in the sample contained all five of the residues detected. On the other hand, it also means that the levels of pesticides that are present on individual pieces of fruit and vegetable are often higher than reported for the composite sample.

Almost half of the conventional fruit and vegetable samples tested from 1994 1999 in the PDP contain two or more residues, as shown in Table 3 (taken from Baker et al.). Seven percent of organic samples had multiple residues. In the testing done by the California DPR, conventional produce was nine times more likely to contain multiple residues than organic samples. Based on the testing by Consumers Union of four crops, conventional samples contained multiple residues 10 times more often than conventional samples. Figure 2 summarizes these findings. In general, soft-skinned fruit and vegetables tend to contain multiple residues more frequently than foods with thicker skins, shells or peels.

Overall, in 2002 PDP testing, about 47 percent of 10,056 fruit and vegetable samples contained two or more residues, and 5.5 percent contained five or more residues (2002 PDP report, Appendix L). Three percent of the 88 organic samples had multiple residues. Accordingly, conventional samples were about 11 times more likely to contain multiple samples than organic produce.

Table 3. Samples containing multiple residues by market claim in three datasets (Table 5, Baker et al., 2002)

	Organic			IPM/NDR			No Market Claim		
	Number Of Samples	Samples with Multiple Residues	Percent Samples with Multiple Residues	Number Of Samples	Samples with Multiple Residues	Percent Samples with Multiple Residues	Number Of Samples	Samples with Multiple Residues	Percent Samples with Multiple Residues
Data Set									
PDP 20 Crops	128	9	7.1%	195	46	23.6%	26,571	12,102	45.5%
DPR 19 Crops	609	8	1.3%	0			34,003	4,055	11.9%
CU 4 crops	67	4	6.0%	45	20	44.4%	68	42	62.0%

PDP results reported in 2001 provide a sense of how vulnerable peaches are to pest damage, as well as how this fruit's soft skin enhances the likelihood that pesticides applied will remain in the fruit at detectable levels. Three conventional peach samples contained 11 residues and seven peach samples had 10 residues, as did two celery samples (2001 PDP report, Appendix L).

A consumer choosing three to five pounds of conventional peaches at the supermarket is more than 11 times more likely to pick fruit with seven or more residues than fruit with no residues. A person buying conventional celery is more likely to purchase produce with five or more residues than celery with one or no residues.

Table 4 allows food-by-food comparisons of the number of residues in organic, "IPM-NDR", and conventional ("no market claim") samples tested by PDP in 2002. This table reports the number of unique residues found in all samples that tested positive for one or more pesticides (third column of data, Table 4). For example, 334 unique residues were found in the 289 samples of apple juice that tested positive. The next two columns report the number of unique residues per sample tested and the number per positive sample. In the case of apple juice, about 40 percent of the conventional samples tested positive and 60 percent contained no residues. The 334 unique residues in apple juice translate, on average, to 0.46 per sample tested (334 unique residues divided by 727 total samples) and 1.16 per positive sample (334 divided by 289).

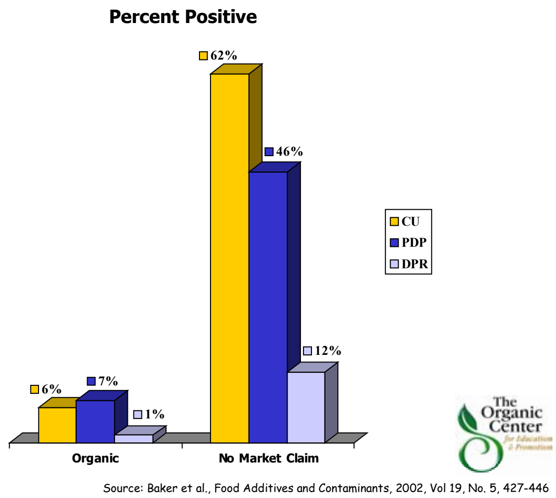


Figure 2. Multiple Residues in Three Datasets

Conventional peaches and celery stand out as the most heavily contaminated foods, by far, as evident in Figure 3. The average positive peach sample contained 4.25 residues and the average positive celery sample had 3.7 residues.

Onions were remarkably clean — only one sample out of 724 contained a single residue. Asparagus was also relatively free of pesticides; only about 10 percent of samples tested contained residues.

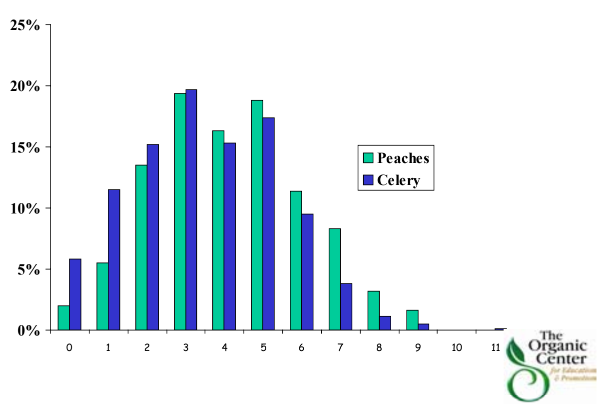


Figure 3. Multiple Residues in Peaches and Celery, 2002 PDP

Table 4. Number of pesticide residues found by market claim and average number of residues in fruits, vegetables and processed foods tested by the USDA's Pesticide Data Program, 2002

		Number of Samples Tested	Number of Positive Samples	Number of Unique Residues Found	Residues per Sample Tested	Residues per Positive Sample
Apple Juice	Organic	2	0	0	0	0
	IPM/NDR	0	0	0	0	0
	No Market Claim	727	289	334	0.459	1.156
Apple Sauce	Organic	0	0	0	0	0
	IPM/NDR	1	1	2	2	2
	No Market Claim	357	172	273	0.765	1.587
Asparagus	Organic	4	0	0	0	0
	IPM/NDR	5	1	1	0.2	0.2
	No Market Claim	699	71	79	0.113	0.113
Banana	Organic	5	0	0	0	0
	IPM/NDR	0	0	0	0	0
	No Market Claim	722	280	291	0.403	1.039
Broccoli	Organic	16	0	0	0	0
	IPM/NDR	1	0	0	0	0
	No Market Claim	720	224	270	0.375	1.205
Carrot	Organic	4	2	4	1	2
	IPM/NDR	0	0	0	0	0
	No Market Claim	550	470	992	1.804	2.111
Celery	Organic	13	5	10	0.769	2
	IPM/NDR	1	1	5	5	5
	No Market Claim	723	687	2,552	3.53	3.715
Mushroom	Organic	3	0	0	0	0
	IPM/NDR	0	0	0	0	0
	No Market Claim	725	449	663	0.914	1.477
Onion	Organic	17	0	0	0	0
	IPM/NDR	0	0	0	0	0
	No Market Claim	724	1	1	0.001	0.001
Peach	Organic	1	1	4	4	4
	IPM/NDR	0	0	0	0	0
	No Market Claim	562	551	2,342	4.167	4.25
Pineapple	Organic	22	1	1	0.045	0.045
	IPM/NDR	0	0	0	0	0
	No Market Claim	358	38	41	0.11	1.079
Potato	Organic	7	6	8	1.143	1.333
	IPM/NDR	0	0	0	0	0
	No Market Claim	363	327	416	1.146	1.272
Spinach	Organic	7	0	0	0	0
	IPM/NDR	0	0	0	0	0
	No Market Claim	356	267	449	1.261	1.682
Sweet Corn, Processed	Organic	2	0	0	0	0
	IPM/NDR	0	0	0	0	0
	No Market Claim	725	29	29	0.04	0.04
Sweet Pea, Processed	Organic	2	0	0	0	0
	IPM/NDR	0	0	0	0	0
	No Market Claim	724	69	91	0.126	1.319

Residue Levels

In PDP testing, some pesticides appear in both the conventional and organic samples of the same food. Baker et al. coined the term "Crop Pesticide Data Pairs," or CPDPs, to refer to such situations when the same pesticide was found in conventional and organic samples of the same food. Comparing the levels of residues appearing in CPDPs is one way to assess differences in the levels of pesticide residues in conventional and organic food.

In 2002 PDP testing, there are 11 pairs of CPDPs for which currently used synthetic pesticide residue levels can be compared, as shown in Table 5. In the case of residues in conventional samples, there typically are many positive samples found, and hence it is appropriate to use the mean of positive samples as the most representative level of the pesticide in that CPDP.

Table 5. Comparison of mean residues in "ORGANIC" and "NO MARKET CLAIM" Crop Pesticide Data Pairs (CPDP) in 5 crops, PDP 2002

		No Market Claim		Organic		Ratio "No Market Claim" Mean Residue to "Organic" Mean
Crop – Pesticide Data Pairs (CPDP)		No. of Positives	Mean Residue (ppm	No. of Positives	Mean Residue (ppm	
Carrot	Iprodione	137	0.04261	1	0.035	1.22
Carrot	Linuron	132	0.09991	1	0.3	0.33
Carrot	Trifluralin	326	0.02363	1	0.028	0.84
Celery	Chlorpyrifos	22	0.00559	1	0.003	1.86
Celery	Chlorthalonil	323	0.39777	2	0.005	79.55
Celery	Piperonyl butoxide	5	0.0362	2	0.0575	0.63
Peach	Dicofol p,p'	30	0.2124	1	0.61	0.35
Peach	Fludioxonil	172	0.36635	1	0.34	1.08
Peach	Phosmet	365	0.08199	1	0.011	7.45
Pineapple	Carbaryl	9	0.04089	1	0.013	3.15
Potato	Chlorpropham	322	2.62484	6	0.32167	8.16
					Average CPDP	**9.51**

In the table, note that there were 137 samples of conventional carrots testing positive for iprodione, which was present at the mean level of 0.043 parts per million (ppm). One organic carrot sample also was found to contain iprodione, at the level of 0.035 ppm. Accordingly, the ratio of the level of iprodione in the conventional versus organic CPDP is 1.22. The ratio in the last column of Table 5 is less than one when the mean level in the organic samples was higher than the mean of positives among the conventional samples. The value is greater than one when the average residue in the conventional samples is greater than the level found in organic samples.

In seven of 11 cases, residues were present in organic food at levels lower than in the corresponding conventional food. In four cases, the residues in the organic food were higher, suggesting possible mislabeling of these foods. On average across these 11 cases, the residue level in conventional samples was 9.5 times higher than in the organic samples. Note the very high ratio value for the celery-chlorothalonil CPDP — 79.5. Even without this case, the average ratio would be 2.5.

Accordingly, for this set of CPDPs, the average residue found in conventional foods exceeds the level in organic samples by several fold. Baker et al. carried out a similar analysis of 22 CPDPs (see Baker et al. Table 7). In 15 cases, the residues found in the organic CPDPs were lower than the corresponding residues in the conventional CPDPs. The authors concluded their analyses of residue levels in conventional versus organic food by saying:

> *"When present, residues in organic foods are likely to be at lower levels than those in non-organic foods." (Baker et al.)*

A Comparison of Pesticide Risk Levels by Country of Origin

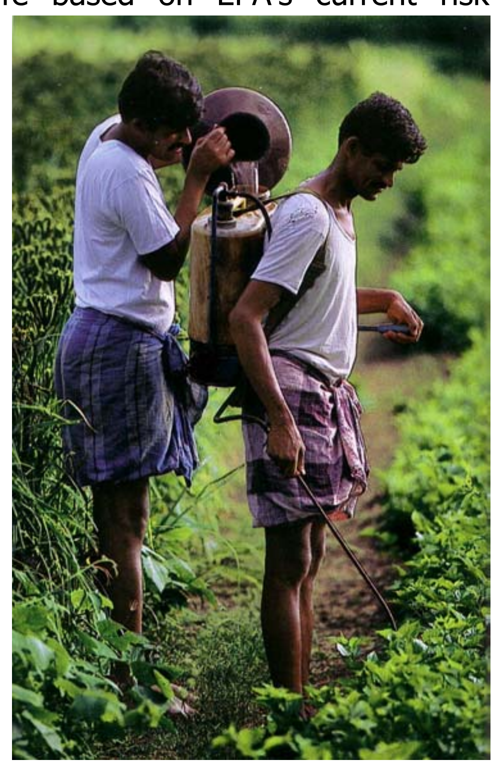
As noted earlier, the USDA Pesticide Data Program tests approximately 600 samples annually of each food in the program, selecting samples from domestic production and imports roughly in proportion to the share of each of national consumption. Accordingly, the PDP provides a basis to compare residue levels in U.S.-grown versus imported organic foods.

