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FENAMIPHOS

ENVIRONMENTAL RISK

ASSESSMENT

provided for
SRRD

by
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C. ENVIRONMENTAL RISK ASSESSMENT

Executive Summary. Fenamiphos is a broad spectrum insecticide and nematicide which belongs to the chemical class of compounds called the organophosphates. Developed during World War II as nerve gases for warfare, organophosphates are toxic organic compounds which contain phosphorus. Their pesticidal properties were discovered in 1943 with the introduction of the first organophosphate insecticide. Organophosphate insecticides kill animals, including insects, by inhibiting cholinesterase, a vital enzyme of the nervous system. Reduction in blood plasma cholinesterase results in disruption of essential nerve activity at nerve endings, thereby interrupting transmission of nerve impulses in the brain, muscles, and glands of the exposed individuals.

Because of its chemical characteristics, fenamiphos is a pesticide that may leach to ground water in vulnerable areas and may runoff into surface waters. Fenamiphos has the potential to contaminate surface water through ground spray drift and runoff. Soil incorporation will reduce but not eliminate the amount of fenamiphos available for runoff. Fenamiphos has a relatively low soil/water partition coefficient; therefore, rather than adsorbing to soil, fenamiphos will dissolve in water and may be available to leach/runoff for several weeks post-application.

Parent fenamiphos is relatively mobile with Kd values in four soils ranging from 0.95 to 3.4 mL/g. From laboratory studies, the sulfoxide and sulfone degradates are more mobile than the parent. Parent fenamiphos has the potential to be moderately persistent under certain conditions. Although the aerobic half-life is short, the anaerobic soil metabolism half-life for the parent is approximately 88 days (13 weeks) which indicates that it will be more persistent in ground water. Persistence data are incomplete for the degradates, but in soil, they appear to be at least as persistent as the parent. Also, both desisopropyl fenamiphos sulfoxide and fenamiphos sulfone have been detected in ground water in Florida, indicating that they are both sufficiently persistent to leach in some environments.

The available acute toxicity data on the technical indicate that fenamiphos is *very highly toxic* to birds (LD_{50} = 1.6 mg/kg; LC_{50} = 38 ppm), *very highly toxic* to mammals (LD_{50} = 2.38 mg/kg, rat), *highly toxic* to bees (LD_{50} 1.87 µg/bee), *very highly toxic* to freshwater fish (LC_{50} = 9.5 ppb), *very highly toxic* to freshwater invertebrates (LC_{50} = 1.3 ppb), and *very highly toxic* to estuarine/marine animals (LC_{50} = 6.2 ppb). The available acute toxicity data on the major degradates, desisopropyl fenamiphos sulfoxide and fenamiphos sulfone, indicate they are *very highly toxic* to mammals (LD_{50} = 3.7 and 2.6 mg/kg, rat) and *moderately toxic* to freshwater fish (LC_{50} = 2.7 and 1.2 ppm, respectively). In addition, fenamiphos sulfoxide is *very highly toxic* to freshwater invertebrates (LC_{50}= 7.5 ppb).

Based on risk quotients calculated using laboratory toxicity data and the estimated environmental concentrations, fenamiphos, as a granular and emulsifiable concentrate, exceeds both the high acute and chronic risk levels of concern for terrestrial and fresh water organisms and the acute risk levels of concern for estuarine/marine organisms. The results of an aquatic mesocosm study, actual field (terrestrial and aquatic) studies, and field incidents confirm these findings. A detailed environmental fate and integrated ecological risk characterization follows.

1. Environmental Fate and Integrated Ecological Risk Characterization

a. Environmental Fate Characterization

(1) Chemical and Physical Parameters

Because of its chemical characteristics, fenamiphos is a pesticide that may leach to ground water in vulnerable areas and/or may runoff into surface waters. Parent fenamiphos is soluble to 400 mg/L in water and does not hydrolyze at environmental pH's. It has a Henry's Law Constant of 1.0×10^{-9} atm*m^3/mol and a vapor pressure of 1.3×10^{-6} Torr at 20 °C. Parent fenamiphos is relatively mobile with Kd values ranging from 0.95 to 3.4 mL/g. From laboratory studies, the sulfoxide and sulfone metabolites are more mobile than the parent. Parent fenamiphos has the potential to be moderately persistent under certain conditions. Although the aerobic half-life is short, the anaerobic soil metabolism half-life for the parent is approximately 88 days (13 weeks) which indicates that it will persist once it reaches ground water. Persistence data are incomplete for the degradates, but in soil, they appear to be at least as persistent as the parent.

(2) Effect on Ground-Water Quality

Because of their chemical characteristics, fenamiphos and its major degradates have the potential to leach to ground water in vulnerable areas. Evidence of leaching in the field exists but it is limited since monitoring has only been conducted in six states and often not in fenamiphos use areas. Because an Maximum Contaminant Level has not been established for fenamiphos and its degradates, no monitoring is required under the Safe Drinking Water Act. The two major fenamiphos use states, California and Florida have monitored for fenamiphos, but this pesticide is also used in 27 other states where no reliable monitoring data are available. The most extensive ground-water monitoring studies for fenamiphos have been conducted in Florida. All data are presented in Table 6.

