US EPA ARCHIVE DOCUMENT

TEXT SEARCHABLE DOCUMENT

US EPA ARCHIVE DOCUMENT

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON D.C., 20460

PC Code: 014002
DP Barcode: 339286

MEMORANDUM

Subject: Registration Review – Preliminary problem formulation for the Ecological Risk Assessment of Cyanamide (Hydrogen Cyanamide)

To: Dana Friedman
Reregistration Branch 2
Special Review and Reregistration Division

From: William P. Eckel, Ph.D., Senior Physical Scientist William P. Eckel 9/14/07
Carolyn Hammer, Environmental Scientist Carolyn Hammer 9/14/07

Through: Dana Spatz, Acting Chief 9/14/07
Environmental Risk Branch 2
Environmental Fate and Effects Division
Office of Pesticide Programs

Attached is the preliminary problem formulation for the ecological risk assessment to be conducted as part of the Registration review of the plant growth regulator cyanamide.

2066639

REGISTRATION REVIEW

ECOLOGICAL RISK ASSESSMENT PROBLEM FORMULATION FOR:

CYANAMIDE

$H_2N\text{-}C{\equiv}N$

PREPARED BY:

William P. Eckel, Ph.D., Senior Scientist
Carolyn Hammer, Environmental Scientist
Environmental Risk Branch 2

APPROVED BY:

Dana Spatz, Acting Chief
Environmental Risk Branch 2
Environmental Fate and Effects Division
Office of Pesticide Programs

US EPA ARCHIVE DOCUMENT

STRESSOR SOURCE AND DISTRIBUTION

Hydrogen cyanamide, (Dormex, EPA Reg. No. 54555-2) is a restricted use plant growth regulator currently registered (under Section 3 of FIFRA) for use on apples, blueberries, cherries, grapes (wine and raisin; desert; non-desert) kiwi fruit (California only), peaches and nectarines. It is registered under FIFRA section 24c on the following crops: blackberries in Georgia (GA03000600), figs in California (CA04000200) and grapes in Hawaii (HI03000300). Hydrogen cyanamide is applied as a single airblast or backpack spray to the plant buds approximately 30 days before bud break to synchronize blossoming and/or produce a more uniform bud break in plants that have received less than their full chill hour requirement. The maximum label rates are presented in Table 1.

Table 1. Maximum label rates for cyanamide

Use Site	Max. Rate per App	Max. Rate Unit/Area *UG	Form	Max.# Apps cc & yr	Max. App Rate/ cc & yr	Min. App Interval (days)	Application Equipment //Type (Reg # Code)
FOOD/FEED USES							
apple	17.6	lb A	SC/L	NS	NS	NS	Sprayer //Spray (a)
blackberry	13.2~	lb A	SC/L	NS	NS	NS	Sprayer //Spray (a)
blueberry	6.6	lb A	SC/L	NS	NS	NS	Sprayer //Spray (a)
cherry	17.6	lb A	SC/L	NS	NS	NS	Sprayer //Spray (a)
fig	17.6~	lb A	SC/L	1/cc	NS	NS	Sprayer //Spray (a)
grapes	17.6~	lb A	SC/L	NS	NS	NS	Sprayer //Spray (a)
kiwi fruit	17.6	lb A	SC/L	NS	NS	NS	Sprayer //Spray (a)
nectarine	6.6	lb A	SC/L	NS	NS	NS	Sprayer //Spray (a)
peach	6.6	lb A	SC/L	NS	NS	NS	Sprayer //Spray (a)

US EPA ARCHIVE DOCUMENT

INTEGRATION OF AVAILABLE INFORMATION

The risk assessments available in the docket, and which serve as the basis for this problem formulation, include the following:

- August 26, 1993 Hydrogen cyanamide. Memo of Understanding Concerning the classification of the Use of Hydrogen Cyanamide as a Plant Growth Regulator on Dormant Grape Vines as a Non- Food Use

- December 3, 1993 Hydrogen Cyanamide Risk Characterization Document, California Department of Pesticide Regulation.

ECOLOGICAL EFFECTS

TOXICITY STUDIES

Aquatic Toxicity, Acute.

The acute toxicity (48-hour EC_{50}) of cyanamide to the freshwater invertebrate Daphnia magna is 3.3 ppm ai, which classifies it as highly toxic (Acc. No. 073728).

A shell deposition test (MRID 448047-04) indicated a 96-hour EC_{50} of 2.3 ppm ai, classifying hydrogen cyanamide as moderately toxic to the Eastern oyster. The NOEC was 0.56 ppm.

The 96-hour LC_{50} for mysids (estuarine invertebrate) exposed to hydrogen cyanamide was 6.3 ppm ai, which classifies this compound as moderately toxic to *Mysidopsis bahia*. The NOEC was 1.4 ppm ai (MRID 448047-03).

For the sheepshead minnow (estuarine fish), the 96-hour LC_{50} was determined to be 58 ppm ai, which classifies hydrogen cyanamide as slightly toxic. The NOEC was determined to be 26 ppm ai (MRID 448047-02).

For the bluegill sunfish (warm freshwater fish), the 96-hour LC_{50} was determined to be 88 ppm ai (Acc. No. 073728). For rainbow trout (cold freshwater fish) the 96-hour LC_{50} is 46 ppm ai (MRID 073728). These results classify cyanamide as slightly toxic to fish.

A literature study (Ecotox ref. 18390) of acute toxicity in rainbow trout (cold freshwater fish) indicated an LC_{50} of 1.93 millimolar, or 81.25 ppm ai, which classifies cyanamide as slightly toxic to fish. The European Food Safety Agency (EFSA, 2006) has also reported the 96-hour LC_{50} for rainbow trout as "less than" 64.8 ppm, and the 21-day LC_{50} to be 11.8 ppm, with a NOEC of 7.5 ppm.

EFSA (2006) reported the LC_{50} for the carp (Cyprinus carpio) to be 80.9 mg/L, with a NOEC of 29.9 mg/L.

US EPA ARCHIVE DOCUMENT

Aquatic Toxicty, Chronic.

Guideline data (MRID 44076702) indicate that Cyanamide (50% ai) is highly toxic to daphnid growth and reproduction of young. The most sensitive endpoint was adult length after 21 days of exposure (LOEC=210 ppb and NOEC = 100 ppb). Numbers of young produced per female per reproduction day was affected at a concentration of 410 ppb.

EFSA (2006) reports a 28-day study on the emergence, growth and development of the midge, Chironomus riparius. The lowest effect levels were for development: NOEC = 6.6 mg ai/L and LOEC = 11.2 mg ai/L.

An Early Life Stage test in rainbow trout (MRID 44076701) indicated a LOEC:<0.507 ppm for growth effects and <4.03 ppm for reproduction, NOEC:<0.507 ppm for growth effects and 2.03 ppm for reproduction. Parameters affected included weight, length, days to hatch, days to swimup, hatch survival. This study was rated supplemental because a true NOEC was not established.

Aquatic Plant toxicity

EFSA (2006) has reported the 90.5-hour EC_{50} for growth inhibition in the alga *Selenastrum capriconutum* to be 13.5 ppm, with a NOEC of 1.0 ppm. The 96-hour EC_{50} for growth (cell density) in *Pseudokirchneriella subcapitata* was reported to be 6.7 ppm, with a NOEC of 2.6 ppm. For *Anabaena flos aquae*, the 72-hour EC_{50} for biomass was 0.67 ppm (NOEC 0.05 ppm), and the EC_{50} for growth rate was 0.65 ppm (NOEC 0.11 ppm).

EFSA (2006) reported the 7-day EC_{50} for duckweed (Lemna gibba) to be 2.33 mg ai/L (based on biomass endpoint), with a NOEC of 0.5 mg ai/L.

Terrestrial Animals: Birds

The oral LD_{50} for the bobwhite quail was determined to be 173 mg/kg (Acc. No. 073728), classifying it as moderately toxic. The 8-day dietary LC_{50} for both mallard duck and bobwhite quail was determined to be greater than 5000 ppm (MRID 42178401, 42178402), which categorizes cyanamide as practically non-toxic on a sub-acute dietary basis.

A reproductive study reported by the European Food Safety Agency (2006) showed no adverse effects in bobwhite quail up to 300 ppm in the feed.

Terrestrial Animals: Mammals

The acute oral LD_{50} for the laboratory rat is 300 mg/kg (Acc. No. 073726), which classifies cyanamide as moderately toxic.

US EPA ARCHIVE DOCUMENT

A two-generation rate reproduction study established a NOEL of 25 ppm or 1.25 mg/kg/day. The endpoints affected were decreases in maternal body weight gain and decreased food consumption.

Terrestrial Invertebrates

An acute contact toxicity study (MRID 438669- 02) showed that cyanamide is essentially non-toxic to the honey bee (LD_{50} >36.2 µg ai/bee, and NOEL approximately 12 µg ai/bee.)

Terrestrial Plants

EFSA (2006) reports the results of Tier 2 Seedling Emergence and Vegetative Vigor studies for Cyanamide L 500 (51.1% ai). The results, adjusted for percent active ingredient, and converted to pounds per acre, are given below. The results are expressed as EC_{50} (50% effective concentration). Under USEPA guidelines, the results of such tests are reported as EC_{25}.