The best way to compare residue levels in domestic versus imported organic food samples is to express each residue as a percentage of the chronic Reference Concentration (cRfC) for the pesticide found. The cRfC concept was developed by Consumers Union as a tool to assist in assessment of the impacts of the Food Quality Protection Act (FQPA) (Groth et al., 2001). The cRfC for a given food is the maximum safe level of a pesticide that can be present in the food for a given person. Levels vary accordingly to the weight of the person and how many grams of a food the person consumes in a day. For most of its FQPA analytical work, Consumers Union calculated cRfCs based on a 20-kilogram child (about 44 pounds) consuming a 100-gram portion of a given food in a day (about one medium apple). These assumptions reflect approximately the 90^{th} percentile in the exposure distribution curve (Consumers Union and NRDC). In other words, about 10 percent of children eating a given food on a given day would be expected to consume more grams per kilogram of bodyweight, and 90 percent of the children would consume the same amount or less per kilogram of bodyweight.

As long as a pesticide residue in a given food is below the applicable cRfC level, a child is not exposed to more of the pesticide than the EPA considers safe. But when residues in food are higher than the applicable cRfC, a child consuming the food is exposed to more than his or her personal safe level, just from that single food.

Appendix Table 2 uses the cRfC concept to place into perspective the risks associated with the residues found in 92 positive samples of organic food tested by PDP from 1994-2002. The table lists the food tested, country of origin, e year tested, pesticide found, level found, the pesticide's cPAD (the maximum allowed exposure per day per kilogram of bodyweight), the pesticide's cRfC based on a 20-kilogram child and 100 gram portion size, and the ratio of the residue level found to the cRfC. Any value over one in the last column is a cause for concern, based on how EPA currently evaluates pesticide dietary risks.

Appendix Table 2 ranks the 92 positive samples from the highest ratio in the last column to the lowest ratio. The first sample in Appendix Table 2 is a Mexican sweet bell pepper found to contain the highly toxic OP methamidophos at 0.68 ppm, resulting in a ratio of 34. If a 20-kilogram child consumed 100 grams of these peppers, he or she would be exposed to 34 times more methamidophos than EPA considers safe. Twelve of the 92 positive samples have ratios greater than one, and cannot be defended as safe based on EPA's current risk assessment methods, policies, and data.



Appendix Tables 2a and 2b break out the 92 samples in Appendix Table 2 by country of origin and calculates the average ratio value for the 73 domestic cases and 19 imported cases. The mean ratio for the domestic cases was 0.44 (Appendix Table 2a). Seven out of 73 had a value of one or greater. The maximum value was 7.63 for a domestic peach sample found to contain a dicofol metabolite.

Among the 19 imported cases, the average ratio was a troubling 2.64 — well above EPA's level of concern (Table 6b). Five out of 19 cases had ratio values greater than one, and the maximum value was 34 (the previously mentioned "hot" sweet bell pepper). Accordingly, on average, the residues that have been found by PDP in imported organic samples pose relative risks six times greater than the residues found in domestic organic samples.

High-risk pesticide residues in imported conventional and organic produce are a growing regulatory and public health concern (Groth et al. 2001). Over the last 10 years, the share of pesticide dietary exposure accounted for by domestically grown produce has declined markedly and the share accounted for by imports has risen proportionally. Implementation of FQPA has clearly led to several important changes in applications of high-risk pesticides on U.S. fruit and vegetable farms, but far fewer changes overseas. Table 6 drives this point home. It shows the 15 samples of peaches found to contain the highest levels of chlorpyrifos in 2002 PDP testing by country of origin, ranked from the highest residue level found to the fifteenth highest. Appendix Table 3 ranks all 194 peach samples tested by the PDP in 2002 by level of chlorpyrifos found; the dominance of imported samples at the high end of the residue distribution is clear.

Table 6. Chlorpyrifos residues in peaches by country of origin and ranked by residue level, 2002 PDP

Rank	Country	Market Claim	Residue Level
1	Chile	No Market Claim	0.079
2	Chile	No Market Claim	0.078
3	Chile	No Market Claim	0.071
4	Chile	No Market Claim	0.056
5	Chile	No Market Claim	0.049
6	Chile	No Market Claim	0.048
7	Chile	No Market Claim	0.047
8	Chile	No Market Claim	0.046
9	Chile	No Market Claim	0.045
10	Chile	No Market Claim	0.043
11	Chile	No Market Claim	0.042
12	Chile	No Market Claim	0.038
13	Chile	No Market Claim	0.037
14	US	No Market Claim	0.036
15	Chile	No Market Claim	0.036

There were 194 positive peach samples out of 563 tested, or 34.5 percent. There were 276 domestic samples and 286 imported samples, 283 from Chile and one of unknown origin (PDP 2002 annual report, Appendix B). Thirty-four positive samples were from U.S.

production, so 12.3 percent of domestic samples were positive. There were 160 positive imported samples, or 56 percent positive. The distribution of residue levels is even more dramatically skewed. Ninety-four of the highest 100 samples, ranked by residue level, were from Chile, and only six were grown in the United States. The highest 15 samples were all from Chile.

Accordingly, when EPA carries out a risk assessment of chlorpyrifos in peaches, by far the majority of risks stem from residues in imports.

This is not an isolated case. The same pattern was found with another major risk driver — dimethoate in fresh grapes, where again the vast majority of the top 100 residues were from Chile (data not presented). In some cases, residues in domestic production pose greater relative risks than residues in imports, but increasingly, the opposite is true.

Pesticide Residues in Organic Food

Certified organic food may not be treated with synthetic pesticides, so why do residues of synthetic pesticides sometimes appear on organic food?

Pesticides are ubiquitous and mobile across agricultural landscapes. Most positive organic samples contain low levels of pesticides that were sprayed on nearby conventional crops.

Pesticides applied on conventional crop acreage sometimes drift in the air and settle onto the plants growing on nearby organic farms. When some pesticides are applied using airplanes and "Ultra-low Volume" formulations, as little as 25 percent of the applied pesticides settle on the target crops, while three-quarters drifts off site. When pesticides are applied using ground equipment on days with modest to moderate winds, losses of 25 percent or more via drift are common.

Irrigation water also moves across agricultural landscapes, picking up pesticide contamination along the way. When irrigation water contaminated with low levels of pesticides is applied on an organic field, organic crops are sometimes contaminated. Pesticides are also carried in dust blowing from one field to another, and sometimes move in fog.

A portion of synthetic pesticide residues detected in organic foods is from organochlorine (OC) insecticide residues in the soil. OCs such as DDT, dieldrin, chlordane and toxaphene, and their breakdown products, are highly persistent in the soil and can still be detected in certain fields despite not being applied for 20 or more years. Certain crops, like squash, melons, cucumbers, carrots, potatoes and spinach, often take up soil-bound OC residues. For this reason, some organic certifiers and baby food companies require growers to test soils for OCs, a simple and affordable measure to avoid planting crops known to soak up OC residues in contaminated fields.

OC residues also find their way into animal forages and grain fed to animals, and hence sometimes appear in meat, eggs and dairy products, as noted in the discussion above about the relative absence of residues in animal products in recent PDP testing.

When residues of synthetic pesticides do show up on organic foods, the levels are on average lower than corresponding residues in conventional food. The National Organic Program (NOP) rule calls upon certifiers to investigate cases where a residue of a synthetic pesticide appears on organic food at a level equal to or greater than 5 percent of the applicable EPA tolerance. NOP adopted this policy to prevent organic farmers from loss of certification over incidental environmental contamination with pesticides not actually applied on their farms.
Table 7 provides insights into possible explanations for the presence of residues in the organic food samples tested as part of the PDP in 2002. Thirty cases are

included in this table. Columns report the food, chemical found, and origin of each sample, as well as the residue level found. In addition, EPA tolerance is reported and the ratio of the residue level found to 5 percent of EPA tolerance.

Table 7. Overview of organic samples with positive residues, 2002 PDP

Crop – Pesticide Data Pairs (CPDP)		Origin	State or Country	Concentration (ppm)	EPA Tolerance	Ratio of Residue Found to 5% of EPA Tolerance	Mean Residue Level (All Samples)	Ratio of Residue Found in Organic Samples to Mean of All
Carrot	**Linuron**	**Domestic**	**Unknown**	**0.3**	**1**	**6.0**	**0.09991**	**3.0**
Peach	**Dicofol p,p'**	**Domestic**	**Unknown**	**0.61**	**10**	**1.22**	**0.2124**	**2.87**
Celery	Acephate	Domestic	Unknown	0.25	10	0.5	0.1091	2.29
Celery	Piperonyl butoxide	Import	Mexico	0.065			0.0362	1.8
Celery	Methamidophos	Domestic	Unknown	0.018	1	0.36	0.0104	1.73
Apple Sauce	Thiabendazole	Domestic	Unknown	0.36	10	0.72	0.21035	1.71
Celery	Oxamyl	Domestic	Unknown	0.048	3	0.32	0.03135	1.53
Celery	Piperonyl butoxide	Import	Mexico	0.05			0.0362	1.38
Carrot	Trifluralin	Domestic	Unknown	0.028	1	0.56	0.02363	1.18
Potato	**Dieldrin**	**Domestic**	**Unknown**	**0.01**	**0.1**	**2.0**	**0.01**	**1.0**
Potato	DDE p,p'	Domestic	Unknown	0.012	1	0.24	0.01215	0.99
Peach	**Fludioxonil**	**Domestic**	**Unknown**	**0.34**	**5**	**1.36**	**0.36635**	**0.93**
Celery	Dicloran	Domestic	Unknown	0.36	15	0.48	0.39244	0.92
Celery	Chlorthalonil	Domestic	Unknown	0.35	15	0.47	0.39777	0.88
Carrot	DDE p,p'	Domestic	Unknown	0.012	3	0.08	0.01407	0.85
Carrot	Iprodione	Domestic	Unknown	0.035	5	0.14	0.04261	0.82
Peach	Dicofol o,p'	Domestic	Unknown	0.17	10	0.34	0.2124	0.8
Celery	Chlorpyrifos	Domestic	CA	0.003	0.1	0.6	0.00559	0.54
Potato	Chlorpropham	Domestic	Unknown	1.1	50	0.44	2.62484	0.42
Apple Sauce	Diphenylamine (DPA)	Domestic	Unknown	0.017	10	0.03	0.05324	0.32
Pineapple	Carbaryl	Import	Mexico	0.013	2	0.13	0.04089	0.32
Potato	Chlorpropham	Domestic	WA	0.46	50	0.18	2.62484	0.18
Asparagus	Chlorpyrifos	Import	Peru	0.006	5	0.02	0.039	0.15
Peach	Phosmet	Domestic	Unknown	0.011	10	0.02	0.08199	0.13
Potato	Chlorpropham	Domestic	WA	0.16	50	0.06	2.62484	0.06
Potato	Chlorpropham	Domestic	Unknown	0.11	50	0.04	2.62484	0.04
Potato	Chlorpropham	Domestic	Unknown	0.065	50	0.03	2.62484	0.02
Potato	Chlorpropham	Domestic	Unknown	0.035	50	0.01	2.62484	0.01
Celery	Chlorthalonil	Domestic	Unknown	0.005	15	0.01	0.39777	0.01
Celery	Chlorthalonil	Domestic	CA	0.005	15	0.01	0.39777	0.01

There are four cases in bold type in the column "Ratio of Residue Found to 5% of the EPA Tolerance." In these four cases, the ratio is greater than one. If these tests had been done after the implementation of the NOP on October 21, 2002 and if the certifier had tested this food or been aware of the PDP finding, the certifier would have been required to investigate and account for the presence of residues at these levels. In 26 other cases, the NOP standard would not have required an investigation, even if the certifier were aware of the residues.

Table 7 also sheds light on whether the NOP policy is likely to work as intended in protecting organic farmers from loss of certification as a result of incidental contamination. The last two columns report the mean residue level found in conventional samples for the same pesticide-food combination, and the ratio between the residue found in an organic sample and the mean of the positives in the corresponding conventional food samples. Any value greater than one represents a case where the residue level in the organic sample was higher than the average level in conventional food — a likely sign of laboratory error, inadvertent mislabeling, problems with chain of custody, or fraud.

In fact, any value in the last column greater than 0.5 is likely a sample where the pesticide had been sprayed on the organic crop. While applicator error and wind conditions might explain a few of these cases, in the majority of the 18 cases with ratios greater than 0.5, it is likely that the pesticide was used on the organic field in much the same way as it had been applied on nearby conventional farms.