In 1992, the registrant agreed to conduct three prospective studies in major use areas: the Florida study began in 1995 and ended in 1996; the Georgia study on tobacco began in 1996 and was terminated recently; the California study on grapes began in October 1997, and only preliminary data has been received to date (August 1999). The preliminary data from the Georgia study do not show a pattern of movement to ground water. However, the Agency cannot draw conclusions as to why this is the case until the complete study is submitted for review. The California study has just been initiated and the Agency has received one preliminary monitoring report on the site. It is too early to draw any conclusions about the outcome at the California site. However, unlike the Georgia site, preliminary data do suggest a pattern of movement to ground water.

Data from monitoring in Florida confirmed that fenamiphos and its degradates leach to ground water at high levels, based on detections of fenamiphos in the prospective study on sandy soils at a citrus use site in the Central Ridge of Florida (Dyer, D. G., et al., 1998). Total residues in one sample ranged up to 87.2 ppb, which greatly exceeded the 2 ppb adult lifetime Health Advisory. It is important to note that while fenamiphos can be applied in multiple seasons over many years in a citrus grove in actual practice, this study simulated the impact of a <u>single</u> application. Based on results of this study

fenamiphos use on citrus was banned on the Central Ridge of Florida, and the registrant was requested to identify other similarly vulnerable areas and proposed additional use restrictions in 1997. As a result of this study, fenamiphos is no longer registered for use on citrus in that area. This study is the Agency's only controlled field study investigating the impact of fenamiphos use on ground-water quality in an area overlain by sandy soils. It is a suitable surrogate for other areas where sandy soils occur and ground-water tables are shallow, particularly in the south-east portion of the country.

An earlier retrospective monitoring study (Lenz, M.F., 1997) reflecting the impact of multiple years of fenamiphos use on Florida citrus reported a high total residue concentration of 252.8 ppb, with maximum total residues in 4 of 6 on-site wells exceeding 65 ppb. The Agency required that a ground-water label advisory be placed on the fenamiphos label as a result of this retrospective study, and, along with the State of Florida, further required additional prospective studies be conducted to more clearly establish the relationship between use according to the label and ground-water impacts.

In California, fenamiphos is on the Ground Water Protection List, indicating that there is a concern for ground-water contamination in the State (Segawa, 1996). The List was created so that monitoring could be conducted for certain pesticides for which there was a ground-water concern. Ground-water monitoring has been conducted for fenamiphos in drinking water wells in the fenamiphos use area and in other wells. To date, no fenamiphos have been reported. Other states including Mississippi, Oregon, Texas, and Washington have conducted some limited ground-water monitoring for fenamiphos. Results from these studies are inconclusive because fenamiphos use areas did not necessarily coincide with monitoring sites and generally only parent fenamiphos was analyzed. No residues were found in any of the wells in these states.

(3) Effect on Surface-Water Quality

Fenamiphos has the potential to contaminate surface water via drift from ground application and runoff.

EFED has only limited monitoring data on the concentrations of fenamiphos and degradates in surface water. Water supply systems are not required to sample and analyze for fenamiphos because it is not currently regulated under the Safe Drinking Water Act (SDWA).

Because reliable monitoring data are not available, the surface water assessment of fenamiphos is based on results of the screening model GENEEC and the model PRZM/EXAMS. GENEEC modeling was conducted for 25 uses, and Tier II PRZM/EXAMS modeling was completed for major crops, with the exception of turf. These major crop groupings are cotton, grapes, peanuts, stone fruits and tobacco. Tier II modeling was not conducted for fenamiphos application to turf because the PRZM 2 model cannot account for the effect of thatch on fate and transport properties of pesticides applied to turf. It is important to note that the modeling results represent estimates of fenamiphos parent concentrations only. The sulfoxide and sulfone degradates are reported to be at least as persistent as fenamiphos in soil and are more mobile. Consequently, they will be available for runoff at least as long as fenamiphos.

Use of fenamiphos on apples, citrus, cotton, and turf could have potentially significant impacts on surface water used for drinking because of hydro-geophysical characteristics of the soil in the regions where these crops are grown. Although fenamiphos is not widely used on some of these crops, the correlation between high use and detections in water resources is very tenuous and, therefore, the impact could be high although the use is low. The estimated acute and chronic concentrations of fenamiphos in surface water for all modeled uses are in Table 5.

The typical incorporation of fenamiphos into the soil should limit the fraction available for runoff. However, relatively high application rates coupled with only moderate susceptibility to biodegradation could result in substantial quantities of fenamiphos available for runoff for several weeks post-application. Although laboratory studies indicate that fenamiphos is susceptible to rapid photodegradation on soil, most of the chemical will be below the top one millimeter of soil and; therefore, will not be exposed to solar irradiation. The susceptibility of fenamiphos to rapid direct aqueous photolysis should greatly limit its persistence in clear, shallow water. However, its resistance to abiotic hydrolysis, its low potential for volatilization from surface water, and only a moderate susceptibility to biodegradation should make its persistence longer in deeper and/or unclear waters, particularly those with low microbiological activities and long hydrologic residence time. An anaerobic soil metabolism half-life of greater than 60 days indicates that it may be substantially more persistent in typically anaerobic sediment/lower water column than in the typically aerobic upper water column. The soil/water partitioning of fenamiphos indicates that its concentration in sediment pore water at equilibrium will be comparable to or somewhat lower than its concentration adsorbed to suspended and bottom sediments. Concentrations in the water column near the sediment interface should be comparable to those in sediment pore water but should decrease in the direction of the water surface.

b. Integrated Ecological Risk Characterization

Environmental factors can greatly modify the fate and distribution of fenamiphos. Like other chemical stressors, fenamiphos can be biotransformed by microbial communities or other environmental fate processes, which influences the degree of exposure to ecological components. Spatial and temporal distributions of ecological components must also be considered in relation to fenamiphos' use. In addition, attributes of individual species must be considered such as habitat needs, food preferences, reproductive cycles, and seasonal activities.