Table 2. Tier 2 Seedling Emergence results

Plant	**Genus, species**	**NOEL, lb ai/acre**	**EC_{50}, lb ai/acre**	**Most Sensitive Parameter**
		Monocots		
Corn	Zea mays	> 14.7	> 14.7	Shoot dry weight, height
Oat	Avena Sativa	> 14.7	> 14.7	Shoot dry weight, height
Onion	Allium cepa	0.031	0.79	
Perennial ryegrass	Lolium perenne	36.6	> 14.7	Shoot dry weight
		Dicots		
Cabbage	Brassica oleracea	0.092	2.80	Shoot dry weight
Carrot	Daucus carota	9.33	440	Shoot height
Cucumber	Cucumis sativus	6.66	35.4	Shoot height
Lettuce	Lactuca sativa	35.1	35.1	Shoot dry weight
Tomato	Lycopersicon esculentum	2.34	8.47	Shoot dry weight

Shoot dry weight was the most sensitive seedling emergence endpoint. Allium cepa (onion) was the most sensitive plant, with an EC_{50} value of 0.79 lb ai/acre for cyanamide applied directly to the soil.

US EPA ARCHIVE DOCUMENT

Table 3. Tier 2 Vegetative Vigor results

Plant	Genus (species)	NOEL lbs ai/acre	EC_{50} lbs ai/acre	Endpoint	EC_{50} lbs ai/acre	Endpoint
Monocots						
Corn	Zea mays	7.1	26.8	shoot dry weight	>28.6	shoot height
Onion	Allium cepa	7.1	70.5	shoot dry weight	1527.5	shoot height
Dicots						
Cabbage	Brassica oleracea	14.3	26.3	shoot dry weight	>28.6	shoot height
Cucumber	Cucumis sativus	1.8	9.8	shoot dry weight	14.0	shoot height
Lettuce	Lactuca sativa	3.6	13.4	shoot dry weight	>14.3	shoot height
Soybean	Glycine max	7.1	15.6	shoot dry weight	>28.6	shoot height
Tomato	Lycopersicon esculentum	<0.89	3.1	shoot dry weight	14.8	shoot height

The most sensitive vegetative vigor endpoint was an EC_{50} of 3.1 lb/acre for shoot dry weight in the tomato.

INCIDENT REPORTS

The Agency has received only two ecological incident reports for cyanamide. Both incidents involved damage to crops. In 1993, a spray application of cyanamide to grapes made during stormy weather allegedly resulted in spray drift that caused defoliation of lemon trees in several nearby groves (I000423-001). In 2001, damage allegedly occurred to kiwi vines following direct treatment during winter months with cyanamide and an aliphatic petroleum solvent (I016036-022). The Agency has received no report of any adverse field effects to animals that have been attributed to the use of cyanamide. The Agency also has received no incident report from pesticide registrants concerning cyanamide contamination of ground or surface water.

A lack of reported incidents does not necessarily mean that such incidents have not occurred. In addition, incident reports for non-target plants and animals typically provide information on mortality events only. Reports for other adverse effects, such as reduced growth or impaired reproduction, are rarely received.

US EPA ARCHIVE DOCUMENT

US EPA ARCHIVE DOCUMENT

EXPOSURE CHARACTERISTICS

The available environmental fate data for hydrogen cyanamide indicate that it is not persistent in soil or water, and is not expected to partition into air except by spray drift at the time of application. Abiotic degradation processes (hydrolysis and photolysis) are not important, as metabolism is much quicker. Cyanamide is completely miscible with water, and in batch equilibrium experiments less than 2% of the mass adsorbed to sandy and silt loam soil. Thus, it is expected to be very mobile in soil-water systems. The degradates of cyanamide include simple nitrogen compounds (dicyanodiamide, guanylurea, guanidine, and urea) which are readily utilized as plant nutrients.

Table 4. Fate Properties of Cyanamide

Property	Value	Source
Aqueous solubility	Completely miscible	EFGWB one-liner database 3/24/1993
Vapor Pressure	0.005 mmHg	
Henry's Law constant	6.15E-06 atm-m^3/mol	
Hydrolysis half-life	pH 5: 237 days pH 7: 66 years pH 9: 105 days	EFGWB one-liner database 3/24/1993
Aqueous photolysis half-life	29 days in pH 5 and pH 7 buffers at 25°C	MRID 42178409
Aerobic soil metabolism	Less than 10 days in moist soil; 12 hours in sandy loam soil	MRID 42178410
Soil partitioning	<2% adsorption in sandy, sandy loam, and silt loam soils	MRID 42178415, 42178414
Anaerobic Soil Metabolism	35-day half life in sandy loam soil	MRID 42178412
Aerobic Aquatic Metabolism	Data review pending	

CHARACTERISTICS OF ECOSYSTEMS POTENTIALLY AT RISK

For cyanamide and pesticides in general, the ecosystems at risk are those in close proximity to the use areas. These would include agricultural fields (orchards and vineyards in this case), surrounding terrestrial habitats, and water bodies directly adjacent to treated fields that may receive chemical residues via drift, volatilization, or runoff. Within water bodies, the water column, sediment, and pore water are all compartments of concern, however, given cyanamide's solubility it is most likely to be found in the water column.

Table 5 gives estimates of the national-level usage of cyanamide. More than half of the usage was on grapes, followed by cherries, blueberries, kiwifruit, apples, figs, and prunes/plums. All reported use for figs and kiwifruit was from California; these crops are registered under special local needs labels (FIFRA section 24c labels) in that state. The maps in Figure 1 show where the registered crops were grown in 1997 in the continental U.S. Taken together, the usage and crop locations give an indication of which environments are potentially at risk from cyanamide use.

Organisms of concern include birds, mammals, reptiles, fish, and terrestrial and aquatic invertebrates, plants, and amphibians. Based on the known effects of cyanamide, terrestrial plants may be the primary concern.

The assessment endpoints are intended to reflect population sustainability and community structure within ecosystems and hence relate back to ecosystems at risk. If risks are expected for given species/taxa based on the screening-level assessment, then risks might be expected to translate to higher levels of biological organization.

Table 5
Screening Level Estimates of Agricultural Uses of Cyanamide 014002
Sorted Alphabetically
(4-25-07)

Crop		Lbs. A.I	Percent Crop Treated.	
			Avg.	Max.
1	Apples	4,000	<1	<2.5
2	Blueberries	20,000	10	10
3	Cherries	30,000	5	10
4	Figs *	2,000	N/C	N/C
5	Grapes	100,000	<1	<2.5
6	Kiwifruit *	10,000	N/C	N/C
7	Prunes & Plums	<500	N/C	N/C

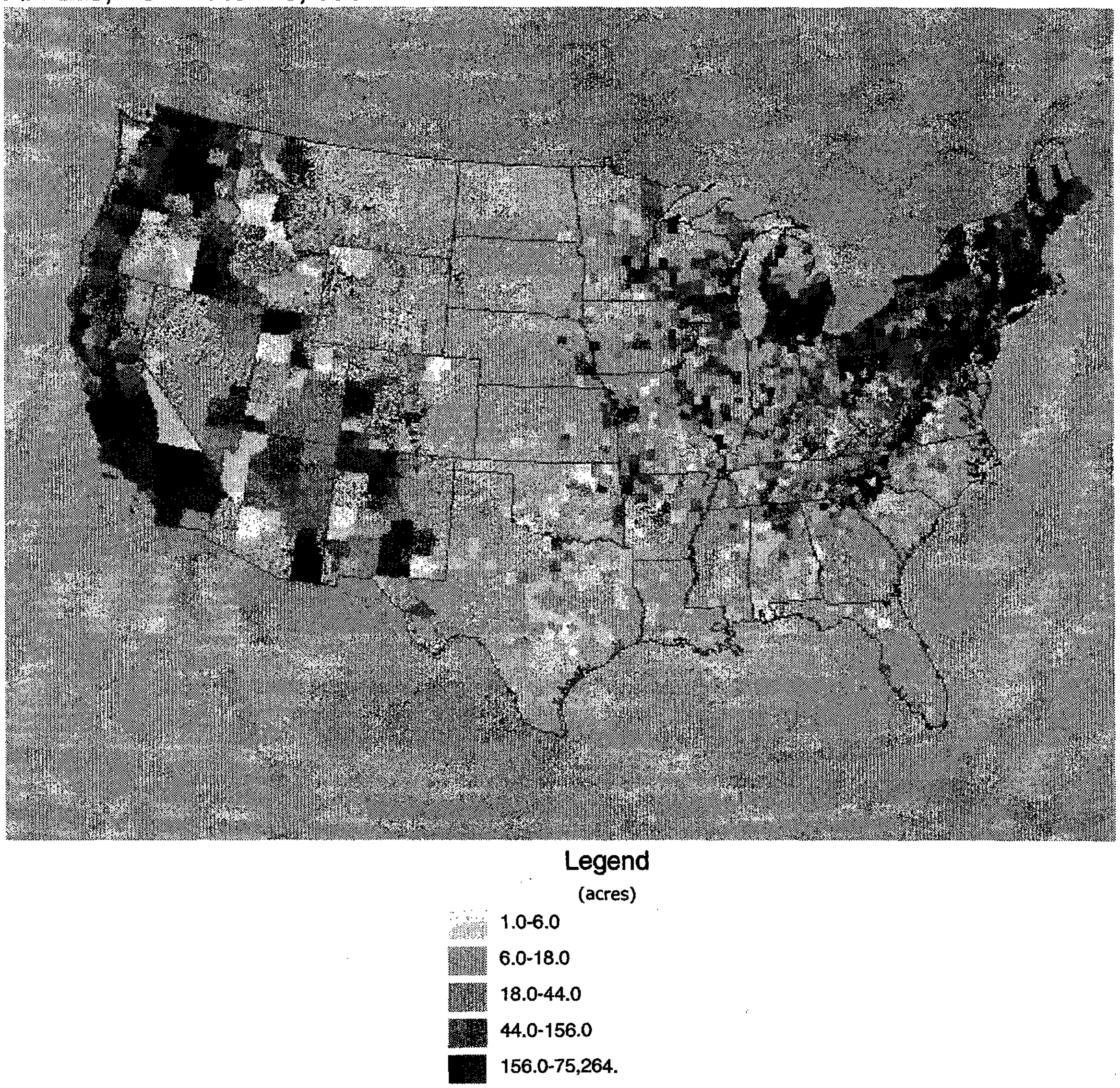
All numbers rounded.
'<500' indicates less than 500 pounds of active ingredient.
'<2.5' indicates less than 2.5 percent of crop is treated.
'<1' indicates less than 1 percent of crop is treated.
* CA data only, but 95% or more of U.S. acres are in California
N/C: Not Calculated