In cases where the ratio in the last column in Table 7 is less than 0.2, such food probably was not sprayed with the pesticide. The residues detected in these nine organic samples likely reflect incidental contamination over which the organic farmer had little control. So, based on 2002 PDP testing, it appears that about one-third of the residues found in organic food were the result of incidental environmental contamination, and two-thirds resulted from laboratory or chain of custody error, mislabeling, or fraud. Beginning with the 2003 crop, it is likely that there will be incremental progress in reducing the incidence of residues in organic food due to chain of custody error, mislabeling and/or fraud as a result of the implementation of the NOP, especially if ample resources and focus are invested in enforcement.

Clearly, some organic samples tested by PDP were actually intensively sprayed conventional samples. One organic peach sample tested positive for four residues, with three of the four residues at levels consistent with use in conventional orchards. Five organic celery samples contained, on average, two residues each. Eight of the 10 residues found were at levels consistent with pesticide use on conventional fields.

The single organic peach sample, the five organic celery samples with an average of two residues, and samples contaminated with OC residues account for 10 of the 18 cases with ratio values greater than 0.5. Devising a routine pesticide surveillance program capable of detecting samples of conventional food that are being shipped and sold as organic remains an important challenge for the USDA and the organic community.

Natural and Biochemical Pesticides Allowed in Organic Production

Under current laws and principles governing organic farming around the world, organic farmers are permitted to apply non-synthetic pesticides including sulfur, horticultural oils, botanical insecticides, *Bacillus thuringiensis* (*Bt*) and several other microbial pesticides, azadirachtin (neem), the new bioinsecticide spinosad, soaps, repellants, natural plant growth regulators, and pheromones. Sulfur, horticultural oils and copper-based fungicides are among the most frequently and heavily used pesticides on both organic and conventional produce farms. These pesticides are used in similar ways for comparable reasons on organic and conventional fruit and vegetable farms.

Several natural pesticides are very important to organic growers but are applied at very low rates per acre, and hence the total number of pounds of pesticides applied of these products is small compared to sulfur, oils and copper fungicides. Appendix Table 4 provides an overview of the use of most pesticides approved for application on certified organic farms. The table lists pesticide name, pesticide type, most recent year when USDA collected use data, percent of crop acres treated, average rate of application per acre and pounds applied. Essentially all of the pesticides in Appendix Table 4 are used on both organic and conventional farms, and for all the high-volume pesticides in the table, the majority of use by far is on conventional crop acres.

Appendix Table 4 makes clear that the volume of many of the natural pesticides predominately used on organic farms is relatively modest. Nationwide, farmers applied just slightly more than 1,000 pounds of the important bioinsecticide azadirachtin, and just a few hundred pounds of several microbial and pheromone-based products. In contrast, far more than 1,000 pounds of a common herbicide like atrazine are applied in a small corner of a single county anywhere in the Midwest where substantial acreage of corn is produced.

While there were once several relatively toxic botanical insecticides approved for organic production, only three remain in relatively common use — pyrethrin, rotenone and sabadilla. A survey of organic farmers carried out by the Organic Farming Research Foundation (OFRF) found that only 9 percent of 1,045 organic farmers applied botanicals regularly (mostly pyrethrin and neem), and that 52 percent never use them, 21 percent use them rarely, and 18 percent "on occasion." Sabadilla is no longer registered for any crop uses other than citrus.

Pesticides containing botanicals tend to degrade rapidly after spraying. Pyrethrin breaks down within 24 hours in most circumstances and within two days in nearly all applications. Rotenone and sabadilla are somewhat more field stable, but only last a few days to a week before degrading. In addition, these botanicals are applied at very low rates. As shown in Appendix Table 4, rotenone is applied at less than one one-hundredth pound per acre per application on most crops and its maximum use rate reported by USDA is 0.1 pound per acre of eggplant. The highest rate of application of pyrethrin is 0.01 pound per acre and the highest use rate of sabadilla is 0.02 pound per acre. In contrast, organophosphate (OP) insecticides are applied to control many of the same insects that botanicals are used to control, but are applied at 50- to 100-times higher rates per acre, and OP residues can last on produce for weeks or months.

Detectable residues of botanicals on harvested crops are exceedingly unlikely because of the combination of very low use rates and quick degradation. This is why EPA has exempted botanicals from the requirement for a tolerance. Nearly all other natural pesticides also pose essentially no dietary risk. No governments test for residues of sulfur or copper-based fungicides because both elements are micronutrients that are essential for a range of cell functions, and because the levels consumed as residues in food do not appreciably add to the levels that naturally occur as part of a normal diet.

Several other natural pesticides allowed for use on organic farms have been deemed "generally recognized as safe" by the Food and Drug Administration, and are sometimes used as food additives. Acetic acid (vinegar) and soaps are examples.

The new and highly effective bioinsecticide spinosad is the only natural pesticide widely used by organic (and conventional) farmers that is known to leave detectable levels of residues on some crops. For example, 31 percent of nectarines were treated with spinosad in 2001 and residues were found by the PDP program in 13.5 percent of 259 nectarine samples tested. But risks were deemed modest given that the residues detected were low, ranging from 0.006 to 0.029 part per million, especially when coupled with spinosad's low mammalian toxicity.

The EPA has determined that there is a "reasonable certainty of no harm" following long-term exposure to spinosad below 0.0268 mg/kg/day (milligrams per kilogram of bodyweight per day). A conventional acre that is treated with spinosad reduces the use of much higher-risk OP and carbamate insecticides. The EPA-set maximum long-term exposure level for high-risk OPs and carbamates is 0.0001 mg/kg/day or less. Accordingly, spinosad is more than 268-times less toxic, ounce-for-ounce, than the insecticides it often replaces on conventional farms.

International Testing of Organic Food for Pesticide Residues

In recent years other countries have started to test for pesticide residues in organic food. The British Pesticide Residue Committee started sampling of organic foods in 2001, following protocols similar to the USDA PDP but using somewhat less sensitive analytical methods. Table 8 reports the frequency of residues found in conventional versus organic samples of the same food.

Out of 1,772 samples of conventional fruit-based foods tested, 48 percent had residues, while only 7 percent of the corresponding organic fruit samples contained residues (out of a total of 59 tested). Conventional fruit samples were 6.8 times more likely to test positive than organic samples.

Table 8. Frequency of positive conventional and organic samples in foods tested by the British Pesticide Residues Committee, 2001-2003

	Conventional			Organic		
	Total Samples	Total Positives	Percent Positive	Total Samples	Total Positives	Percent Positive
Fruit	1,888	929	50%	60	4	7%
Grain Related	239	101	42%	17	0	
Infant Food	343	24	7%	131	1	1%
Meat/Milk Based	1,421	145	10%	137	3	2%
Other	168	12	7%	10	0	
Processed Foods	1,039	330	32%	37	2	5%
Vegetable	1,768	497	28%	74	4	5%

In grains, U.K. testing found that 42 percent of 239 samples had residues, while none of the 17 organic samples had residues.

Conventional baby food was seven times more likely to contain residues than organic baby food.

Among processed foods tested, 5 percent of organic samples contained residues compared to 32 percent of conventional samples.

Seventy-four samples were tested of organic vegetables, with only 5 percent testing positive, compared to 28 percent of conventional samples.

The British test results can also be used to assess differences in residue levels in crop pesticide data pairs, providing insight into the levels of pesticides found in conventional versus organic food. Table 9 covers the eight CPDPs identified in U.K. testing from 2001-2003. The average ratio of residue levels found in conventional samples compared to corresponding organic samples is 6.2.

The percentages of samples found to contain residues in U.K. testing are lower across the board than PDP results, in all likelihood because less sensitive analytical methods were used. But overall, the patterns of residues found in the U.K. testing of conventional and organic foods are similar to the patterns evident in U.S. test results.

Recently, the Department of Primary Industries, an agency of the state government of Victoria, Australia, released a report on pesticide residue tests carried out in 2002 and 2003 focusing on certified organic foods. The research team determined that a sample size of 300 would provide a 95 percent confidence limit that at least one violative residue would be detected if the overall violation rate is at least 1 percent.

Table 9. Comparison of organic and conventional mean residues found in eight Crop Pesticide Data Pairs tested by the British Pesticide Residues Committee, 2001-2003

Crop - Pesticide Data Pair (CPDP)		Conventional		Organic		Ratio
Crop/Food	Pesticide	Number of Positives	Mean of Positives	Number of Positives	Mean of Positives	
Cereal Bars	Chlormequat	61	0.2664	2	0.2	1.3
Citrus, soft	Imazalil	69	1.91	1	0.1	19.1
Citrus, soft	2-phenylphenol	23	0.81	1	0.3	2.7
Cucumbers	Dithiocarbamate	10	0.17	1	0.1	1.7
Dried Fruit	Procymidone	17	0.218	2	0.01	21.8
Infant Food	Hydrogen phosphide	9	0.0013	1	0.006	0.2
Mushrooms	Chlormequat	6	0.26	1	0.2	1.3
Potatoes	Oxadixyl	22	0.039	1	0.03	1.3
					AVERAGE RATIO	**6.2**

About two-thirds of the 300 samples tested were vegetables and herbs, another one-third were fruits, and 4 percent of the samples were cereals and oilseeds. The analytical methods were able to detect common organophosphate, OC, synthetic pyrethroid, and carbamate insecticides, as well as triazine herbicides. The methods used were able to detect only one fungicide, iprodione.

Out of the 300 samples of organic food tested, only two contained a pesticide residue. One sample of cantaloupe was positive for dieldrin, a long-banned OC. One sample of apples contained the post-harvest fungicide iprodione at the very low level of 0.054 ppm. The certifying organization traced the sample back to the farmer and determined that organic fruit had been stored in wooden crates that had previously been used to store iprodione-treated fruit.

In the discussion section of the Department of Primary Industries report, the authors wrote:

> *"This new research on Victoria-grown, certified organic and biodynamic produce supports organic industry claims of clean produce and provides statistically valid data that organic produce is virtually free of chemical residues." (DPI report)*

PROVEN BENEFITS OF ORGANIC FARMING SYSTEMS IN REDUCING PESTICIDE RESIDUES IN FOOD

Extensive and highly sensitive pesticide residue testing carried out by the U.S. Department of Agriculture shows that conventional fresh fruits and vegetables are:

- three to more than four times more likely on average to contain residues than organic produce;
- eight to 11 times more likely to contain multiple pesticide residues than organic samples;
- shown to contain residues at levels three to 10 times higher, on average, than corresponding residues in organic samples.

Accordingly, seeking out organic fruits and vegetables offers consumers an option proven to significantly reduce dietary exposure to pesticides. For many people on most days, consumption of organic fruits and vegetables will virtually eliminate dietary exposure to pesticides and this will, in turn, reduce the frequency and magnitude of one risk factor that can contribute to a variety of diseases and health problems.

The opportunity to nearly eliminate pesticide exposure via the diet by consuming organic food is borne out by extensive testing in both the United States and countries abroad.

A few conventional fruits and vegetables are heavily contaminated with pesticides, including some foods that are frequently consumed by infants and children:

Fruits	Vegetables
Apples	Celery
Pears	Spinach
Peaches	Sweet Bell Peppers
Nectarines	
Strawberries	
Cherries	

Multiple pesticide residues are commonly found in these nine fruits and vegetables. Samples with no residues are uncommon, and in some cases, rare. The pesticide risk reduction benefits of seeking out and consuming certified organic apples, pears, peaches, strawberries, cherries, celery, spinach and sweet bell peppers are particularly significant, especially for woman of childbearing age and infants and children.

In general, the pesticide residues found in imported organic produce raise more significant risk concerns than the residues found in U.S.-grown samples. On average, the residues that have been found in recent USDA testing of imported organic samples pose relative risks six times greater than the residues found in domestic organic samples. With the implementation of the NOP as of October 21, 2002, all imported produce must meet the requirements of the NOP in order to be sold as organic in the United States. Certifying organizations may need to more aggressively assess pest management systems and pesticide use by organic farmers abroad to avoid problems. If substantial differences emerge in the frequency and levels of pesticides in imported produce in contrast to U.S. grown produce, the USDA will need to focus more attention on pest management and pesticide use-related certification procedures in the accreditation process.

Perspectives on Controversies and Conflicting Claims

The focus statement at the beginning of this document noted three claims that reflect different views on the public health benefits stemming from reducing pesticide exposures through consumption of organic food. Here, we draw upon evidence presented in this State of Science Review in addressing these controversies and conflicting claims.