As stated in the fate section of this document (Section 3a), it appears that fenamiphos dissipates in the soil by microbial degradation to fenamiphos sulfoxide and sulfone followed by leaching into the soil. Eventually, further degradation occurs via aerobic and anaerobic soil metabolism, with respective degradation half-lives of 15.7 and 87.9 days. Parent fenamiphos is soluble in water (400 mg L^{-1}); in addition to microbial degradation, fenamiphos may move offsite after application through runoff and/or leaching. Parent fenamiphos readily photodegrades, with a half-life of 3.23 hours, when exposed to natural light on the soil surface; hence, the label directions recommend incorporating the product below the soil surface through mechanical means or through irrigation directly after application to maintain the efficacy of the active ingredient, fenamiphos.

(1) Summary of the Weight-of-Evidence, Terrestrial

Birds, Reptiles, Terrestrial-Phase Amphibians, and Mammals. Birds, wild mammals, reptiles, and terrestrial stages of amphibians comprise the group of animals called the terrestrial vertebrates.

(a) Spatial and Temporal Patterns of Adverse Effects, Terrestrial
Currently, fenamiphos is labeled for broadcast application to turf, tobacco, kiwi fruit and various ornamentals; however, the predominant risks resulting from broadcast applications are associated with the turf and tobacco uses. The turf and tobacco field studies, and the incident data associated with turf use support these risk conclusions.

Data from several incident reports indicate that fenamiphos caused avian mortality under field conditions. In February of 1990, the Environmental Protection Agency received a report with a certainty index of "highly probable" from Martin County, Florida, about American Robins (*Turdus migratorius*) and Cedar Waxwings (*Bomycilla cedrorum*) killed by a fenamiphos application to turf (See Appendix C for definition of terms.). Tissue sample analyses confirmed that their poisoning was the result of the fenamiphos application. In June of 1995, EPA received a report with a certainty index of "probable" about an accidental poisoning of a Great Blue Heron (*Ardea herodias*) in relation to an application of fenamiphos to a golf course.

On June 6, 1995, the Agency received a report about a family's terrier that walked across a golf course in Florida after the turf had been treated with Nemacur 3. The dog died, and the golf course closed for the day.

From 1994 to 1996, during the reregistration process, mitigation measures were implemented to reduce the risks resulting from fenamiphos use. Labels were amended to incorporate new rate reductions and restrictions for many uses including turf.

In November of 1996, EPA again received a report with a certainty index of "highly probable" from Bay County, Florida, that 28 American Coot (*Fulica americana*) were killed by a fenamiphos application to a golf course. American Coot are slate-colored, duck-like waterfowl which inhabit ponds, lakes, marshes, and salt bays and feed on their shores and surrounding grassy areas. Based on this incident and other incidents involving registered uses of Nemacur, EPA concludes that use of Nemacur on turf can cause bird kills even when the product is used in accordance with current label directions and restrictions (See Appendix C, Table 1C.).

In February of 1998, the Agency received a report with a certainty index of "highly probable" from Fresno County, California, on a bird and fish kill (28 birds and 1,000 fish) due an accidental misuse in a kiwi fruit orchard. The end-use formulations, Nemacur 3, 10G, and 15G, are very highly to highly toxic to mammals on an acute oral basis.

Acute and Chronic Risks Directly After Application. Because of the likely availability on the soil surface and the high potential for terrestrial vertebrate exposure, broadcast applications of Nemacur 3EC and 10G pose the greatest hazard directly after and up-to-24 hours post-application. Although label directions require soil incorporation by mechanical methods or by irrigation to move fenamiphos

down into the soil profile, a portion of the applied fenamiphos will be available, prior to photo-degradation, as (1) granules at the soil surface or (2) in solution as moist fenamiphos-laden soil. (See the exposure assessment and RQ tables in subsequent sections for additional qualification and quantification of the risks.).

Additional but less quantifiable routes of exposure are (1) dermal when birds land in and reptiles or terrestrial-phase amphibians enter the field after treatment and are exposed by fenamiphos-laden soil, and (2) inhalation when these terrestrial vertebrates inhale fumes that may be present at the soil surface directly after and up to 4 hours post-application of Nemacur. Technical fenamiphos is highly to very highly toxic to mammalian species. Other vertebrate species are typically more sensitive, and presumably for dermal and inhalation exposure routes, technical fenamiphos will be very highly toxic to avian, reptilian and terrestrial-phase amphibians.