Note:
OPPIN **does not** include "Prunes & Plums" as registered uses for Cyanamide.
OPPIN **does** include "Nectarines" and "Peaches" as registered uses for Cyanamide but no usage has been observed in our usage databases.

US EPA ARCHIVE DOCUMENT

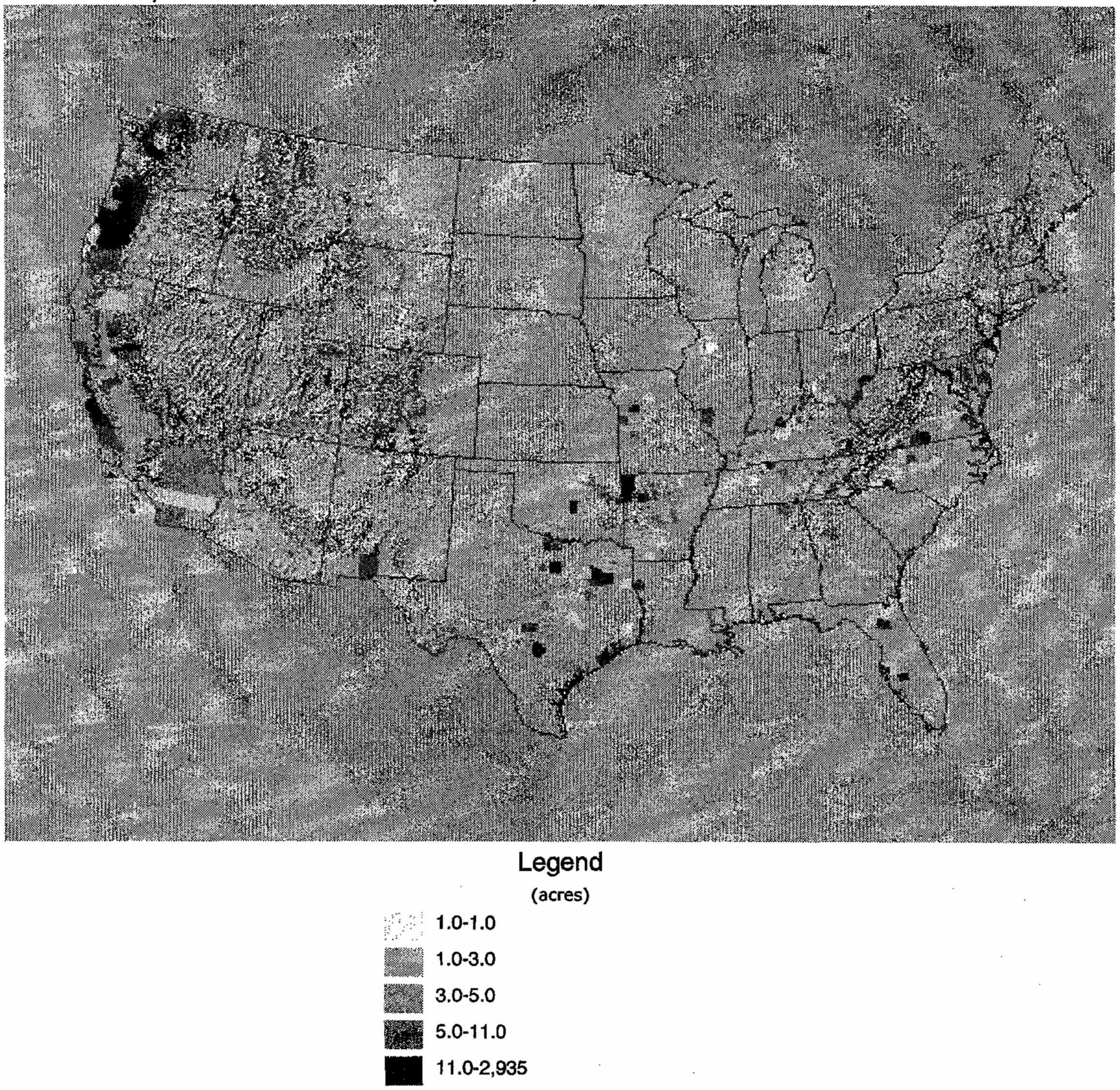
Figure 1. Major Growing Areas in the U.S. Source: USDA Economic Research Service, http://maps.ers.usda.gov/AgResources/, accessed July 31, 2007.