Claim 1. *Because organic farmers are not supposed to spray their crops with synthetic pesticides, the presence of residues in some samples of organic food must mean that a portion of organic farmers are not following the rules.*

This argument indirectly questions the integrity of organic farmers, as well as the ability of certifiers, state programs and now, the USDA, to effectively enforce the pesticide use restrictions imposed by the National Organic Program rule. While farm-level compliance is not perfect and more effort is needed in the enforcement of the national rule's pesticide provisions, other factors almost certainly account for the majority of cases where a synthetic pesticide residue is found on or in certified organic food.

Pesticides sometimes drift in the air from a conventional field over onto an organic field. Just as organic farmers cannot protect their crops from genetically engineered pollen blowing in the wind, organic crop fields are vulnerable to synthetic pesticides in the ambient environment. As much as three-quarters of the pesticides applied by air onto crops drift elsewhere; regardless of how a pesticide is applied, drift losses less than 10 percent are uncommon. Pesticides can also be carried in dust blowing from one field to another, and sometimes move in fog.

Some of the most common residues found in certain organic foods are organochlorine insecticides like DDT, dieldrin, chlordane and toxaphene, or their breakdown products. These insecticides were banned for most food uses years ago and have not been applied by ***any*** farmers in the United States for decades. But OCs are very stable in the soil and are still picked up by certain plants. Some organic certifiers have, in the past, required farmers to test their fields for OC residues bound to soil, in order to avoid the planting of crops known to pick up OC residues in contaminated fields. But this precautionary step has not been widely adopted, and hence some organic root and vegetable crops contain OC residues.

Irrigation water is another potential source of pesticide "drift" onto organic farms. But documentation of pesticide contamination of organic crops from irrigation water does not exist. Because of the substantial dilution that occurs when pesticides enter rivers and irrigation canals, it is unlikely that pesticide contamination of organic crops by irrigation water is a significant problem.

Last, post-harvest handling and storage sometimes leads to cross-contamination of organic food. Residues of pesticides can remain on packing equipment and in storage bins. Pesticides applied post-harvest in packing sheds and storage facilities can move to areas where organic foods are stored or processed.

Claim 2. *Natural pesticides approved for use on organic farms may actually pose dietary risks comparable to the synthetic pesticides used on conventional food.*

The National Organic Program has approved a number of pesticides containing natural ingredients for use by certified organic farmers (e.g., sulfur, oils, soaps, copper-based fungicides, botanical insecticides, insect pheromones, the microbial insecticide *Bacillus thuringiensis*). Residues of some of these natural substances, particularly sulfur, are common on fruits and vegetables, whether produced on an organic or conventional farm.

The government does not routinely test for natural pesticides in conventional or organic food, and EPA has not conducted detailed risk assessments on most natural pesticides. Lack of government focus reflects the widely accepted conclusion among regulatory authorities in the United States and internationally that most natural pesticides pose essentially no risk to people through residues in food. The active ingredients in several natural pesticides are common household products (e.g., soaps, vinegar and pepper) and/or have been determined by the Food and Drug Administration (FDA) to be "generally recognized as safe," (GRAS) (e.g., cinnamon extract, boric acid). Some are essential micronutrients that the body needs to survive (e.g., sulfur and copper).

Given the lack of testing for natural pesticides, there is no way to definitively disprove the claim that natural pesticide residues in organic food are as hazardous to people as the synthetic chemical residues in conventional food. For the same reason, there is no evidence in support of the claim and indeed, there is much evidence that strongly suggests it is groundless.

While a few botanical pesticides are relatively toxic, only two of these, the insecticides pyrethrin and rotenone, are still used to any significant extent in agricultural production. Use of a third botanical, sabadilla, is now limited to just citrus production. Because of thick peels on citrus fruits, residues of sabadilla in the edible portions or juices of oranges, lemons, and grapefruit are extremely unlikely. Botanical insecticides are applied annually on a small percent of organic and conventional crop acreage and at very low rates per acre (less than one-tenth of a pound per acre). In addition, they are unstable once exposed to sunlight and degrade within a few days under most conditions. For these reasons, the assertion that botanical pesticide residues in organic foods pose risks as great as synthetic pesticide residues in conventional food can be dismissed.

Claim 3. *Pesticide residues found in conventional food pose essentially no risk, so it should not matter to consumers that organic food contains relatively fewer residues.*

Scientists who study pesticide risks in the diet generally agree that the levels of pesticide residues in conventional food rarely pose significant risks to healthy adults who are not chemically sensitive to pesticides. But scientists also agree that the developing fetus in pregnant women, infants and children, those occupationally exposed, and people with compromised immune systems are vulnerable to health problems following exposures to synthetic pesticides. In most cases, pesticides are probably not the ***sole*** cause of a developmental or health problem, but are one of several risk factors that, in combination, trigger minor to serious illness or developmental problems in otherwise healthy people.

As stressed throughout this State of Science Review, the degree to which organic food reduces pesticide dietary risks compared to conventional food is a function of the frequency of residues in food, the number of residues in a given sample of food, the average levels of residues present in food, and the relative toxicity of pesticides found in conventional and organic food. Fortunately, extensive data are available to quantify most of these differences. For vulnerable population groups, especially infants and children, the differences are significant and promise measurable public health benefits.

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Guide to Acronyms

AMS	Agricultural Marketing Service
cPAD	Chronic Population Adjusted Dose (Maximum allowed exposure per day per kilogram of bodyweight)
CPDP	Crop Pesticide Data Pairs
cRfC	Chronic Reference Concentration
CU	Consumers Union
DPR	California Department of Pesticide Regulation
EPA	Environmental Protection Agency
FDA	Food and Drug Administration
FQPA	Food Quality Protection Act
GRAS	Generally Recognized as Safe
IPM	Integrated Pest Management
IPM-NDR	Integrated Pest Management-No Detectable Residue
NAS	National Academy of Sciences
NDR	No Detectable Residues
NOP	National Organic Program
OC	organochlorine
OFRF	Organic Farming Research Foundation

OP	organophosphate
OTA	Organic Trade Association
PDP	Pesticide Data Program
SSR	State of Science Review
USDA	United States Department of Agriculture

Appendix Table 1. Frequency of pesticide residues in fruits, vegetables and processed foods by market claim, excluding the residues of banned organochlorines: PDP 2002

	ORGANIC			IPM/NDR			NO MARKET CLAIM		
	Number of Samples	Number of Positives	Percent Positive	Number of Samples	Number of Positives	Percent Positive	Number of Samples	Number of Positives	Percent Positive
FRUITS									
Pineapple	2	1	50%			0%	358	38	11%
Peaches	1	1	100%			0%	562	551	98%
Banana	5					0%	722	280	39%
TOTAL FRUITS	**8**	**2**	**25%**				**1,642**	**869**	**53%**
PROCESSED FOODS									
Apple Sauce				1	1	100%	357	172	48%
Sweet Pea, Proc	5					0%	724	69	10%
Sweet Corn, Proc	2					0%	725	29	4%
Apple Juice	2					0%	727	289	40%
TOTAL PROCESSED FOODS	**9**			**1**	**1**	**100**	**2,533**	**559**	**22%**
VEGETABLES									
Spinach	7					0%	356	252	71%
Potato	7	5	71%			0%	363	327	90%
Onion	17					0%	724	1	0%
Mushroom	3					0%	725	449	62%
Celery	13	5	38%			0%	723	687	95%
Carrot	4	1	25%	1	1	100%	550	445	81%
Broccoli	16			1		0%	720	224	31%
Asparagus	4			5	1	20%	699	71	10%
TOTAL VEGETABLES	**71**	**11**	**15%**	**7**	**2**	**29%**	**4,860**	**2,456**	**51%**
ALL FOODS	**88**	**13**	**15%**	**8**	**3**	**38%**	**9,035**	**3,884**	**43%**
TOTAL 2002 PDP		**13**	**15%**	**8**	**3**	**38%**	**9,035**	**3,884**	**43%**

Appendix Table 2. Ratio of residue level found to chronic reference concentration (cRfC) for positive organic samples, PDP 1994-2002

Commodity	Country of Origin	PDP Year	Pesticide	Concentration (ppm)	cPAD	cRfC	Ratio
Sweet bell peppers	Mexico	1999	Methamidophos	0.68	0.0001	0.02	34
Peaches	US	2002	Dicofol p,p'	0.61	0.0004	0.08	7.625
Cantaloupe	Mexico	2000	Methamidophos	0.15	0.0001	0.02	7.5
Winter Squash	US	1997	Dieldrin	0.071	0.00005	0.01	7.1
Peaches - Composites	Chile	2000	Chlorpyrifos	0.023	0.00003	0.006	3.8333
Spinach	US	1997	Methamidophos	0.072	0.0001	0.02	3.6
Peaches	US	2002	Dicofol o,p'	0.17	0.0004	0.08	2.125
Sweet bell peppers	Mexico	1999	Diazinon	0.061	0.0002	0.04	1.525
Strawberries fresh	US	1999	Chlorpyrifos	0.007	0.00003	0.006	1.1666
Cantaloupe	Mexico	1999	Methamidophos	0.021	0.0001	0.02	1.05
Cucumbers	US	1999	Dieldrin	0.01	0.00005	0.01	1
Potato	US	2002	Dieldrin	0.01	0.00005	0.01	1
Peaches - Single	Chile	2000	Chlorpyrifos	0.005	0.00003	0.006	0.8333
Sweet bell peppers	Mexico	1999	Parathion methyl	0.003	0.00002	0.004	0.75
Oranges	US	1994	Formetanate	0.3	0.002	0.4	0.75
Celery	US	1994	Oxamyl	0.11	0.001	0.2	0.55
Celery	US	2002	Chlorpyrifos	0.003	0.00003	0.006	0.5
Nectarines	US	2000	Chlorpyrifos	0.003	0.00003	0.006	0.5
Spinach	US	1997	DDE	0.044	0.0005	0.1	0.44
Spinach	US	1996	DDE	0.042	0.0005	0.1	0.42
Spinach	US	1995	DDE	0.034	0.0005	0.1	0.34
Carrot	US	1995	DDE	0.029	0.0005	0.1	0.29
Cucumbers	US	1999	Endosulfan sulfate	0.033	0.0006	0.12	0.275
Carrot	US	1994	DDE	0.026	0.0005	0.1	0.26
Carrots	US	2000	DDE p,p'	0.026	0.0005	0.1	0.26
Spinach	US	1995	DDT	0.023	0.0005	0.1	0.23
Spinach	US	1997	DDE	0.021	0.0005	0.1	0.21
Potato	US	2001	DDE p,p'	0.019	0.0005	0.1	0.19
Carrot	US	2002	Linuron	0.3	0.008	1.6	0.1875
Potatoes	US	1995	Chlorpropham	1.6	0.05	10	0.16
Spinach	US	1996	DDE	0.014	0.0005	0.1	0.14
Spinach	US	1996	DDT	0.014	0.0005	0.1	0.14
Spinach	US	1995	Omethoate	0.008	0.0003	0.06	0.1333
Carrot	US	1995	DDE	0.013	0.0005	0.1	0.13
Spinach	US	1995	DDE	0.013	0.0005	0.1	0.13
Lettuce	US	1999	DDE p,p'	0.012	0.0005	0.1	0.12
Carrot	US	1996	DDE	0.012	0.0005	0.1	0.12
Carrot	US	2002	DDE p,p'	0.012	0.0005	0.1	0.12
Potato	US	2002	DDE p,p'	0.012	0.0005	0.1	0.12
Carrot	US	2001	DDE p,p'	0.012	0.0005	0.1	0.12
Carrot	US	2001	DDE p,p'	0.012	0.0005	0.1	0.12
Lettuce	US	2001	DDE p,p'	0.012	0.0005	0.1	0.12
Carrot	US	2001	DDE p,p'	0.012	0.0005	0.1	0.12

Appendix Table 2. (cont.) Ratio of residue level found to chronic reference concentration (cRfC) for positive organic samples, PDP 1994-2002