In 1990, a team of scientists from Utah State University evaluated inhalation, preening, and dermal routes of exposure of an organophosphate pesticide—in addition to the traditional oral route—to determine the relative contribution of *each* to the toxicologic response of Northern Bobwhite Quail. Their findings indicate that dermal exposure and preening are major exposure routes leading to cholinesterase inhibition in birds exposed to field applications of pesticide.[1]

Because fenamiphos and its end-use formulations, Nemacur 3EC, 10G and 15, are highly to very highly toxic to terrestrial vertebrates, dermal, inhalation or oral routes of exposure considered singly or in combination, can result in significant impairment or death of exposed individual(s). Those individuals which survive initial exposure will have decreased ability to escape predation due to depressed blood plasma cholinesterase levels. Even individuals which survive acute exposure and predation may still experience reproductive impairment. The mammalian data submitted to EPA indicate that offspring of those individuals who survive to reproduce will have a higher potential to display developmental abnormalities in both the first (F1) and second (F2) generations. In addition, the F1 generation typically exhibits reduced body weights, depressed blood plasma cholinesterase levels and fewer surviving young.

Acute and Chronic Risks Day-One to Day-Forty Post-Application. Fenamiphos is water soluble, and readily taken up by plants; a systemic pesticide, fenamiphos is translocated throughout the treated plants imparting nematicidal qualities to the crop.

Terrestrial vertebrates, whether they feed on vegetation or on other animals, are dependent directly or indirectly on plant life. Leaves, stems, twigs, bark, buds, fruits, seeds, roots, and sap of different plants all furnish wildlife with food. Next to vegetation, seeds probably constitute the major wildlife food source. Seeds make up the entire diet of some songbirds and are a segment of the diets of ducks, geese, grouse, pheasant and partridges. Of the plants growing in and around the farm field or golf course, grasses are valuable seed sources for wildlife. Fruits and flower heads of many broadleaf plants growing around the field or golf course also serve as a food source for wildlife.

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1 Crystal Driver, Michael Ligotke & al, Utah State University at Logan, Utah, *Routes of Uptake and Their Relative Contribution to the Toxicologic Response of Northern Bobwhite (Colinus virginianus0 to an Organophosphate Pesticide,"* Environmental Toxicology and Chemistry, Volume 10, pp.21-33, 1991.

Therefore, terrestrial vertebrates are likely to be exposed over a longer duration due to their consumption of fenamiphos-treated plant tissues.

Acute Risks from Exposure to Environmental Degradates. In addition, to adverse effects resulting from exposure to parent fenamiphos, terrestrial vertebrates may be exposed to the environmental degradates, fenamiphos sulfone and sulfoxide. These degradates are very highly toxic to birds and mammals. Because reptiles and amphibians, in general, tend to be more acutely sensitive to xenobiotics (manmade chemicals) than birds and mammals, one can presume that these two environmental degradates are very highly toxic to reptiles and amphibians as well. The acute risks to terrestrial vertebrates resulting from acute exposure to the degradates of fenamiphos are high.

Risks from Fenamiphos and Other Pesticides Due to Simultaneous and Sequential Applications. Unless the label of a registered pesticide specifically prohibits tank mixing a particular combination, it is legal in the United States to mix and simultaneously apply pesticides. In addition, labels may specify intervals between multiple applications of the same pesticide, but do not prohibit sequential applications of different pesticides or specify an application interval in these instances. Experiments completed in 1978, and again in 1984, with organophosphate and carbamate insecticides demonstrated that interactions do occur between organophosphate and carbamate insecticides. Treatment of laboratory birds with an organophosphate and later with a carbamate resulted in a 5- to 15-fold decrease in toxicity of the carbamate, whereas treatment with a carbamate and then an organophosphate resulted in a 3- to 8-fold increase in toxicity of the organophosphate.[2, 3]

In summary, spring is the season when plants and animals reappear and reproduce—it is also when the first application of fenamiphos will most likely occur. Many terrestrial species traverse home ranges that are from several acres to several square miles in size, increasing the likelihood of exposure to pesticides during and after treatment. In addition, bird banding studies reveal that many birds return to nest in exactly the same locations every year increasing the likelihood of recurrent exposure if fenamiphos is used on the same treatment areas in subsequent years.[4]

(b) Uncertainties in Risks, Terrestrial

EFED's avian pesticide assessment model is intended as a screening tool; the model compares the results of avian laboratory toxicity tests and Estimated Environmental Concentrations (Risk Quotient Values, RQs) to established criteria (Levels of Concern, LOCs). These LOCs are established such that if a pesticide meets or exceeds these criteria, a substantial question of safety exists. When criteria are established, Acute and Chronic LOCs are developed using the data from 36 pesticides

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2 J. J. Gordon, J. L. Leadbeater, and M. P. Maidment, "The Protection of Animals Against Organophosphate Poisoning by Pretreatment with a Carbamate," Toxicology and Applied Pharmacology, 1978, Volume 43, pp. 207-216.

3 T. H. Miyaoka, T. H. Takahaski, S. Tsuda, and Y. Shirasu, "Potention of Acute Toxicity of 2-Sec-Butylphenyl N-Methylcarbamate (BPMC) by Fenthion in Mice," Fundamental and Applied Toxicology, 1984, Volume 4, pp. 802-807.

4 Ibid., p. 144.

where effects are observed to occur at specified levels.[5] Therefore, the screening criteria are established to account for variability, uncertainty, and ensure that if unreasonable adverse effects are likely, these risks could be identified as LOCs. Because the same assessment model that is used for birds is also used for wild mammals, the same underlying assumptions and uncertainties exist when extrapolating laboratory data to field conditions. However, intraspecific (within a species) extrapolations from the laboratory rodent to the wild rodent, for example, are less an issue than it is for avian laboratory to field extrapolations. Mammalian intraspecies variability is addressed by Dourson and Stara (1983) who analyzed 490 studies and compared probit log-dose slopes. From these they determined that differences due to genetic variability of test species only resulted in a intraspecies uncertainty factor of ten.