APPLES, TOTAL ACRES, 1997



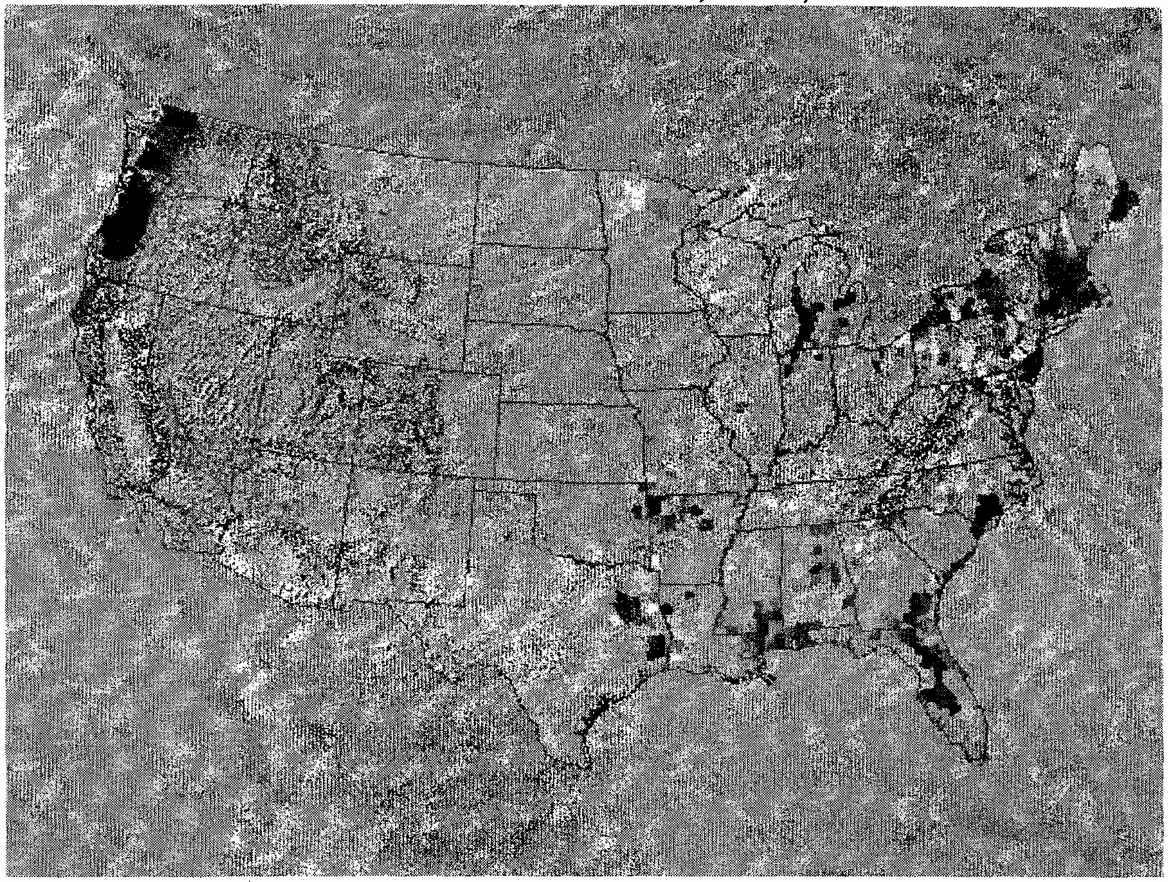
US EPA ARCHIVE DOCUMENT

BLACKBERRIES, POUNDS HARVESTED, ACRES, 1997



US EPA ARCHIVE DOCUMENT

TAME BLUEBERRIES HARVESTED, ACRES, 1997

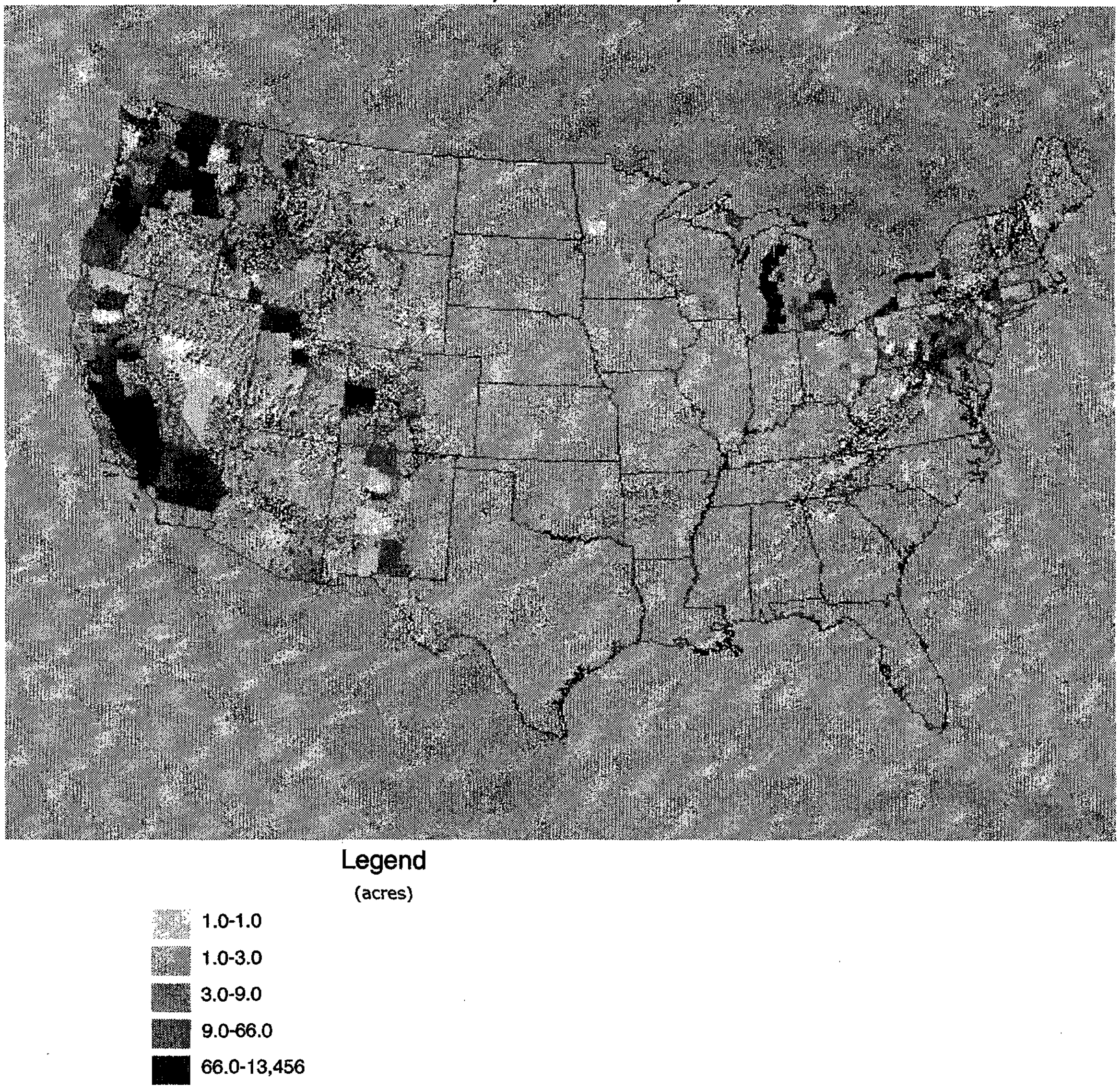


Legend
(acres)