Commodity	Country of Origin	PDP Year	Pesticide	Concentration (ppm)	cPAD	cRfC	Ratio
Carrots	US	2000	DDE p,p'	0.012	0.0005	0.1	0.12
Strawberries	US	1998	Methomyl	0.19	0.008	1.6	0.1187
Potato	US	2002	Chlorpropham	1.1	0.05	10	0.11
Sweet bell peppers	Mexico	1999	Endosulfan sulfate	0.012	0.0006	0.12	0.1
Cantaloupe	Mexico	2000	Endosulfan sulfate	0.012	0.0006	0.12	0.1
Sweet bell peppers	Mexico	1999	Endosulfan II	0.01	0.0006	0.12	8.3333
Cucumbers	US	1999	Endosulfan II	0.01	0.0006	0.12	8.3333
Peaches	US	1995	Endosulfans	0.01	0.0006	0.12	8.3333
Spinach	US	1997	DDE	0.008	0.0005	0.1	0.08
Lettuce	US	2001	DDE p,p'	0.008	0.0005	0.1	0.08
Peaches - Composites	Chile	2000	Azinphos methyl	0.021	0.00149	0.298	7.0469
Sweet bell peppers	Mexico	1999	Endosulfan I	0.008	0.0006	0.12	6.6666
Cucumbers	US	1999	Endosulfan I	0.008	0.0006	0.12	6.6666
Potato	US	2001	Chlorpropham	0.66	0.05	10	0.066
Peaches - Composites	Chile	2000	Iprodione	0.83	0.0725	14.5	5.7241
Peaches	US	2002	Fludioxonil	0.34	0.03	6	5.6666
Spinach	US	1997	DDE	0.005	0.0005	0.1	0.05
Spinach	US	1997	DDT	0.005	0.0005	0.1	0.05
Spinach	US	1995	TDE (DDD)	0.005	0.0005	0.1	0.05
Spinach	US	1997	Permethrins	0.49	0.05	10	0.049
Potato	US	2002	Chlorpropham	0.46	0.05	10	0.046
Peaches - Single	Chile	2000	Azinphos methyl	0.01	0.00149	0.298	3.3557
Peaches - Single	Chile	2000	Iprodione	0.42	0.0725	14.5	2.8965
Celery	Mexico	2002	Piperonyl Butoxide	0.065	0.0175	3.5	1.8571
Sweet Bell Peppers	US	2000	Methomyl	0.027	0.008	1.6	0.0168
Potato	US	2002	Chlorpropham	0.16	0.05	10	0.016
Celery	Mexico	2002	Piperonyl Butoxide	0.05	0.0175	3.5	1.4285
Green Beans	US	2000	Acephate	0.003	0.0012	0.24	0.0125
Potato	US	2002	Chlorpropham	0.11	0.05	10	0.011
Potato	US	2001	Chlorpropham	0.11	0.05	10	0.011
Pears fresh	US	1999	o-Phenylphenol	0.037	0.02	4	0.0092
Carrot	US	2002	Trifluralin	0.028	0.024	4.8	5.8333
Banana	Mexico	2001	Chlorothalonil	0.022	0.02	4	0.0055
Strawberries	US	1998	Iprodione	0.079	0.0725	14.5	5.4482
Peaches	US	2002	Phosmet	0.011	0.011	2.2	0.005
Pineapple	Mexico	2002	Carbaryl	0.013	0.014	2.8	4.6428
Sweet Potato	US	1997	o-Phenylphenol	0.017	0.02	4	0.0042
Potato	US	2002	Chlorpropham	0.035	0.05	10	0.0035
Spinach	US	1997	DCPA	0.007	0.01	2	0.0035
Broccoli	US	1994	DCPA	0.007	0.01	2	0.0035
Pears fresh	US	1999	Diphenylamine (DPA)	0.017	0.03	6	2.8333
Potato	US	2001	Chlorpropham	0.028	0.05	10	0.0028
Oranges	US	2000	Thiabendazole	0.05	0.1	20	0.0025

Appendix Table 2. (cont.) Ratio of residue level found to chronic reference concentration (cRfC) for positive organic samples, PDP 1994-2002

Commodity	Country of Origin	PDP Year	Pesticide	Concentration (ppm)	cPAD	cRfC	Ratio
Carrot	US	2002	Iprodione	0.035	0.0725	14.5	2.4137
Potato	US	2001	Chlorpropham	0.017	0.05	10	0.0017
Potato	US	2001	Chlorpropham	0.017	0.05	10	0.0017
Celery	US	2002	Chlorthalonil	0.005	0.02	4	0.0012
Celery	US	2002	Chlorthalonil	0.005	0.02	4	0.0012
Sweet Bell Peppers	US	2000	Metalaxyl	0.017	0.074	14.8	1.1486
					AVERAGE		0.8926

Appendix Table 2a. Ratio of residue level found to chronic reference concentration (cRfC) for positive organic samples by country of origin – Domestic samples, PDP 1994-2002

Commodity	Country of Origin	PDP Year	Pesticide Pesticide	Concentration Concentration	(ppm)	cPAD	cRfC Ratio
Peaches	US	2002	Dicofol p,p'	0.61	0.0004	0.08	7.62
Winter Squash	US	1997	Dieldrin	0.071	0.00005	0.01	7.1
Spinach	US	1997	Methamidophos	0.072	0.0001	0.02	3.6
Peaches	US	2002	Dicofol o,p'	0.17	0.0004	0.08	2.12
Strawberries fresh	US	1999	Chlorpyrifos	0.007	0.00003	0.00	1.16
Cucumbers	US	1999	Dieldrin	0.01	0.00005	0.01	1
Potato	US	2002	Dieldrin	0.01	0.00005	0.01	1
Oranges	US	1994	Formetanate hydrochlorid	0.3	0.002	0.4	0.75
Celery	US	1994	Oxamyl	0.11	0.001	0.2	0.55
Celery	US	2002	Chlorpyrifos	0.003	0.00003	0.00	0.5
Nectarines	US	2000	Chlorpyrifos	0.003	0.00003	0.00	0.5
Spinach	US	1997	DDE	0.044	0.0005	0.1	0.44
Spinach	US	1996	DDE	0.042	0.0005	0.1	0.42
Spinach	US	1995	DDE	0.034	0.0005	0.1	0.34
Carrot	US	1995	DDE	0.029	0.0005	0.1	0.29
Cucumbers	US	1999	Endosulfan sulfate	0.033	0.0006	0.12	0.27
Carrot	US	1994	DDE	0.026	0.0005	0.1	0.26
Carrots	US	2000	DDE p,p'	0.026	0.0005	0.1	0.26
Spinach	US	1995	DDT	0.023	0.0005	0.1	0.23
Spinach	US	1997	DDE	0.021	0.0005	0.1	0.21
Potato	US	2001	DDE p,p'	0.019	0.0005	0.1	0.19
Carrot	US	2002	Linuron	0.3	0.008	1.6	0.18
Potatoes	US	1995	Chlorpropham	1.6	0.05	10	0.16
Spinach	US	1996	DDE	0.014	0.0005	0.1	0.14
Spinach	US	1996	DDT	0.014	0.0005	0.1	0.14
Spinach	US	1995	Omethoate	0.008	0.0003	0.06	0.13
Spinach	US	1995	DDE	0.013	0.0005	0.1	0.13
Carrot	US	1995	DDE	0.013	0.0005	0.1	0.13
Lettuce	US	1999	DDE p,p'	0.012	0.0005	0.1	0.12
Carrot	US	1996	DDE	0.012	0.0005	0.1	0.12
Carrot	US	2002	DDE p,p'	0.012	0.0005	0.1	0.12
Potato	US	2002	DDE p,p'	0.012	0.0005	0.1	0.12
Carrot	US	2001	DDE p,p'	0.012	0.0005	0.1	0.12
Carrot	US	2001	DDE p,p'	0.012	0.0005	0.1	0.12
Lettuce	US	2001	DDE p,p'	0.012	0.0005	0.1	0.12
Carrot	US	2001	DDE p,p'	0.012	0.0005	0.1	0.12
Carrots	US	2000	DDE p,p'	0.012	0.0005	0.1	0.12
Strawberries	US	1998	Methomyl	0.19	0.008	1.6	0.11
Potato	US	2002	Chlorpropham	1.1	0.05	10	0.11
Cucumbers	US	1999	Endosulfan II	0.01	0.0006	0.12	8.33
Peaches	US	1995	Endosulfans	0.01	0.0006	0.12	8.33
Spinach	US	1997	DDE	0.008	0.0005	0.1	0.08
Lettuce	US	2001	DDE p,p'	0.008	0.0005	0.1	0.08
Cucumbers	US	1999	Endosulfan I	0.008	0.0006	0.12	6.66
Potato	US	2001	Chlorpropham	0.66	0.05	10	0.06
Peaches	US	2002	Fludioxonil	0.34	0.03	6	5.66

Appendix Table 2a. (cont.) Ratio of residue level found to chronic reference concentration (cRfC) for positive organic samples by country of origin – Domestic samples, PDP 1994-2002

Commodity	Country of Origin	PDP Year	Pesticide Pesticide	Concentration Concentration	(ppm)	cPAD	cRfC Ratio
Spinach	US	1997	DDE	0.005	0.0005	0.1	0.05
Spinach	US	1997	DDT	0.005	0.0005	0.1	0.05
Spinach	US	1995	TDE (DDD)	0.005	0.0005	0.1	0.05
Spinach	US	1997	Permethrins	0.49	0.05	10	0.04
Potato	US	2002	Chlorpropham	0.46	0.05	10	0.04
Sweet Bell Peppers	US	2000	Methomyl	0.027	0.008	1.6	0.01
Potato	US	2002	Chlorpropham	0.16	0.05	10	0.01
Green Beans	US	2000	Acephate	0.003	0.0012	0.24	0.01
Potato	US	2002	Chlorpropham	0.11	0.05	10	0.01
Potato	US	2001	Chlorpropham	0.11	0.05	10	0.01
Pears fresh	US	1999	o-Phenylphenol	0.037	0.02	4	0.00
Carrot	US	2002	Trifluralin	0.028	0.024	4.8	5.83
Strawberries	US	1998	Iprodione	0.079	0.0725	14.5	5.44
Peaches	US	2002	Phosmet	0.011	0.011	2.2	0.00
Sweet Potato	US	1997	o-Phenylphenol	0.017	0.02	4	0.00
Potato	US	2002	Chlorpropham	0.035	0.05	10	0.00
Spinach	US	1997	DCPA	0.007	0.01	2	0.00
Broccoli	US	1994	DCPA	0.007	0.01	2	0.00
Pears fresh	US	1999	Diphenylamine (DPA)	0.017	0.03	6	2.83
Potato	US	2001	Chlorpropham	0.028	0.05	10	0.00
Oranges	US	2000	Thiabendazole	0.05	0.1	20	0.00
Carrot	US	2002	Iprodione	0.035	0.0725	14.5	2.41
Potato	US	2001	Chlorpropham	0.017	0.05	10	0.00
Potato	US	2001	Chlorpropham	0.017	0.05	10	0.00
Celery	US	2002	Chlorthalonil	0.005	0.02	4	0.00
Celery	US	2002	Chlorthalonil	0.005	0.02	4	0.00
Sweet Bell Peppers	US	2000	Metalaxyl	0.017	0.074	14.8	1.14
				AVERAGE RATIO ALL YEARS			**0.44**

Appendix Table 2b. Ratio of residue level found to chronic reference concentration (cRfC) for positive organic samples by country of origin – import samples, PDP 1994-2002

Commodity	Country of Origin	PDP Year	Pesticide Pesticide	Concentration Concentration	(ppm)	cPAD	cRfC Ratio
Sweet bell peppers	Mexico	1999	Methamidophos	0.68	0.0001	0.02	34
Cantaloupe	Mexico	2000	Methamidophos	0.15	0.0001	0.02	7.5
Peaches - Composites	Chile	2000	Chlorpyrifos	0.023	0.00003	0.00	3.83
Sweet bell peppers	Mexico	1999	Diazinon	0.061	0.0002	0.04	1.52
Cantaloupe	Mexico	1999	Methamidophos	0.021	0.0001	0.02	1.05
Peaches - Single Serving	Chile	2000	Chlorpyrifos	0.005	0.00003	0.00	0.83
Sweet bell peppers	Mexico	1999	Parathion methyl	0.003	0.00002	0.00	0.75
Sweet bell peppers	Mexico	1999	Endosulfan sulfate	0.012	0.0006	0.12	0.1
Cantaloupe	Mexico	2000	Endosulfan sulfate	0.012	0.0006	0.12	0.1
Sweet bell peppers	Mexico	1999	Endosulfan II	0.01	0.0006	0.12	8.33
Peaches - Composites	Chile	2000	Azinphos methyl	0.021	0.00149	0.29	7.04
Sweet bell peppers	Mexico	1999	Endosulfan I	0.008	0.0006	0.12	6.66
Peaches - Composites	Chile	2000	Iprodione	0.83	0.0725	14.5	5.72
Peaches - Single Serving	Chile	2000	Azinphos methyl	0.01	0.00149	0.29	3.35
Peaches - Single Serving	Chile	2000	Iprodione	0.42	0.0725	14.5	2.89
Celery	Mexico	2002	Piperonyl Butoxide	0.065	0.0175	3.5	1.85
Celery	Mexico	2002	Piperonyl Butoxide	0.05	0.0175	3.5	1.42
Banana	Mexico	2001	Chlorothalonil	0.022	0.02	4	0.00
Pineapple	Mexico	2002	Carbaryl	0.013	0.014	2.8	4.64
				AVERAGE RATIO ALL YEARS			**2.64**