(2) Summary of the Weight-of-Evidence, Aquatic

Freshwater and Estuarine/Marine Fish and Invertebrates and Aquatic-Phase Amphibians. Although submitted aquatic data principally focus on fish and aquatic invertebrates, these data are currently extrapolated to include amphibians[6]. Invertebrates species tend to float or drift along in the water source, whereas most fish are strong swimmers and can move freely throughout their respective environments. In general, the ability to escape tends to lessen exposure.

(a) Spatial and Temporal Patterns of Adverse Effects, Aquatic

Fenamiphos is generally applied in the Spring as a single application prior to or at planting for most crop uses. However, banana, plantain, pineapple, turf, citrus, strawberries, protea, anthurium, and nursery stock uses allow for additional applications through the growing season, thereby increasing the extent and magnitude of exposures to aquatic animals living in environments surrounding a treated area. Because fenamiphos and its end-use formulations are highly to very highly toxic to aquatic animal life, because fenamiphos is applied at many pounds of active ingredient per acre for its labeled uses, and because fenamiphos is soluble in water and does not readily bind to soil such fenamiphos, fenamiphos will most likely move offsite into aquatic environments resulting in a cornucopia of predicted adverse effects. The reported incidents associated with turf use on golf course sites and the submitted pond system study (mesocosm) document laboratory findings which indicate that exposed fish and invertebrates will experience mortality and reproductive impairment.

A fish kill occurred while researchers were conducting a turf field study. The kill involved more than 100 fish and was the result of a heavy rain that caused a pond to overflow onto the treated portion of the golf course. With the incident report, the registrant also submitted a paper entitled "Assessment of a New Jersey Lake Contaminated with Fenamiphos," presented by the New Jersey Department of Environmental Protection at the Third National Research Conference in Richmond, Virginia on November 8 and 9, 1990 (MRID 41012902). This paper discusses a fish kill after a golf course was treated with fenamiphos. The first two of a four lake system suffered massive fish kills

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5 Ecological Levels of Concern, A Comparative Analysis, Office of Pesticide Programs, USEPA, Washington, D.C., March 1995.

6 Frogs, toads, salamanders, newts and wormlike caecilians comprise the class, amphibians. These cold-blooded vertebrates have aquatic larval stages which breathe by gills, and adult stages which breathe by lungs.

(200-to-1,000 dead fish) from a Nemacur 10G application to a nearby golf course before a heavy rainfall. Three-thousand and thirty-five pounds of Nemacur 10G was applied over 15.9 acres of golf course (19 lb ai/acre). Since 1981, EPA received numerous reports involving fish kills from fenamiphos uses. However, from 1990 to 1994, EPA averaged three reports per year about massive fish kills (200-to-1,000 dead fish) resulting from granular applications of Nemacur to golf courses in various counties of Florida. The majority of these reports had a certainty index of "highly probable" (See Appendix C for additional explanation of terminology.). Since these incidents, the application rate for Nemacur 10G has been reduced and certain restrictions were imposed (November 8, 1995, see turf field study results in avian section, above); currently only 10 acres can be treated in a 24-hour period on U.S. golf courses, with a maximum seasonal application of 20 lb ai/acre.

Currently, the number of reported fenamiphos incidents appears to be declining, suggesting that massive fish kills caused by fenamiphos application(s) to golf courses are decreasing; but they are not disappearing. In February and June of 1996, EPA again received reports of massive fish kills associated with fenamiphos granular applications to golf courses in two counties of Florida. One incident had a certainty index of "probable" and the other a certainty index of "highly probable;" only one of the two reports appears to be associated with a misuse of Nemacur 10G. Based on these incidents, EFED concludes that use of Nemacur 10G on golf courses can cause fish kills even when the product is used in accordance with current label directions and restrictions.

Risks from Exposure to Environmental Degradates. Aquatic animals also may be exposed to the environmental degradates, fenamiphos sulfone and sulfoxide. With the exception of acute risks to endangered and threatened species, the acute risks to freshwater fish from fenamiphos sulfone and sulfoxide exposure is low because these degradates are acutely only moderately toxic; the acute risks to freshwater invertebrates, however, is high for fenamiphos sulfoxide based on the submitted, supplemental acute toxicity study indicating that fenamiphos sulfoxide is very highly toxic to aquatic invertebrates. Due to the lack of acute toxicity data on the degradate, fenamiphos sulfone, the acute risks to aquatic invertebrates cannot be determined. Similarly, the acute and chronic risks to estuarine/marine animals and the chronic risks to freshwater animals cannot be determined due to the lack of chronic toxicity data.

(b) Uncertainties in Risks, Aquatic

Aquatic exposure models estimate the upper bound concentration of pesticide possible in a pond of water without an outlet. Therefore, the EEC does not take into account dilution of the pesticide within the aquatic environment. In addition, interspecies, intraspecies, and laboratory-to-field extrapolations and presumptions on the potential concentrations in the environment rather than using actual residue data greatly increase the uncertainty factors; nevertheless, acute risks to aquatic animals were still determined to be high.