1.0-4.0
4.0-8.0
8.0-19.0
19.0-51.0
51.0-6,635

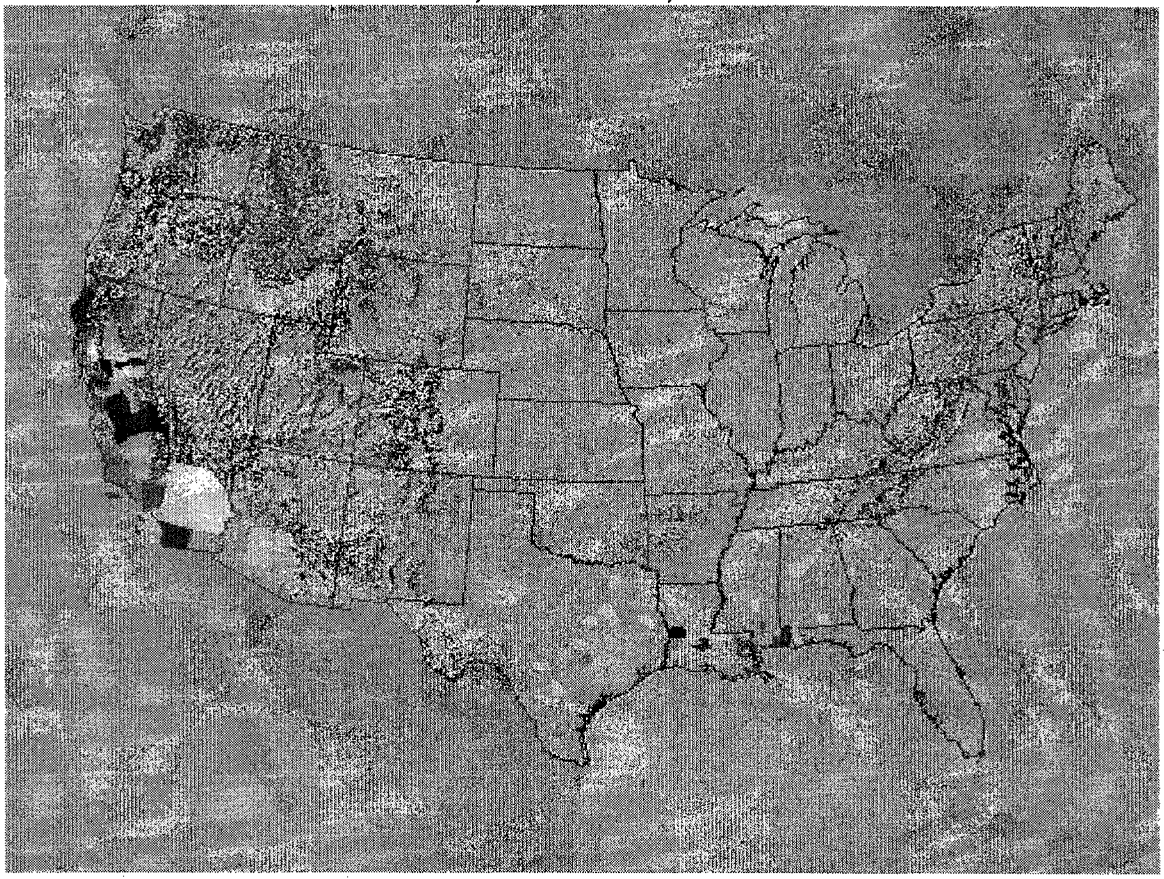
US EPA ARCHIVE DOCUMENT

CHERRIES, TOTAL ACRES, 1997

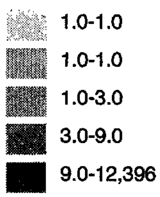


US EPA ARCHIVE DOCUMENT

FIGS, TOTAL ACRES, 1997

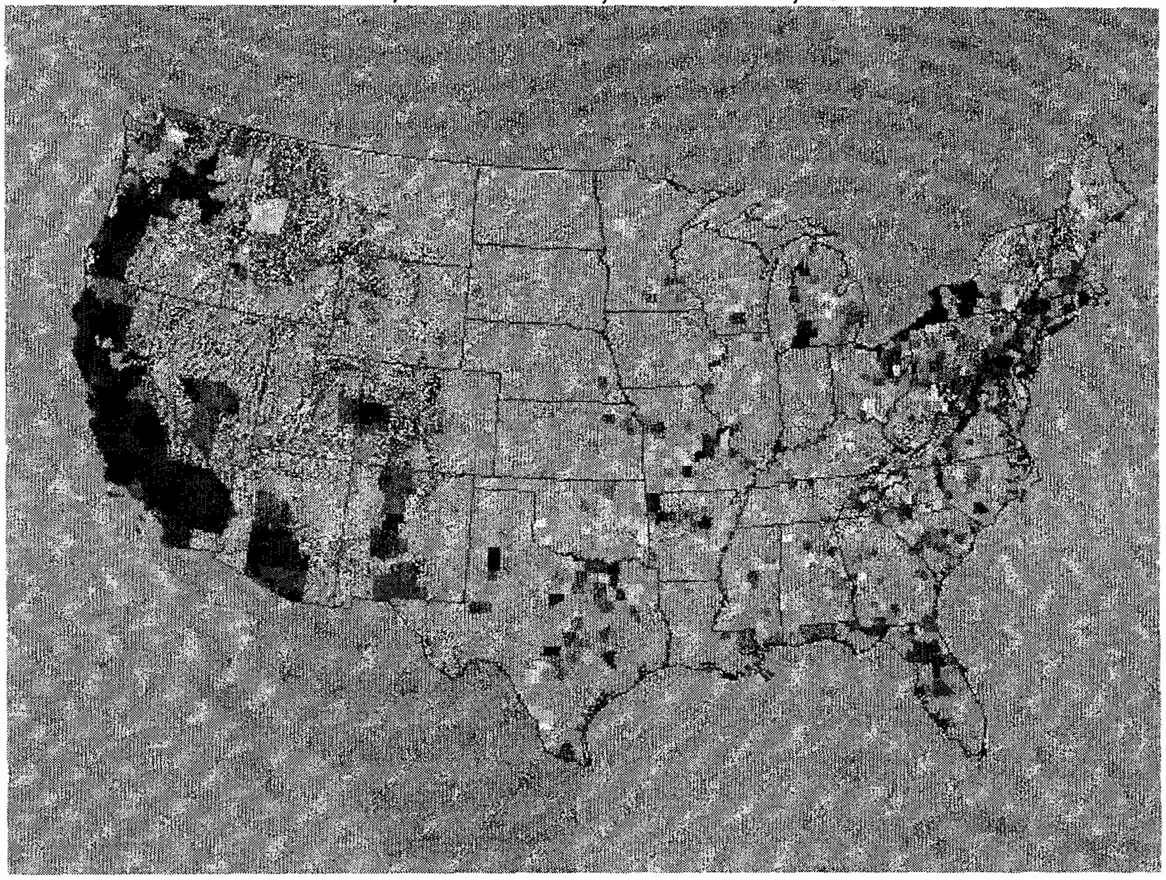


Legend
(acres)



US EPA ARCHIVE DOCUMENT

GRAPES, FRESH WEIGHT, TOTAL ACRES, 1997

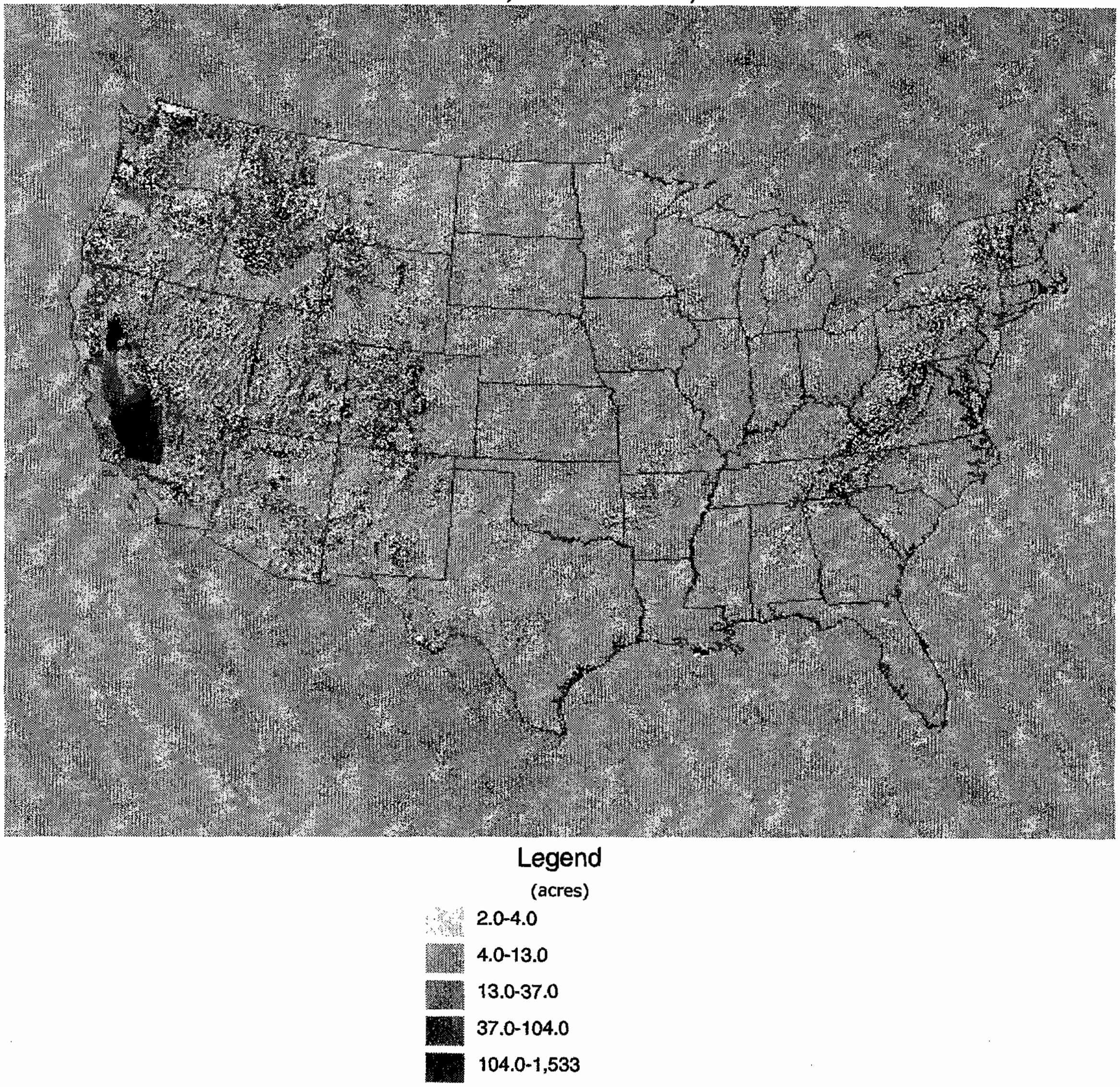


Legend
(acres)