Appendix Table 3. Chlorpyrifos residues in peaches by country of origin and ranked by residue level, 2002 PDP

	Country of Origin	Commodity Claim	Residue Level
1	Chile	No Market Claim	0.079
2	Chile	No Market Claim	0.078
3	Chile	No Market Claim	0.071
4	Chile	No Market Claim	0.056
5	Chile	No Market Claim	0.049
6	Chile	No Market Claim	0.048
7	Chile	No Market Claim	0.047
8	Chile	No Market Claim	0.046
9	Chile	No Market Claim	0.045
10	Chile	No Market Claim	0.043
11	Chile	No Market Claim	0.042
12	Chile	No Market Claim	0.038
13	Chile	No Market Claim	0.037
14	US	No Market Claim	0.036
15	Chile	No Market Claim	0.036
16	Chile	No Market Claim	0.035
17	Chile	No Market Claim	0.035
18	Chile	No Market Claim	0.031
19	Chile	No Market Claim	0.031
20	Chile	No Market Claim	0.028
21	Chile	No Market Claim	0.028
22	Chile	No Market Claim	0.028
23	Chile	No Market Claim	0.028
24	Chile	No Market Claim	0.027
25	Chile	No Market Claim	0.025
26	Chile	No Market Claim	0.025
27	Chile	No Market Claim	0.025
28	Chile	No Market Claim	0.024
29	Chile	No Market Claim	0.023
30	US	No Market Claim	0.023
31	Chile	No Market Claim	0.021
32	Chile	No Market Claim	0.02
33	Chile	No Market Claim	0.018
34	Chile	No Market Claim	0.017
35	US	No Market Claim	0.017
36	Chile	No Market Claim	0.016
37	Chile	No Market Claim	0.016
38	Chile	No Market Claim	0.016
39	Chile	No Market Claim	0.015
40	Chile	No Market Claim	0.015
41	Chile	No Market Claim	0.015
42	Chile	No Market Claim	0.015
43	Chile	No Market Claim	0.015
44	Chile	No Market Claim	0.015
45	Chile	No Market Claim	0.014
46	Chile	No Market Claim	0.014

Appendix Table 3. (cont.) Chlorpyrifos residues in peaches by country of origin and ranked by residue level, 2002 PDP

	Country of Origin	Commodity Claim	Residue Level
47	Chile	No Market Claim	0.014
48	Chile	No Market Claim	0.013
49	Chile	No Market Claim	0.012
50	Chile	No Market Claim	0.012
51	Chile	No Market Claim	0.012
52	Chile	No Market Claim	0.012
53	Chile	No Market Claim	0.011
54	Chile	No Market Claim	0.011
55	Chile	No Market Claim	0.011
56	Chile	No Market Claim	0.011
57	Chile	No Market Claim	0.011
58	Chile	No Market Claim	0.01
59	Chile	No Market Claim	0.01
60	Chile	No Market Claim	0.01
61	Chile	No Market Claim	0.01
62	Chile	No Market Claim	0.0096
63	Chile	No Market Claim	0.0092
64	Chile	No Market Claim	0.009
65	Chile	No Market Claim	0.0085
66	Chile	No Market Claim	0.0084
67	Chile	No Market Claim	0.0082
68	Chile	No Market Claim	0.0081
69	Chile	No Market Claim	0.0081
70	Chile	No Market Claim	0.0078
71	Chile	No Market Claim	0.0075
72	Chile	No Market Claim	0.0071
73	Chile	No Market Claim	0.0068
74	Chile	No Market Claim	0.0067
75	Chile	No Market Claim	0.0062
76	Chile	No Market Claim	0.0062
77	Chile	No Market Claim	0.0062
78	Chile	No Market Claim	0.0061
79	Chile	No Market Claim	0.006
80	Chile	No Market Claim	0.006
81	Chile	No Market Claim	0.006
82	Chile	No Market Claim	0.0058
83	Chile	No Market Claim	0.0057
84	Chile	No Market Claim	0.0056
85	Chile	No Market Claim	0.0054
86	Chile	No Market Claim	0.0051
87	Chile	No Market Claim	0.0051
88	Chile	No Market Claim	0.005
89	US	No Market Claim	0.005
90	Chile	No Market Claim	0.0049
91	Chile	No Market Claim	0.0047
92	Chile	No Market Claim	0.0047

Appendix Table 3. (cont.) Chlorpyrifos residues in peaches by country of origin and ranked by residue level, 2002 PDP

	Country of Origin	Commodity Claim	Residue Level
93	Chile	No Market Claim	0.0047
94	Chile	No Market Claim	0.0046
95	Chile	No Market Claim	0.0045
96	Chile	No Market Claim	0.0045
97	Chile	No Market Claim	0.0044
98	US	No Market Claim	0.0044
99	Chile	No Market Claim	0.0043
100	US	No Market Claim	0.004
101	Chile	No Market Claim	0.004
102	Chile	No Market Claim	0.002
103	Chile	No Market Claim	0.002
104	Chile	No Market Claim	0.002
105	Chile	No Market Claim	0.002
106	Chile	No Market Claim	0.002
107	Chile	No Market Claim	0.002
108	Chile	No Market Claim	0.002
109	Chile	No Market Claim	0.002
110	Chile	No Market Claim	0.002
111	Chile	No Market Claim	0.002
112	Chile	No Market Claim	0.002
113	Chile	No Market Claim	0.002
114	Chile	No Market Claim	0.002
115	Chile	No Market Claim	0.002
116	Chile	No Market Claim	0.002
117	Chile	No Market Claim	0.002
118	Chile	No Market Claim	0.002
119	Chile	No Market Claim	0.002
120	Chile	No Market Claim	0.002
121	Chile	No Market Claim	0.002
122	Chile	No Market Claim	0.002
123	Chile	No Market Claim	0.002
124	Chile	No Market Claim	0.002
125	Chile	No Market Claim	0.002
126	Chile	No Market Claim	0.002
127	Chile	No Market Claim	0.002
128	Chile	No Market Claim	0.002
129	Chile	No Market Claim	0.002
130	Chile	No Market Claim	0.002
131	US	No Market Claim	0.002
132	Chile	No Market Claim	0.002
133	US	No Market Claim	0.002
134	US	No Market Claim	0.002
135	US	No Market Claim	0.002
136	US	No Market Claim	0.002
137	US	No Market Claim	0.002
138	US	No Market Claim	0.002

Appendix Table 3. (cont.) Chlorpyrifos residues in peaches by country of origin and ranked by residue level, 2002 PDP

	Country of Origin	Commodity Claim	Residue Level
139	US	No Market Claim	0.002
140	US	No Market Claim	0.002
141	US	No Market Claim	0.002
142	US	No Market Claim	0.002
143	Chile	No Market Claim	0.002
144	Chile	No Market Claim	0.002
145	Chile	No Market Claim	0.002
146	US	No Market Claim	0.002
147	US	No Market Claim	0.002
148	US	No Market Claim	0.002
149	US	No Market Claim	0.002
150	US	No Market Claim	0.002
151	US	No Market Claim	0.002
152	US	No Market Claim	0.002
153	US	No Market Claim	0.002
154	US	No Market Claim	0.002
155	Chile	No Market Claim	0.002
156	US	No Market Claim	0.002
157	US	No Market Claim	0.002
158	US	No Market Claim	0.002
159	US	No Market Claim	0.002
160	US	No Market Claim	0.002
161	US	No Market Claim	0.002
162	US	No Market Claim	0.002
163	Chile	No Market Claim	0.002
164	Chile	No Market Claim	0.002
165	US	No Market Claim	0.002
166	Chile	No Market Claim	0.002
167	Chile	No Market Claim	0.002
168	Chile	No Market Claim	0.002
169	Chile	No Market Claim	0.002
170	Chile	No Market Claim	0.002
171	Chile	No Market Claim	0.002
172	Chile	No Market Claim	0.002
173	Chile	No Market Claim	0.002
174	Chile	No Market Claim	0.002
175	Chile	No Market Claim	0.002
176	Chile	No Market Claim	0.002
177	Chile	No Market Claim	0.002
178	Chile	No Market Claim	0.002
179	Chile	No Market Claim	0.002
180	Chile	No Market Claim	0.002
181	Chile	No Market Claim	0.002
182	Chile	No Market Claim	0.002
183	Chile	No Market Claim	0.002
184	Chile	No Market Claim	0.002

Appendix Table 3. (cont.) Chlorpyrifos residues in peaches by country of origin and ranked by residue level, 2002 PDP

	Country of Origin	Commodity Claim	Residue Level
185	Chile	No Market Claim	0.002
186	Chile	No Market Claim	0.002
187	Chile	No Market Claim	0.002
188	Chile	No Market Claim	0.002
189	Chile	No Market Claim	0.002
190	Chile	No Market Claim	0.002
191	Chile	No Market Claim	0.002
192	Chile	No Market Claim	0.002
193	Chile	No Market Claim	0.002
194	Chile	No Market Claim	0.002

DOMESTIC AVERAGE	IMPORT AVERAGE
0.0	**0.01**

Appendix Table 4. Crop uses of pesticides allowed in organic production based on the most recent year of NASS pesticide use survey data

	Pesticide Type	Most Recent Data Year	Percent Crop Acres Treated	Rate of Application	Pounds Applied
Acetic Acid	H				
Corn		2002	1	0.39	152,000
Soybeans		2002	1	0.4	328,000
wheat other spring		2002	3	0.46	146,000
wheat winter		2002	1	0.47	56,000
Azadirachtin	I				
Apples		2001	1	0.01	19
Broccoli		2002	1	0.02	16
cabbage fresh		2000	1	0.02	9
Celery		2002	4	0.009	15
Cucumbers fresh		2002	1	0.02	6
Lettuce head		2002	1	0.03	27
Lettuce other		2002	4	0.02	100
Onions bulb		2002	4	0.04	400
Onions dry		2000	1	0.01	11
Pears		2001	4	0.03	100
Spinach fresh		2002	4	0.02	24
Strawberries		2002	19	0.03	300
Winter Squash		2002	1	0.008	4
Bacillus cereus	O				
Cotton Upland		2001	12	0.01	21,336
Bacillus subtilus	F				
Apples		2001	1	0.01	25
Celery		2002	2	0.01	7
Grapes		2001	1	0.01	53
grapes wine		2001	1	0.01	26
Lettuce head		2002	4	0.01	73
Lettuce other		2002	6	0.01	66

Appendix Table 4. (cont.) Crop uses of pesticides allowed in organic production based on the most recent year of NASS pesticide use survey data

	Pesticide Type	Most Recent Data Year	Percent Crop Acres Treated	Rate of Application	Pounds Applied
Basic copper sulfate	F				
Apples		2001	4	0.65	11,600
Cherries sweet		2001	2	5.62	7,100
Grapefruit		2001	10	3.2	49,700
Grapefruit nonbearing		1991	20	3.67	0
Grapes		2001	1	0.48	12,700
Lemons		2001	15	3.16	31,200
Melon watermelon		2000	0	0.98	600
Olives		1999	19	6.09	52,600
Orange fresh		1997	23	2.47	128,600
Orange proc		1997	16	2.27	425,600
Oranges		2001	4	2.32	91,900
Oranges nonbearing		1991	12	0.85	0
Peaches		2001	6	8.94	76,600
Peanuts		1991	2	0.31	15,000
Pears		2001	3	2.81	5,700
Potatoes fall		1998	5	0.96	8,000
Tangelos		2001	3	1.3	1,100
Tangerines		2001	8	2.82	16,300
Tomatoes fresh		2002	0	1.03	2,300
Basic copper zinc sulfate	F				
Apples		1999	0	0.1	74

Appendix Table 4. (cont.) Crop uses of pesticides allowed in organic production based on the most recent year of NASS pesticide use survey data