Due to the lack of chronic toxicity and residue data, the chronic risks to aquatic environments are unknown. Life-cycle studies were not submitted; therefore, it is unknown whether or at what levels negative impacts could occur on the life-cycle of aquatic organisms when exposed to fenamiphos.

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The life-cycle test is designed to show reproductive and developmental effects resulting from exposure.

At this time, very limited information on the fate of the degradates in the environment has been submitted. Therefore, the calculated risk quotients for fenamiphos sulfone and sulfoxide presume conversion rates based only on this limited information; therefore, confidence in the RQ values provided are low due to the lack of environmental fate data on the degradates.

2. Use Characterization

Fenamiphos is registered for use on the following sites: apples, asparagus, bananas (plantains), beets, Brussels sprouts, cabbage, cherries, Chinese cabbage (bok choy), citrus fruits, cotton, eggplant, garlic, golf course turf, grapes, kiwi fruits, commercial /industrial lawns, nectarines, okra, ornamental and nursery stocks, peaches, peanuts, non-bell peppers, pineapples, raspberries, strawberries, and tobacco.

Fenamiphos is formulated as either a 10 percent (Nemacur 10G) or 15 percent (Nemacur 15G) active ingredient granulated product or a 35 percent active ingredient (Nemacur 3) emulsifiable concentrate product. Nemacur 10G is primarily used on turf use sites (i.e., golf courses, lawns, and sod farms) while Nemacur 15G is primarily used on fruit, vegetables and field crops. Both granular formulations are used to control thrips and nematodes. The emulsifiable concentrate formulation is used on turf, fruits, vegetables, and field crops. Fenamiphos is typically applied as a band or broadcast soil application made preplant, at planting, or postplant prior to emergence of the crop; however, if the plants are already established, fenamiphos is applied by banding (10- to 12-inch bands) on the top of the plant row, then it is watered in with at least 0.5 inches of water.

Yearly usage of fenamiphos is about 853,000 pounds of active ingredient (a.i.) on about 280,000 acres. Approximately 55% of the usage is on four crops: tobacco, 230,000 pounds a.i.; grapes,130,000 pounds a.i.; oranges, 45,000 pounds a.i.; and peanuts,74,000 pounds of active ingredient. These four crops account for approximately 60% of the treated acreage.

For all sites, except pineapple, less than 20% of the available acreage is treated with fenamiphos. Approximately 25% of the pineapple acreage is treated.

This quantitative usage analysis (QUA, Kiely, 8/1999) updates estimates provided in an earlier BEAD usage profile (Maurer, 3/95). The usage estimates for this QUA are based primarily on data from 1990 through 1996. These data indicate usage of fenamiphos on more sites than the previous estimate, but with fewer acres treated and pounds of active ingredient applied.

3. Exposure Characterization

The Agency has sufficient data for comprehensive qualitative and quantitative environmental fate and ground- and surface-water assessments for fenamiphos. However, at this time, three data requirements in the environmental fate guidelines are either not fulfilled or need to be upgraded. These are as follows: (1) the unaged portion of the leaching/adsorption/desorption (GDLN 163-1);

(2) terrestrial field dissipation (GDLN 164-1); and (3) prospective ground-water monitoring (GDLN 166-1). Additionally, the Agency is requiring a limited surface-water monitoring program.

a. Environmental Fate Assessment

The major routes of dissipation for soil-incorporated fenamiphos appear to be microbial metabolism coupled with or followed by leaching of the degradates and further degradation to its metabolites. The laboratory aerobic metabolism half-life for fenamiphos was 15.7 days and the anaerobic half-life was 87.9 days. The Freundlich K_{ads} values for fenamiphos ranged from 0.95 mL/g for sandy loam soil to 3.4 mL/g for silt loam soil, indicating that fenamiphos has the potential to be highly mobile to mobile in the soils tested; there was no correlation between the amount of organic matter and the K_{ads}. In column leaching studies, the degradates fenamiphos sulfoxide and fenamiphos sulfone appear to be more mobile than parent fenamiphos. In the upgradeable field studies conducted with Nemacur 3 EC, parent fenamiphos degraded with calculated half-lives of 16-to-17 days. Parent fenamiphos was not detected below the surface 0- to 6-inch soil horizon at the Chualar site and as far as the 18- to 24-inch soil horizon at the Fresno site. The sulfoxide and sulfone degradates were detected as far as the 30- to 36-inch soil horizon at the Fresno site. If fenamiphos is on the soil surface or in the water, then photolysis appears to be rapid with photolysis half-lives between 2-to-4 hours. Fenamiphos was relatively stable to hydrolysis in sterile buffered systems with calculated half-lives of greater than 235 days.

b. Environmental Fate and Transport Data

(1) Degradation

(a) Hydrolysis

Based on acceptable hydrolysis data fenamiphos appears to be relatively stable to hydrolysis in buffer solutions with reported half-lives of 245 days at pH 5.0, 301 days at pH 7.0, and 235 days at pH 9.0. The major degradate reported was fenamiphos sulfoxide which accounted for less than or equal to 9.9 percent of the radioactivity at all pH levels by day 31. The pH 9 samples also contained fenamiphos phenol at 5.2 percent radioactivity by day 31 (MRID 42149302).