1.0-1.0
1.0-4.0
4.0-11.0
11.0-50.0
50.0-265,544

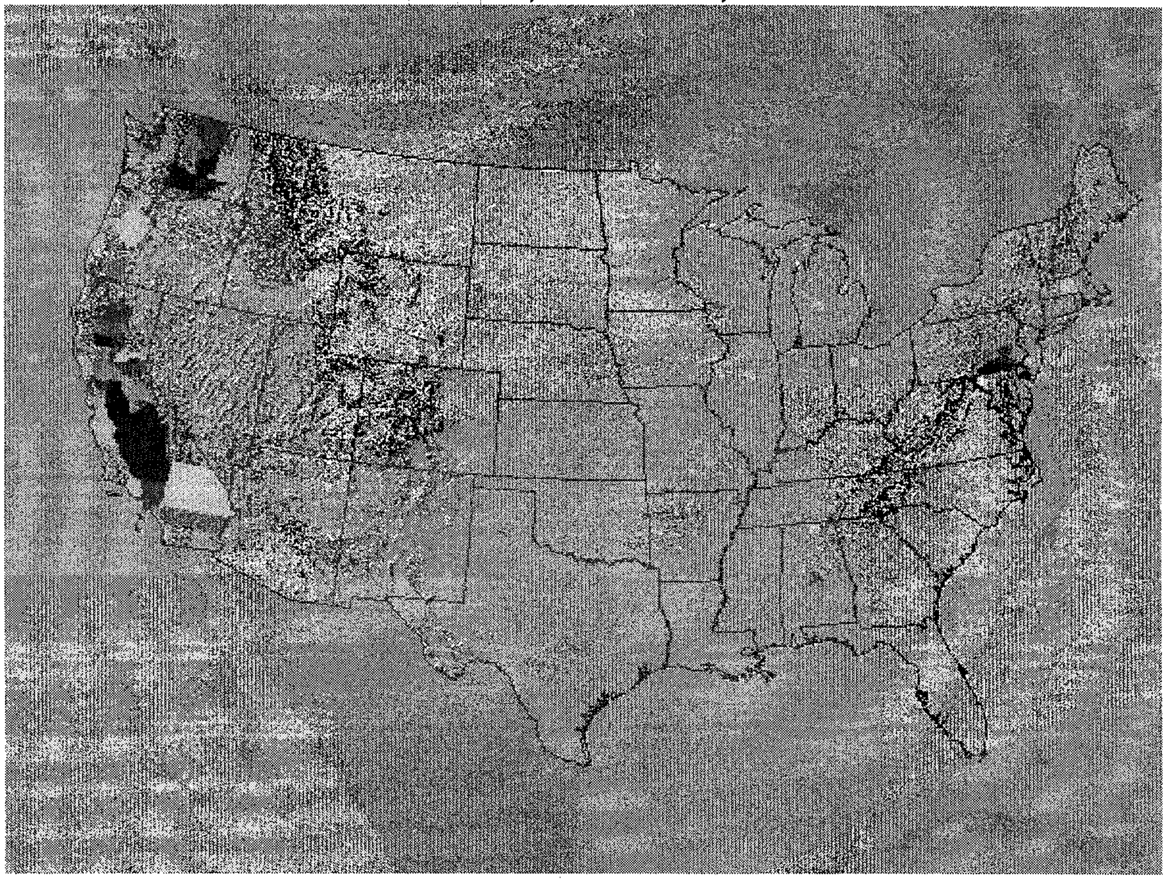
US EPA ARCHIVE DOCUMENT

KIWIFRUIT, TOTAL ACRES, 1997



US EPA ARCHIVE DOCUMENT

NECTARINES, TOTAL ACRES, 1997

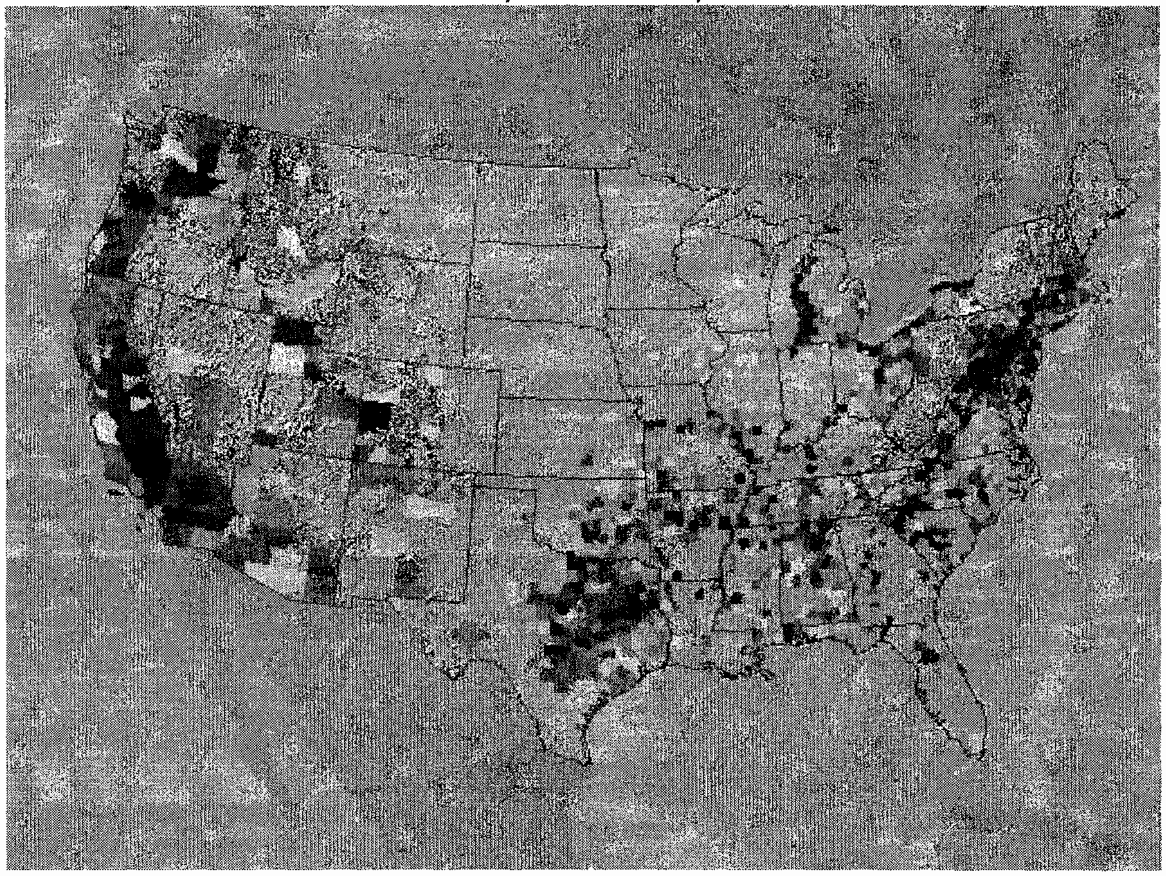


Legend
(acres)

- 1.0-3.0
- 3.0-9.0
- 9.0-30.0
- 30.0-116.0

US EPA ARCHIVE DOCUMENT

PEACHES, TOTAL ACRES, 1997



Legend
(acres)

1.0-3.0
3.0-10.0
10.0-25.0
25.0-73.0
73.0-15,885.

US EPA ARCHIVE DOCUMENT

ASSESSMENT ENDPOINTS

Assessment endpoints are defined as "explicit expressions of the actual environmental value that is to be protected." Defining an assessment endpoint involves two steps: 1) identifying the valued attributes of the environment that are considered to be at risk; and 2) operationally defining the assessment endpoint in terms of an ecological entity (i.e., a community of fish and aquatic invertebrates) and its attributes (i.e., survival and reproduction). Therefore, selection of the assessment endpoints is based on valued entities (i.e., ecological receptors), the ecosystems potentially at risk, the migration pathways of pesticides, and the routes by which ecological receptors are exposed to pesticide-related contamination. The selection of clearly defined assessment endpoints is important because they provide direction and boundaries in the risk assessment for addressing risk management issues of concern. Changes to assessment endpoints are typically estimated from the available toxicity studies, which are used as the measures of effects to characterize potential ecological risks associated with exposure to a pesticide, such as cyanamide.

To estimate exposure concentrations, the ecological risk assessment considers a single application at the maximum application rate to fields that have vulnerable soils. The most sensitive toxicity endpoints are used from surrogate test species to estimate treatment-related direct effects on acute mortality and chronic reproductive, growth and survival assessment endpoints. Toxicity tests are intended to determine effects of pesticide exposure on birds, mammals, fish, terrestrial and aquatic invertebrates, and plants. These tests include short-term acute, sub-acute, and reproduction studies and are typically arranged in a hierarchical or tiered system that progresses from basic laboratory tests to applied field studies. The toxicity studies are used to evaluate the potential of a pesticide to cause adverse effects, to determine whether further testing is required, and to determine the need for precautionary label statements to minimize the potential adverse effects to non-target animals and plants.

Data on the toxicity of cyanamide to aquatic and terrestrial plants has been submitted to the Agency, but has not yet been reviewed for validity. However, given the registered use of cyanamide as a plant growth regulator, and warnings on the label regarding leaf loss and blossom loss in adjacent crops, adverse effects on terrestrial plants are expected to be a major focus of the risk assessment.

In terms of direct effects to terrestrial plants, both dicots and monocots are sensitive to cyanamide. Tests performed using the hydrogen cyanamide indicated that cabbage was the most sensitive dicot to hydrogen cyanamide , with shoot dry weight, as measured during a seedling emergence test, as the most sensitive endpoint (NOEC = 0.092 lbs. a.i./A, EC_{25} = 2.80 lbs. a.i./A). Onion was the most sensitive monocot, with an EC_{50} of 0.79 lbs. a.i./A and an NOAEL of 0.031 lbs. a.i./A in seedling emergence tests.

Because of the potential risk to listed and non-listed plants, unicellular algae, aquatic invertebrates, birds, and mammals, should exposure occur, listed species in all taxa may potentially be affected indirectly due to alterations in their habitat (e.g., food sources, shelter, and areas to reproduce).

US EPA ARCHIVE DOCUMENT

Because of the application timing for cyanamide (30 days before bud break), applications will occur in the winter and early spring. Thus, toxic effects are expected to occur mostly in evergreen plants (e.g., citrus). Leaf loss has been noted in lemon trees exposed to cyanamide. A spray drift buffer to prevent adverse effects in plants will need to be calculated.

Based on a preliminary analysis of exposure, there may be a concern for direct, acute and chronic effects in freshwater invertebrates. This may in turn have indirect effects on consumers of invertebrates such as fish and amphibians via a reduction in available food items.

US EPA ARCHIVE DOCUMENT

CONCEPTUAL MODEL

In order for a chemical to pose an ecological risk, it must reach ecological receptors in biologically significant concentrations. An exposure pathway is the means by which a pesticide moves in the environment from a source to an ecological receptor. For an ecological exposure pathway to be complete, it must have a source, a release mechanism, an environmental transport medium, a point of exposure for ecological receptors, and a feasible route of exposure.