		Pesticide Type	Most Recent Data Year	Percent Crop Acres Treated	Rate of Application	Pounds Applied
Bt		I				
	Almonds		1999	18	0.01	1,670
	Apples		2001	13	0.01	658
	Apples nonbearing		1991	1	0.01	0
	Apricots		2001	19	0.01	51
	artichoke		2000	6	0.01	21
	Beans snap fresh		2002	18	0.01	1,215
	Blackberries		2001	12	0.01	11
	Blueberries		2001	8	0.01	36
	Broccoli		2002	8	0.01	253
	Cabbage fresh		2002	52	0.01	3,329
	Cabbage kraut		2000	9	0.01	8
	Cauliflower		2002	7	0.01	104
	Celery		2002	19	0.01	266
	Cherries sweet		2001	10	0.01	76
	cherries tart		2001	2	0.01	10
	Collard		2000	56	0.01	442
	Corn sweet fresh		2002	3	0.01	440
	Cotton Upland		2001	1	0.01	1,016
	Cucumbers fresh		2002	18	0.01	723
	Cucumbers proc		2002	6	0.01	568
	eggplant		2000	15	0.01	50
	Grapes		2001	10	0.01	1,474
	grapes nonbearing		2001	3	0.01	159
	Grapes raisins		2001	3	0.01	16
	grapes table		2001	25	0.01	409
	grapes wine		2001	11	0.01	700
	Greens mustard		2000	34	0.01	131
	Greens turnip		2000	21	0.01	91
	Kale		2000	40	0.01	25
	Lettuce head		2002	8	0.01	399
	Lettuce other		2002	8	0.01	241
	Melon cantaloupe		2002	8	0.01	296
	Melon honeydew		2002	13	0.01	1,301
	Melon other		1996	9	0.01	254
	Melon watermelon		2002	13	0.01	1,301
	Nectarines		2001	23	0.01	143
	Onions bulb		2002	1	0.01	54
	Onions dry		2000	3	0.01	137
	Orange fresh		1997	16	0.01	366
	Oranges		2001	1	0.01	44
	Peaches		2001	12	0.01	215
	Pears		2001	4	0.01	36
	Pecans		1999	3	0.01	0

Appendix Table 4. (cont.) Crop uses of pesticides allowed in organic production based on the most recent year of NASS pesticide use survey data

	Pesticide Type	Most Recent Data Year	Percent Crop Acres Treated	Rate of Application	Pounds Applied
Peppers bell		2002	34	0.01	5,467
Plums		2001	15	0.01	102
Prunes		2001	3	0.01	144
Raspberries		2001	38	0.01	132
Soybeans		1998	1	0.01	3,285
Spinach fresh		2002	12	0.01	129
Strawberries		2002	46	0.01	1,521
Sugarbeets		2000	1	0.01	78
Tobacco		1996	10	0.01	498
Tomatoes fresh		2002	47	0.01	9,032
Tomatoes proc		2002	15	0.01	1,332
Winter Squash		2002	10	0.01	566
Capsaicin	O				
Cherries sweet		1991	1	3.6	2,100
Codling moth pheromone	I				
Apples		1997	20	0.058	2,042
Pears		1997	20	0.058	649
Copper	F				
Winter squash		1992	20	2.686	3,025
Copper ammonium	F				
Beans snap proc		1998	2	0.15	400
Celery		1998	6	0.39	1,200
Cherries sweet		1997	2	0.69	800
Grapes		1993	1	0.95	6,900
Onions bulb		2002	2	0.21	1,000
Onions dry		2000	2	0.18	1,600
Oranges		1999	1	1	7,500
Peaches		1999	3	0.35	12,800
Pears		1997	1	0.27	400
Peppers bell		2002	4	0.2	3,300
Potatoes fall		2001	2	0.27	8,000
Strawberries		2000	2	0.37	1,900
Tangerines		1993	3	1.09	800
Tomatoes fresh		2000	2	0.36	4,700
Tomatoes proc		1998	1	0.49	2,400
Winter squash		2000	1	0.25	100
Copper chloride hydroxide	F				
Apples		2001	1	3.6	11,200
Cherries sweet		2001	1	5.39	7,900
Grapefruit		2001	10	5.05	91,900
Pears		2001	0	0.5	200

Appendix Table 4. (cont.) Crop uses of pesticides allowed in organic production based on the most recent year of NASS pesticide use survey data

	Pesticide Type	Most Recent Data Year	Percent Crop Acres Treated	Rate of Application	Pounds Applied
Copper hydroxide	F				
Almonds		1999	30	2.25	564,600
Apples		2001	16	1.97	118,800
Apples nonbearing		1991	2	1.68	0
Apricots		2001	13	2.84	11,100
Avocado		1999	8	3.23	101,200
Beans lima proc		2000	3	1.08	2,005
Beans snap fresh		2002	15	0.76	26,700
Beans snap proc		2002	8	0.6	11,000
Blackberries		2001	34	1.1	3,400
Blueberries		2001	4	2.13	3,800
Blueberries nonbearing		1991	4	1.46	0
Broccoli		2002	1	0.32	500
Cabbage fresh		2002	3	0.54	1,600
Carrots fresh		2002	8	0.63	10,400
Carrots proc		2000	18	0.52	4,500
Cauliflower		2002	2	0.34	300
Celery		2002	24	0.51	4,600
Cherries sweet		2001	26	3.41	77,000
cherries tart		2001	5	1.58	5,100
Collard		2000	5	0.49	500
Cucumbers fresh		2002	17	0.38	5,000
Cucumbers proc		2002	3	0.53	2,200
eggplant		2000	12	0.64	800
Grapefruit		1999	37	2.24	284,100
Grapefruit nonbearing		1991	50	1.7	0
Grapes		2001	32	0.56	317,100
grapes nonbearing		2001	19	0.72	41,500
Grapes raisins		2001	19	0.72	41,500
grapes table		2001	65	0.58	64,100
grapes wine		2001	37	0.53	181,100
Greens mustard		2000	6	0.54	400
Greens turnip		2000	4	0.64	800
Hazelnuts		1999	13	5.25	19,600
Lemons		2001	9	1.63	14,800
Lettuce head		1998	0	0.25	200
Lettuce other		2000	2	0.36	1,200
Limes		1999	87	4.07	31,500
Melon cantaloupe		2002	1	0.37	200
Melon honeydew		2002	17	0.51	21,500
Melon watermelon		2002	17	0.51	21,500
Nectarines		2001	53	3.82	108,000
Olives		2001	5	3.87	9,200
Onions bulb		2002	25	0.66	52,800

Appendix Table 4. (cont.) Crop uses of pesticides allowed in organic production based on the most recent year of NASS pesticide use survey data

	Pesticide Type	Most Recent Data Year	Percent Crop Acres Treated	Rate of Application	Pounds Applied
Onions dry		2000	31	0.75	103,900
Orange fresh		1997	11	2.39	100,700
Orange proc		1997	41	1.9	953,000
Oranges		2001	34	1.92	981,300
Oranges nonbearing		1991	31	1.65	0
Peaches		2001	22	3.13	119,000
Peaches nonbearing		1991	8	1.64	0
Peanuts		1991	7	0.96	154,000
Pears		2001	25	1.71	46,200
Pears nonbearing		1991	27	4.17	0
Peas green proc		2000	1	0.92	1,400
Peppers bell		2002	48	0.46	127,800
Plums		2001	25	2.71	70,100
Potatoes fall		2001	9	0.53	93,000
Prunes		2001	5	3.36	20,400
Pumpkin		2002	9	0.46	2,800
Raisins		1999	28	0.71	86,600
Raspberries		2001	42	0.97	7,700
Spinach fresh		2002	5	0.93	2,100
Strawberries		2002	4	0.46	1,400
Sweet cherries nonbearing		1991	11	2.72	0
Tangelos		2001	53	1.82	25,400
Tangerines		1999	28	1.98	58,400
Tangerines nonbearing		1991	55	1.67	0
Tart cherries nonbearing		1991	2	0.42	0
Temples		2001	58	2.35	21,800
Tomatoes fresh		2002	61	0.69	580,100
Tomatoes proc		2002	5	0.89	15,200
Walnuts		1999	45	3.13	630,000
Winter Squash		2002	17	0.66	17,700
Copper oxide	F				
Apricots		2001	11	3.54	12,700
Grapes		2001	8	0.9	80,400
Nectarines		2001	7	5.08	18,700
Peaches		2001	5	4.89	41,800
Plums		2001	1	5.27	4,000
Copper oxychloride	F				
Apples		2001	3	2.5	24,800
Peaches		2001	0	1.52	800
Pears		2001	1	4.6	2,200

Appendix Table 4. (cont.) Crop uses of pesticides allowed in organic production based on the most recent year of NASS pesticide use survey data

	Pesticide Type	Most Recent Data Year	Percent Crop Acres Treated	Rate of Application	Pounds Applied
Copper oxychloride sulfate	F				
Apples		2001	3	1.87	33,400
Apples nonbearing		1991	4	1.71	0
Cherries sweet		2001	1	3.85	4,000
cherries tart		2001	4	1.83	5,000
Grapefruit		1995	16	4.22	328,000
Grapes		2001	3	2.44	145,200
grapes table		2001	20	2.53	116,200
grapes wine		2001	2	2.52	24,100
Oranges		1999	9	2.67	540,000
Peaches		2001	3	2.04	11,800
Pears		2001	8	1.54	11,500
Pumpkin		2000	1	1.36	1,000
Sweet cherries nonbearing		1991	1	3.36	0
Tangelos		1999	25	2.81	16,100
Tangerines		1999	20	2.99	53,000
Tart cherries nonbearing		1991	5	1.53	0
Tomatoes fresh		2000	1	1	7,400
Copper resinate	F				
Apples		1999	0	0.26	300
Cucumbers fresh		1998	2	0.09	200
Cucumbers proc		1998	1	0.13	600
eggplant		2000	2	0.11	19
Grapes		2001	0	0.16	800
Lettuce other		1998	5	0.09	400
Melon cantaloupe		1998	1	0.09	200
Melon watermelon		1998	2	0.08	600
Onions bulb		2002	5	0.19	4,300
Peaches		2001	6	0.02	1,500
Peanuts		1991	2	0.17	7,000
Peppers bell		2000	1	0.1	300
Potatoes fall		1998	5	0.1	1,000
Pumpkin		2000	1	0.15	100
Strawberries		2002	5	0.18	500
Tomatoes fresh		2002	1	0.16	300
Winter Squash		2002	1	0.14	59

Appendix Table 4. (cont.) Crop uses of pesticides allowed in organic production based on the most recent year of NASS pesticide use survey data

	Pesticide Type	Most Recent Data Year	Percent Crop Acres Treated	Rate of Application	Pounds Applied
Copper sulfate	F				
Apples		2001	2	1.72	15,600
Apples nonbearing		1991	2	0.9	0
Avocado		1999	1	1.43	2,900
Blackberries		2001	12	2.04	1,400
Blueberries		2001	1	1.82	1,300
Cabbage fresh		2002	1	0.17	300
Cherries sweet		2001	3	1.96	4,400
cherries tart		2001	2	1.25	1,700
Cucumbers fresh		2002	3	0.39	1,400
eggplant		2000	3	0.23	59
Grapefruit		2001	6	0.78	16,300
Grapes		1999	0	1.15	2,100
Hazelnuts		1991	6	1.93	3,400
Lemons		1993	9	3.35	14,700
Limes		1999	2	0.77	200
Orange fresh		1997	5	3.15	39,300
Orange proc		1997	5	1.19	39,300
Oranges		2001	3	0.93	45,800
Peaches		2001	1	1.25	2,300
Pears		2001	4	0.59	1,700
Peppers bell		2000	0	0.46	500
Potatoes fall		1998	4	0.51	4,000
Pumpkin		2002	1	0.52	500
Raspberries		2001	22	1.93	5,600
Rice		2000	5	3.11	461,000
Strawberries		1998	3	0.35	500
Sweet cherries nonbearing		1991	7	1.62	0
Tangelos		2001	10	1	2,000
tangerines		2001	9	0.86	4,500
Tomatoes fresh		2002	2	0.6	6,500
Winter squash		2000	1	0.29	400
Copper, and oxides	F				
Tomatoes proc		1998	1	1.62	4,600
Cuprous chloride	F				
Tomatoes fresh		2000	1	0.58	594
Cuprous oxide	F				
Almonds		1999	2	2.87	35,400
Apricots		1999	6	4.22	6,900
Grapes		1997	1	0.94	9,500
Peaches		1999	4	4.85	29,200
Walnuts		1999	4	4.7	55,900

Appendix Table 4. (cont.) Crop uses of pesticides allowed in organic production based on the most recent year of NASS pesticide use survey data