(b) Photodegradation in Water

Based on acceptable aqueous photolysis data, fenamiphos rapidly photodegrades in water. The aqueous photolysis half-life was between 0.32 days at pH 7.0 when exposed to artificial light (450 watt mercury arc lamp emitting light of approximately 5200 uW/cm^2 intensity at the sample surface) between 300 and 600 nm. After 24 hours of irradiation fenamiphos accounted for approximately 4 percent of the applied radioactivity and the major degradates reported were fenamiphos sulfonic acid phenol (approximately 19 percent), fenamiphos sulfoxide (approximately 17 percent), and fenamiphos sulfonic acid (approximately 6 percent) (MRID 40608001).

(c) Photodegradation on Soil

Fenamiphos photodegrades on soil when exposed to natural sunlight. Based on acceptable soil photolysis data, the half-life of fenamiphos was 3.23 hours when exposed to natural sunlight. The radioactive components identified from the treated exposed soil samples were fenamiphos sulfoxide and parent fenamiphos (MRID 40608001).

(d) Aerobic Soil Metabolism

Fenamiphos metabolizes in soil under aerobic conditions. Based on acceptable aerobic soil metabolism data, fenamiphos applied at a rate of 13.7 parts per million (ppm) to Howe sandy loam soil degraded with a half-life of 15.7 days using linear regression. Sampling intervals from 0-to-100 days were used to calculate the half-life; the r-square is 0.85. Fenamiphos degraded to form fenamiphos sulfoxide which was a maximum of 51.4 percent of the applied radioactivity by day 14 and degraded with a half-life of 62 days. Fenamiphos sulfoxide degraded to fenamiphos sulfone and fenamiphos sulfone phenol. Fenamiphos sulfone was a maximum of 3.5 percent of the applied at 14 days posttreatment and degraded with a half-life of 29 days. The third degradate, fenamiphos sulfone phenol was a maximum of 23.5 percent at 63 days posttreatment and degraded with a half-life of 147 days. Fenamiphos sulfoxide phenol and fenamiphos sulfone anisole were recovered at less than 6 percent of the applied. By the end of the study 34.2 percent of the applied radioactivity was recovered as $^{14}CO_2$. The proposed metabolic pathway indicated that fenamiphos transformed to the corresponding sulfoxide metabolite and further degraded to fenamiphos sulfoxide phenol and fenamiphos sulfone phenol. An additional ancillary study indicated that the rate of fenamiphos degradation increased as temperature increased from 16^0C to 28^0C (MRIDs 42149303, 41064302, 40933701 and 40524601).

(e) Anaerobic Soil Metabolism

Fenamiphos metabolizes in soil under anaerobic conditions. Based on acceptable anaerobic soil metabolism data, fenamiphos applied at a rate of 13.3 ppm to a Howe sandy loam soil, degraded with a half-life of 87.9 days. In this study, fenamiphos was incubated for 6 days under aerobic conditions followed by 60 days incubation under anaerobic conditions. Fenamiphos declined from 36.3 percent on day 0 of anaerobic incubation (following the 6-day aerobic incubation) to 21.8 ± 1.9 percent after 60 days of anaerobic incubation. The major metabolite was fenamiphos sulfoxide (maximum of 46.5 percent at day 6 of aerobic conditions and decreasing to 14.3 percent after 60 days anaerobic incubation). Other reported metabolites were fenamiphos sulfone (maximum of 0.5 percent on days 52 and 66), fenamiphos phenol (maximum of 3.2 percent on day 36), fenamiphos sulfone phenol (maximum of 8.7 percent on day 66), and fenamiphos sulfone anisole (<1 percent on day 66) (MRID #s 41286901 and 40524601).

(2) Mobility

Fenamiphos and its metabolites have the potential to be mobile in soil. Based on upgradeable batch equilibrium data the reported Freundlich K_{ads} values from four unclassified soils ranged from 0.95 in a sandy loam soil to 3.4 in a silt loam soil with no correlation between organic carbon and

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adsorption. These values indicate that parent fenamiphos has the potential to be relatively mobile in the soils tested. Based on acceptable column leaching studies, parent fenamiphos was mobile (16.2 to 63.8 percent of applied radioactivity was found in the leachate). The major metabolites, fenamiphos sulfoxide and fenamiphos sulfone, were more mobile than the parent. The greatest mobility of fenamiphos and its metabolites was in the soil with the lowest cation exchange capacity and the lowest percentage of organic matter (Indiana sand soil) and vice versa (Kansas sandy loam soil). No parent fenamiphos was found in the leachate from the Kansas sandy loam soil. The leachate from the soil columns contained 47.2 percent of applied radioactivity in the California sandy loam soil, 63.8 percent in the Indiana sand soil, and 16.2 percent in the Kansas sandy loam soil. Of this radioactivity found in the leachates, the majority (greater than or equal to 76 percent) was fenamiphos sulfoxide (MRID #s 40547502, 40547501, 40774808, and 40774807).

(3) Laboratory Volatility

Based on acceptable laboratory volatilization data, fenamiphos did not volatilize very rapidly when applied at a rate of 12 lbs of active ingredient per acre (a.i./A) to a sandy loam soil. After 7 days less than 0.1 percent fenamiphos volatilized indicating that volatilization was not a major route of dissipation for fenamiphos applied to the soil (MRID 40774810).