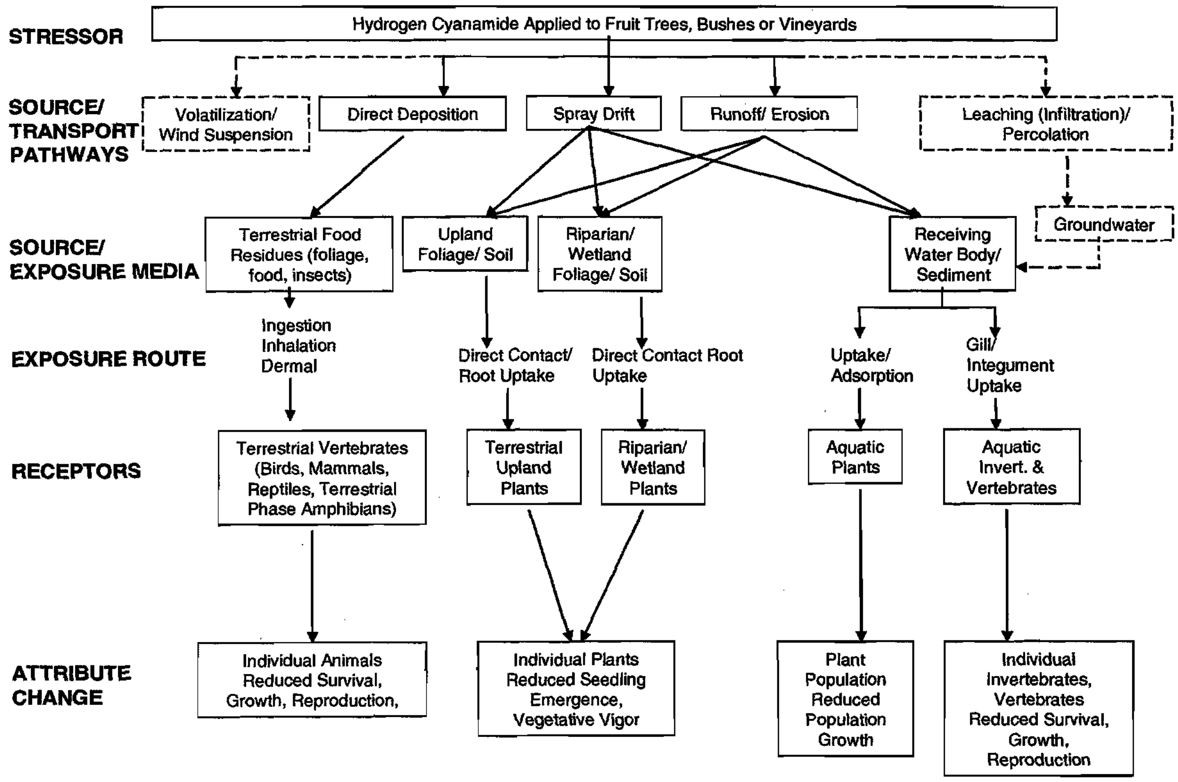
The conceptual model (**Figure 2**) depicts the potential pathways for ecological risk associated with hydrogen cyanamide use. The conceptual model provides an overview of the expected exposure routes for organisms within the hydrogen cyanamide action area. For terrestrial organisms, the major route of exposure considered is the dietary route; consumption of food items such as plant leaves or insects that have cyanamide residues as a result of spraying, drift, and volatilization. Inhalation and dermal exposure may also be important exposure routes, as cyanamide is known to be irritating to the eyes, skin, and respiratory tract. For aquatic animal species, the major routes of exposure are considered to be via the respiratory surface (gills) or the integument. Direct contact and/or root uptake is the major route of exposure for terrestrial and wetland (riparian) plants, while aquatic plants may be exposed via direct uptake and adsorption. Estimated exposure concentrations for all organisms are obtained through the use of several Agency exposure models.

RISK HYPOTHESIS

Based on an examination of the physical/chemical properties of hydrogen cyanamide, the fate and disposition in the environment, and mode of application, a conceptual model was developed that represents the possible relationships between the stressor, ecological receptors, and the assessment endpoints. The major transport pathways for hydrogen cyanamide are spray drift and run-off, resulting in exposure to various terrestrial and aquatic receptors. The Agency has received only two ecological incident reports for cyanamide. Both incidents involved damage to crops. The Agency has received no report of any adverse field effects to animals that have been attributed to the use of cyanamide. The Agency also has received no incident report from pesticide registrants concerning cyanamide contamination of ground or surface water. Based upon the information gathered to date, the risks of concern are primarily related to direct effects on aquatic species and non-target terrestrial plants. Additionally, there is concern for indirect effects on listed species.

US EPA ARCHIVE DOCUMENT

FIGURE 2. ECOLOGICAL CONCEPTUAL DIAGRAM FOR HYDROGEN CYANAMIDE



US EPA ARCHIVE DOCUMENT

ANALYSIS PLAN OPTIONS

In Registration Review, pesticide ecological risk assessments will follow the Agency's Guidelines for Ecological Risk Assessment, will be in compliance with the paper titled "Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs, U.S. Environmental Protection Agency" ("Overview Document") (January 2004), and will be done in accordance with Section 7 of the Endangered Species Act.

Previously completed screening level risk assessments and exceedences of Agency levels of concern indicate a need to further examine and refine acute risk to terrestrial and aquatic plants. Spray drift buffers (300 yards) are currently based on effects to aquatic ecosystems, but need to be revisited based on effects data for both aquatic species and terrestrial plants, and quantitative exposure estimates. Finally, analysis of potential indirect effects on listed species is required.

The Agency wishes to better understand the potential for adverse effects via dermal and inhalation exposure routes, since cyanamide is known to be irritating via these routes.

Table 4 shows the current status of risk assessments for registered uses of hydrogen cyanamide. The inputs for aquatic exposure modeling in previous assessments were based on different assumptions that may affect the resulting RQ values. In addition to refining the terrestrial plant risk assessment, other uncertainties and potential paths forward are described below.

- A series of terrestrial (tier one) and aquatic plant toxicity studies were submitted and are under review. Upon initial screening, the results of the terrestrial plant toxicity studies indicate that a Tier II analysis will be required. The Tier I studies are the same that are referenced in the EFSA (2006) assessment. The EFSA assessment also includes the results of Tier II vegetative vigor and seedling emergence studies by the same authors as the Tier I studies. In the EFSA assessment, the toxicity endpoints reported in each of the terrestrial plant studies are the NOAEL and EC_{50}. It is EFED policy to evaluate risks to plants using the NOAEL/NOAEC and the EC_{25}. The raw data from the Tier II study would be needed in order to calculate the appropriate endpoint (EC_{25}). Risk to plants will be assessed using the TerrPlant model. The following studies have been submitted to fulfill these guideline requirements and are currently under review:

    - 45380701 Meister, A. (2000) Effects of Cyanamide L 500 on the Vegetative Nontarget Plant Species: Tier I: Vegetative Vigor Limit Test: Final Report: Lab Project Number: 7042087: 851-002. Unpublished study prepared by Institut fur Biologische Analytik und Consulting IBACON GmbH. 64 p. {OPPTS 850.4150}

    - 45380702 Meister, A. (2000) Effects of Cyanamide L 500 on the Seedling Emergence of Nontarget Plant Species: Tier I: Seedling Emergence Limit Test: Final Report: Lab Project Number: 7041086: 851-001. Unpublished study prepared by Institut fur Biologische Analytik und Consulting IBACON GmbH. 89 p. {OPPTS 850.4100}

US EPA ARCHIVE DOCUMENT

- 45382201 Hertl, J. (2000) Toxicity of SKW Cyanamide L 500 to Anabaena flos-aquae in an Algal Growth Inhibition Test: Final Report: Lab Project Number: 6677210. Unpublished study prepared by Institut fur Biologische Analytik und Consulting IBACON GmbH. 78 p.

- 45382202 Volkl, S. (2000) (Carbon 14)-Cyanamide Route and Rate of Degradation in Aerobic Aquatic Systems: Lab Project Number: 744952. Unpublished study prepared by RCC, Ltd. 177 p.

- 45406601 Seyfried, B. (2000) Toxicity of Cyanamide L 500 to Pseudokirchneriella subcapitata (Formerly Selenastrum capricornutum) in a 96-Hour Algal Growth Inhibition Test: Lab Project Number: 744963. Unpublished study prepared by RCC Ltd. 76 p. {OPPTS 850.5400}

- 45406602 Hertl, J. (2000) Toxicity of SKW Cyanamide L 500 to the Aquatic Plant Lemna gibba in a Growth Inhibition Test: Final Report: Lab Project Number: 6679240. Unpublished study prepared by Institut fur Biologische Analytik und Consulting IBACON GmbH. 76 p. {OPPTS 850.4400}

- Results of Tier one aquatic exposure modeling (GENEEC) indicate the potential for acute and chronic risk to invertebrates. Tier two modeling (PRZM/EXMS) will be conducted to refine the aquatic expected environmental concentrations (EECs).

- Cyanamide is mobile and not expected to be persistent in water. Therefore, chronic exposure to organisms that inhabit the water column would require repeated applications of cyanamide. Because only one application per crop cycle is allowed, it is unlikely that chronic aquatic exposure will occur. Chronic effects to aquatic organisms are not expected.

  An early life stage test in rainbow trout (MRID 44076701) was submitted. While the study was scientifically sound, it was classified as supplemental because effects were observed at all concentrations tested, and therefore a true NOEC could not be established. The authors of the study responded that a NOEAC could be statistically determined and the study should therefore fulfill the guideline. After consideration of the issue by the EFED Aquatic Biology Technical Team, a NOEAC value was estimated and accepted by EFED (Memo, October 8, 1999). A NOAEC of 0.8 ppm for rainbow trout will be used to evaluate the effects of chronic exposure to freshwater fish. The results of a long-term exposure study with the midge were included in the EFSA (2006) report and will be considered in the risk characterization. There are no chronic effects data for estuarine/marine fish or invertebrates. In the absence of this data, estuarine/marine animals will be assumed to be as sensitivite to cyanamide as freshwater species. It is possible that this assumption will underestimate risk and this uncertainty can only be allievated by chronic toxicity data for saltwater species. There are very few chemical compounds with a similar structure or mode of action. In some cases, EFED uses toxicity data from similar compounds to estimate the relative sensitivity of freshwater and saltwater species. Because there are so few chemicals, which have limited data sets, this method will not be used.