	Pesticide Type	Most Recent Data Year	Percent Crop Acres Treated	Rate of Application	Pounds Applied
Cydia pomonella granulosis	I				
Apples		2001	1	0.02	68
Gossyplure	O				
Cotton Upland		1999	0	0.004	108
Harpin protein	O				
Apples		2001	1	0.003	6
Peppers bell		2002	4	0.01	27
Strawberries		2002	12	0.009	100
Tomatoes proc		2002	4	0.006	100
Hydrogen peroxide	O				
Tomatoes fresh		2000	1	0.99	2,100
Kaolin	I				
Apples		2001	5	30.39	610,300
Pears		2001	14	31.55	576,100
Neem oil	I				
Lettuce head		2000	1	2.09	4,500
Lettuce other		2000	5	2.29	10,700
Melon watermelon		2000	1	1.78	1,600
Oranges		1999	1	5.29	24,700
Strawberries		2000	2	4.18	5,200
Octadecadienol (E,Z)	O				
Peaches		2001	1	0.006	4
Octadecadienol (Z,Z)	O				
Peaches		2001	1	0.006	4
Petroleum distillate	I				
Corn sweet fresh		2002	1	2.12	3,500
Pears		2001	86	16.86	3,040,900
Winter Squash		2002	5	4.64	102,100

Appendix Table 4. (cont.) Crop uses of pesticides allowed in organic production based on the most recent year of NASS pesticide use survey data

	Pesticide Type	Most Recent Data Year	Percent Crop Acres Treated	Rate of Application	Pounds Applied
Petroleum oils	I				
Almonds		1999	58	19.07	8,728,500
Apples		2001	61	20.06	6,769,400
Apricots		2001	38	18.19	225,100
Avocado		2001	32	19.15	1,058,200
Blackberries		2001	9	5.99	4,200
Blueberries		2001	2	16.04	9,800
Cherries sweet		2001	3	16.86	61,300
Cherries tart		1999	1	21.5	9,900
Corn		2001	0	0.99	56,000
Corn sweet fresh		2000	0	0.97	1,100
Corn sweet proc		2002	1	3.17	10,900
Cotton upland		1998	1	1.28	182,000
Grapefruit		2001	78	27.56	5,156,000
Grapes		2001	4	5.94	346,600
grapes table		2001	7	8.91	71,800
grapes wine		2001	4	4.89	172,100
Hazelnuts		1999	7	11.97	23,300
Lemons		2001	46	52.2	2,582,900
Limes		1999	80	15.4	126,600
Nectarines		2001	68	33.81	1,385,000
Olives		2001	1	27.37	12,700
Onions dry		2000	1	0.49	2,200
Orange fresh		1997	24	43.95	2,855,000
Orange proc		1997	88	28.86	40,999,700
Oranges		2001	70	35.58	43,895,900
Peaches		2001	33	28.58	1,605,600
Pears		2001	4	9.62	33,300
Pecans		1991	2	6.94	0
Pistachios		1999	5	35.98	189,000
Plums		2001	60	30.77	1,172,600
Prunes		2001	43	22.07	1,123,500
Raspberries		2001	6	3.07	7,300
Strawberries		2000	4	6.9	13,500
Tangelos		2001	70	31.96	476,000
Tangerines		1999	53	31.77	1,501,000
Temples		2001	76	29.15	268,700
Tomatoes fresh		2000	1	2.29	3,100
Walnuts		1999	8	8.22	326,400
Winter squash		2000	1	6.63	10,500

Appendix Table 4. (cont.) Crop uses of pesticides allowed in organic production based on the most recent year of NASS pesticide use survey data

	Pesticide Type	Most Recent Data Year	Percent Crop Acres Treated	Rate of Application	Pounds Applied
Potassium bicarbonate	F				
Grapes		2001	13	1.68	364,300
grapes wine		2001	23	1.68	327,800
Pumpkin		2000	1	3.05	1,000
Strawberries		2002	8	2.71	13,200
Potassium salt of oleic acid	I				
Grapes		2001	1	1.39	16,700
grapes wine		2001	1	3.02	13,800
Strawberries		2002	3	3.46	3,700
Pseudomonas fluorescens	F				
Apples		2001	1	0.19	800
Pears		2001	6	0.1	1,100
Pyrethrins	I				
Apples		2001	1	0.03	100
broccoli		2000	1	0.01	9
Cabbage fresh		1998	1	0.007	5
Cauliflower		1998	6	0.007	38
Celery		2002	5	0.01	14
Cherries sweet		2001	0	0.07	84
Cucumbers fresh		2000	3	0.005	7
Lettuce head		2002	1	0.007	13
Lettuce other		2002	3	0.01	33
Peas green proc		2000	6	0.02	200
Potatoes fall		1998	7	0.01	152
Spinach fresh		2002	3	0.007	6
Strawberries		2002	3	0.02	40
Tomatoes fresh		2000	2	0.005	33
Rotenone	I				
Beans snap fresh		2000	0	0.004	50
Broccoli		1998	1	0.005	3
cabbage fresh		2000	1	0.06	41
celery		2000	4	0.005	5
Cucumbers fresh		2000	3	0.005	7
eggplant		2000	1	0.1	2
Lettuce head		2002	1	0.005	5
Lettuce other		2002	2	0.008	18
Pumpkin		2000	1	0.02	9
Spinach fresh		2002	3	0.005	4
Strawberries		2002	2	0.006	5
Tomatoes fresh		2000	2	0.007	51
Winter squash		2000	1	0.05	56

Appendix Table 4. (cont.) Crop uses of pesticides allowed in organic production based on the most recent year of NASS pesticide use survey data

	Pesticide Type	Most Recent Data Year	Percent Crop Acres Treated	Rate of Application	Pounds Applied
Sabadilla	I				
Avocado		1999	11	0.03	200
Grapefruit		1997	2	0.02	100
Lemons		1997	38	0.03	500
Orange fresh		1997	12	0.02	1,100
Oranges		1997	3	0.02	1,100
Soaps	I				
Apples		1999	0	2.7	3,700
broccoli		2000	1	7.48	10,100
Grapes		1999	0	9.49	21,500
Lettuce other		2000	1	6.52	6,700
Onions dry		2000	0	0.98	400
Strawberries		2000	2	4.44	5,600
Tomatoes fresh		2000	5	1.93	25,300
Winter squash		2000	2	1.89	15,900

Appendix Table 4. (cont.) Crop uses of pesticides allowed in organic production based on the most recent year of NASS pesticide use survey data

	Pesticide Type	Most Recent Data Year	Percent Crop Acres Treated	Rate of Application	Pounds Applied
Spinosad	I				
Almonds		1999	5	0.09	3,000
Apples		2001	36	0.1	16,600
Apricots		2001	9	0.09	500
Beans snap fresh		2000	9	0.09	1,300
Blueberries		2001	0	0.06	85
Broccoli		2002	38	0.07	3,100
Cabbage fresh		2002	38	0.06	3,200
Cauliflower		2002	28	0.07	900
Celery		2002	37	0.09	1,600
Collard		2000	24	0.06	500
Corn sweet fresh		2002	2	0.08	900
Cotton Upland		2001	1	0.05	11,000
Cucumbers fresh		2002	19	0.08	900
eggplant		2000	14	0.09	100
Grapefruit		2001	1	0.11	100
Greens mustard		2000	17	0.06	100
Greens turnip		2000	6	0.06	100
Kale		2000	32	0.07	200
Lemons		1999	12	0.1	800
Lettuce head		2002	71	0.07	18,100
Lettuce other		2002	46	0.08	8,700
Melon cantaloupe		2002	11	0.06	600
Melon honeydew		2002	4	0.1	800
Melon watermelon		2002	4	0.1	800
Nectarines		2001	31	0.09	1,600
Olives		2001	30	0.1	4,725
Oranges		2001	6	0.09	5,100
Peaches		2001	5	0.09	700
Peppers bell		2002	49	0.09	5,600
Plums		2001	10	0.1	600
Potatoes fall		2001	2	0.04	718
Soybeans		2000	0	0.04	5,000
Spinach fresh		2002	34	0.08	1,300
Strawberries		2002	37	0.09	2,000
Tangerines		1999	6	0.09	300
Tomatoes fresh		2002	38	0.08	11,400
Tomatoes proc		2000	2	0.09	500
Winter Squash		2002	9	0.1	800

Appendix Table 4. (cont.) Crop uses of pesticides allowed in organic production based on the most recent year of NASS pesticide use survey data

		Pesticide Type	Most Recent Data Year	Percent Crop Acres Treated	Rate of Application	Pounds Applied
Sulfur		F				
	Almonds		1999	1	10.01	62,300
	Apples		2001	36	4.94	1,274,300
	Asparagus		2002	2	6.88	19,300
	Avocado		1999	2	5.84	9,800
	Beans lima proc		1998	7	1.66	7,100
	Beans snap fresh		2002	27	1.58	165,500
	Blackberries		2001	10	3.82	6,300
	Blueberries		1997	1	5.3	2,600
	Broccoli		1998	0	2.57	1,500
	Cabbage fresh		2002	1	0.98	1,200
	Carrots fresh		2002	6	13.34	74,500
	Carrots proc		2002	16	5.81	13,100
	Cherries sweet		2001	36	6.42	429,300
	cherries tart		2001	89	3.72	471,300
	Collard		2000	3	2.28	3,000
	Cotton upland		2000	0	1.19	38,000
	Cucumbers fresh		2002	6	0.92	3,500
	Cucumbers proc		2002	1	0.89	1,100
	Dates		1997	18	54.95	133,800
	eggplant		2000	13	2.31	5,300
	Grapefruit		1999	44	12.72	944,100
	Grapes		2001	79	7.93	38,787,500
	grapes nonbearing		2001	78	8.16	7,233,600
	Grapes raisins		2001	78	8.16	7,233,600
	grapes table		2001	96	5.27	3,911,900
	grapes wine		2001	85	8.57	23,496,400
	Greens mustard		2000	6	1.04	1,100
	Greens turnip		2000	2	2.57	1,200
	Lemons		1999	5	32.96	137,200
	Lettuce head		2002	1	3.1	7,400
	Lettuce other		2002	2	1.84	5,600
	Limes		1999	32	7.88	20,400
	Melon cantaloupe		2002	9	13.24	159,200
	Melon honeydew		2002	7	6.59	129,900
	Melon other		1996	11	11.17	298,400
	Melon watermelon		2002	7	6.59	129,900
	Nectarines		2001	37	5.8	117,300
	Okra		2000	20	1.05	4,700
	Onions bulb		2002	2	0.91	5,000
	Onions dry		2000	1	1.33	3,100
	Orange fresh		1997	0	11.45	8,200
	Orange proc		1997	11	13.17	1,170,400
	Oranges		2001	10	11.53	1,069,200

Appendix Table 4. (cont.) Crop uses of pesticides allowed in organic production based on the most recent year of NASS pesticide use survey data

	Pesticide Type	Most Recent Data Year	Percent Crop Acres Treated	Rate of Application	Pounds Applied
Peaches		2001	62	7.66	2,802,900
Peanuts		1991	27	1.47	1,569,000
Pears		2001	38	10.34	352,600
Pecans		1999	12	6.27	0
Pecans nonbearing		1991	8	3.54	0
Peppers bell		2002	25	1.31	117,800
Pistachios		1999	39	9.88	485,300
Plums		2001	14	4.08	25,500
Potatoes fall		2001	5	2.53	181,000
Prunes		2001	11	10.27	138,700
Pumpkin		2002	8	12.28	37,600
Raisins		1999	75	8.26	6,364,000
Raspberries		1997	1	9.76	2,000
Strawberries		2002	58	3.24	256,800
Sugarbeets		2000	11	25.13	7,595,000
Tangelos		2001	11	20.09	53,900
Tangerines		1999	25	14.85	185,600
Temples		2001	19	22.22	50,000
Tomatoes fresh		2002	18	4.13	231,500
Tomatoes proc		2002	51	23.91	4,775,900
Winter Squash		2002	16	2.63	65,500
Tetradecen-1-OL (Z)	O				
Apples		2001	0	0.08	100
Grapes		2001	1	0.001	5
Tetradecen-1-yl (E)	O				
Grapes		2001	1	0.004	21
Z-8-Dodecenol	O				
Apples		2001	1	0.03	50
Nectarines		2001	18	0.01	112
Peaches		2001	11	0.01	210
Z-8-Dodecenyl acetate	O				
Apples		2001	1	0.03	100
Nectarines		2001	18	0.03	300
Peaches		2001	11	0.03	600