US EPA ARCHIVE DOCUMENT

- Cyanamide is classified as practically non-toxic to birds on an acute oral basis. However, as discussed in the 1993 assessment, high application rates (6.45 to 34 lbs ai/A) resulted in LOC exceedances, indicating the potential for risk to birds. At the time of the previous assessment, no avian reproductive toxicity data had been submitted. Reproductive effects are expected based on the magnitude of acute LOC exeedances. A recently submitted study of bobwhite quail reproductive effects is currently under review and this study will help to clarify the potential for reproductive effecs to birds.

- Cyanamide is classified as moderately toxic to mammals on an acute basis, but like birds, the high application rates result in LOC exeedances indicating the potential for risk to mammals. Risks to birds, mammals and insects will be evaluated using TREX. Additionally, indirect effects to birds and mammals due to effects on plant species will be considered.

- The product label specifies a buffer of 300 yards between the edge of the application area and any water bodies to protect wildlife and plants. Using tier II models, PRZM/EXMS, AgDrift, and AgDisp, this buffer will be re-evaluated. Organisms of concern include aquatic invertebrates and plants. The appropriate buffer to protect each of these taxa will be calculated separately.

If the planned ecological risk assessment indicates that cyanamide may potentially impact, either directly or indirectly, listed species or critical habitat, and therefore does not support a "not likely to adversely affect" determination, further refinements will be made. This will involve determining whether use of cyanamide "may affect" a particular listed species, and if so, whether it is "likely to adversely affect" the species, or in the case of critical habitat, whether use of the pesticide may destroy or adversely modify any principle constituent elements for the critical habitat, and if so, whether the expected impacts are "likely to adversely affect" the critical habitat. The first step in the process is to improve the exposure estimates based on refining the geographic proximity of cyanamide's use and the listed species and/or critical habitat. If there is no geographic proximity, this information would support a determination that cyanamide use will have no effect on the species or critical habitat. If after conducting the first step of this analysis the Agency determines that geographic proximity exists, both potential direct effects and any potential indirect effects of the pesticide use will be examined. This process is consistent with the Agency's Overview Document. The Agency will consult as necessary with the U.S. Fish and Wildlife Service and National Marine Fisheries Service (Services), consistent with the Services' regulations.

If the screening level risk assessment identifies potential concerns for indirect effects on listed species for those organisms dependent upon terrestrial plants, the next step for EPA and the Services would be to identify which listed species and critical habitat are potentially implicated. Analytically, the identification of such species and critical habitat can occur in either of two ways. First, the agencies could determine whether the action area overlaps critical habitat or the occupied range of any listed species. If so, EPA would examine whether cyanamide's potential impacts on non-endangered species would affect the listed species indirectly or directly affect a constituent element of the critical habitat. Alternatively, the agencies could determine which listed species depend on biological resources, or have constituent elements that fall into, the taxa

US EPA ARCHIVE DOCUMENT

that may be directly or indirectly impacted by cyanamide. Then EPA would determine whether the use of cyanamide overlaps the critical habitat or the occupied range of those listed species.

ANTICIPATED DATA NEEDS

The Agency does not foresee requiring any additional environmental fate studies listed in 40 CFR Part 158 prior to conducting the planned assessments. However, there is currently insufficient data on terrestrial plant toxicity to complete this assessment. Tier II vegetative vigor and seedling emergence studies are a data gap. There are no submitted studies of the reproductive effects of chronic exposure to estuarine organisms. Submission of these studies will reduce uncertainty. In the absence of chronic estuarine/marine toxicity data, effects to salt water organisms will be assumed equivalent to effects on freshwater species.

The Agency will also conduct a search of the open literature to ensure that all best available science is utilized. The Agency uses the ECOTOX database as its mechanism for searching the open literature for ecological effects information. ECOTOX integrates three previously independent databases - AQUIRE, PHYTOTOX, and TERRETOX - into a system which includes toxicity data derived predominately from the peer-reviewed literature, for aquatic life, terrestrial plants, and terrestrial wildlife, respectively.

Terrestrial Toxicity

- Plants, Tier II; we have received the Tier I vegetative vigor and seedling emergence studies, however, the data do not provide enough information to determine that there is no risk to plants, and therefore risk will be presumed. The raw data from the Tier II plant study presented in the EFSA assessment would greatly reduce this uncertainty.

OTHER INFORMATION NEEDS

There is specific information that will assist the Agency in refining the ecological risk assessment, including any species-specific effects determinations. The Agency is very much interested in obtaining the following information:

1. use or potential use distribution (e.g., acreage and geographical distribution of relevant crops)
2. use history
3. median and 90th percentile reported use rates (lbs. a.i./acre) from usage data – national, state, and county
4. sub-county crop location data
5. directly acquired county-level usage data (not derived from state level data)
    a. maximum reported use rate (lbs. a.i./acre) from usage data – county
    b. percent crop treated – county
    c. median and 90th percentile number of applications – county
    d. total pounds per year – county
    e. the year the pesticide was last used in the county/sub-county area
    f. the years in which the pesticide was applied in the county/sub-county area

US EPA ARCHIVE DOCUMENT

6. state or local use restrictions
7. ecological incidents (non-target plant damage and avian, fish, reptilian, amphibian and mammalian mortalities) not already reported to the Agency
8. monitoring data
9. clarification on the maximum labeled rates, especially for apples, cherry, nectarine, blueberry, and peaches.

The analysis plan will be revisited and may be revised depending upon the data available in the open literature and the information submitted by the public in response to the opening of the Registration Review docket.

TABLE 4
CURRENT STATUS OF ECOLOGICAL RISK ASSESSMENT FOR REGISTERED USES OF HYDROGEN CYANAMIDE
(CROP AND USE INFORMATION PROVIDED BY BEAD)

Crop	Form	Application rate Previously Assessed (lbs. a.i./A)	Included in Previous EFED Screening Risk Assessment?	LOC's Exceeded in Tier I Screening Risk Assessment (?: not determined) RQ is in parenthesis
apple	SC/L	34.4	Yes	Birds: acute (0.3 to 23.86) Mammals: acute (0.26 to 26.14), chronic (20.64 to 330) Terrestrial Plants: ? Freshwater Fish: none Freshwater Invertebrates: chronic (1.32) Estuarine/Marine Fish: ? E-M Invertebrates: ? Aquatic Plants:
blackberry	SC/L	13.2~	Yes	Birds: Mammals: Terrestrial Plants: Freshwater Fish: none Freshwater Invertebrates: chronic (1.32) Estuarine/Marine Fish: E-M Invertebrates: Aquatic Plants:
blueberry	SC/L	6.45	Yes	Birds: acute (0.06 to 4.47) Mammals: acute (0.05 to 4.90), chronic (3.88 to 61.92) Terrestrial Plants: ? Freshwater Fish: none Freshwater Invertebrates: none Estuarine/Marine Fish: ? E-M Invertebrates: ? Aquatic Plants:?
cherry	SC/L	34.4	Yes	Birds: acute (0.3 to 23.86) Mammals: acute (0.26 to 26.14), chronic

US EPA ARCHIVE DOCUMENT

Crop	Form	Application rate Previously Assessed (lbs. a.i./A)	Included in Previous EFED Screening Risk Assessment?	LOC's Exceeded in Tier I Screening Risk Assessment (?: not determined) RQ is in parenthesis
				20.64 to 330.24) Terrestrial Plants: ? Freshwater Fish: none Freshwater Invertebrates: chronic (1.32) Estuarine/Marine Fish: ? E-M Invertebrates: ? Aquatic Plants:?
nectarine	SC/L	12.9	Yes	Birds: acute (0.11 to 8.95) Mammals: acute 0.1 to 9.8), chronic 7.76 to 123.84) Terrestrial Plants: ? Freshwater Fish: none Freshwater Invertebrates: none Estuarine/Marine Fish: ? E-M Invertebrates: ? Aquatic Plants: ?
peach	SC/L	12.9	Yes	Birds: acute (0.11 to 8.95) Mammals: acute (0.1 to 9.8), chronic (7.76 to 123.84) Terrestrial Plants: ? Freshwater Fish: none Freshwater Invertebrates: none Estuarine/Marine Fish: ? E-M Invertebrates:? Aquatic Plants: ?
fig	SC/L	17.6~	No	Birds: Mammals: Terrestrial Plants: Freshwater Fish: Freshwater Invertebrates: Estuarine/Marine Fish: E-M Invertebrates: Aquatic Plants:
grapes	SC/L	17.6~	No	Birds: Mammals: Terrestrial Plants: Freshwater Fish: Freshwater Invertebrates: Estuarine/Marine Fish: E-M Invertebrates: Aquatic Plants:
kiwi fruit	SC/L	17.6	No	Birds: Mammals: Terrestrial Plants: Freshwater Fish: Freshwater Invertebrates: Estuarine/Marine Fish: E-M Invertebrates: Aquatic Plants:

US EPA ARCHIVE DOCUMENT

US EPA ARCHIVE DOCUMENT