(4) Terrestrial Field Dissipation

Based on upgradeable terrestrial field dissipation studies conducted in Chualar and Fresno, California on established turf plots, parent fenamiphos (Nemacur 3 EC) applied at 10 lb ai/acre degraded with half-lives of 16 and 17 days. In the field fenamiphos sulfoxide degraded with an average half-life of 75 days and fenamiphos sulfone degraded with an average half-life of 55 days. Parent fenamiphos was not detected (detection limit of 0.01 ppm) below the 0- to 6-inch soil horizon at the Chualar site and as far as the 18- to 24-inch soil horizon at the Fresno site. Fenamiphos sulfoxide was detected as far as the 24- to 30-inch soil horizon at the Chualar site and as far as the 30- to 36-inch soil horizon at the Fresno site. These studies confirmed the results of the laboratory leaching and adsorption/desorption studies demonstrating that the metabolites fenamiphos sulfoxide and fenamiphos sulfone are both more mobile than the parent and have a greater potential to leach in the soil. It appears that fenamiphos dissipates in the soil by microbial degradation to fenamiphos sulfoxide and fenamiphos sulfone followed by leaching into the soil and eventual further degradation as proposed in the aerobic soil metabolism study. (MRID #s 42149301 and 42216201)

At both sites, established turf plots were treated with Nemacur 3 EC at 10 lb ai/acre. At the Chualar site the maximum concentration reported for total fenamiphos residues was 0.32 ppm (0.21 ppm parent fenamiphos) while at the Fresno site, the maximum total residue was 4.06 ppm (parent fenamiphos was 2.67 ppm). These field studies were considered upgradeable pending an explanation of low recoveries at one site and information on turf sampling at both sites. No information from acceptable field dissipation studies using granular (Nemacur 15G) formulations is currently available (MRID 42149303).

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(5) Fish Bioaccumulation

Fenamiphos does not bioaccumulate in fish to any appreciable extent. Based on an acceptable fish bioaccumulation study, the maximum bioaccumulation factors (BCFs) for fenamiphos residues were 89x for whole fish, 24x for fillet tissue, and 230x for viscera. After 28 days the BCFs were 21x, 61x and 98x for fillet, whole fish, and viscera, respectively. During the 14-day depuration period, more than 95 percent of the accumulated ^{14}C-fenamiphos residues depurated. The primary metabolite was phenol sulfone which accounted for up to 51.0 percent of the radioactivity found in viscera tissues. Parent fenamiphos, the sulfoxide, sulfone, phenol, and phenol sulfoxide metabolites were each less than 10 percent of accumulated residues. These results indicated that fenamiphos did not bioaccumulate in fish and any residues taken up by fish were depurated when fish were no longer exposed to these residues (MRIDs 40274201, 40274202, and 40274203).

c. Terrestrial Exposure Assessment

EFED will be using Hoerger and Kenaga estimates (1973) as modified by Fletcher and other researchers (1994) to approximate the residues *on* plants and insects. Hoerger-Kenaga categories represent preferred foods of various terrestrial vertebrates: fruits and bud and shoot tips of leafy crops are preferred by upland game birds; leaves and stems of leafy crops are consumed by hares and hoofed mammals; seeds, seed pods and grasses are consumed by rodents; and insects are consumed by various birds, mammals, reptiles and terrestrial-phase amphibians.

Terrestrial vertebrates also may be exposed to pesticides applied to soil by ingesting pesticide granules and/or pesticide-laden soil when foraging. Rich in minerals, soil comprises 5-to-30 percent of dietary intake by many wildlife species.[7] They also may be exposed by other routes, such as by walking on exposed granules and/or pesticide-laden soil or by drinking pesticide-contaminated water.

(1) Fenamiphos Residues from Nemacur 3 on Plants and Insects

Hoerger-Kenaga estimates were based on residue data correlated from more than 20 pesticides on more than 60 crops. Representative of many geographic regions (7 states) and a wide array of cultural practices, Hoerger-Kenaga estimates also considered differences in vegetative yield, surface/mass ratio and interception factors. In 1994, Fletcher, Nellessen and Pfleeger, reexamined the Hoerger-Kenaga simple linear model ($y=Bx$, where x=application rate and y=pesticide residue in ppm) to determine the accuracy of terrestrial EEC's. They compiled a data set of pesticide day-0 and residue-decay data involving 121 pesticides (85 insecticides, 27 herbicides, and 9 fungicides from 17 different chemical classes) on 118 species of plants. Their analyses indicate that Hoerger-Kenaga estimates needed only minor modifications to elevate the predictive values for forage and fruit categories from 58 to 135 ppm and from 7 to 15 ppm, respectively. Otherwise, the Hoerger-Kenaga estimates were accurate in predicting the maximum residue values after a 1 lb ai/acre

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7 W. N. Beyer and E.E. Connor, "Estimates of Soil Ingestion by Wildlife," U.S. Fish and Wildlife Service, Patuxent Wildlife Research Center at Laurel, MD and S. Gerould, U.S. Geological Survey, Reston, VA.

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application. Mean values represent the arithmetic mean of values from samples collected the day of pesticide treatment.

Table 1: Estimated Environmental Concentration on Food Items of Terrestrial Vertebrates (ppm)

Food Items	EEC (ppm) Predicted Maximum Residue[1]	EEC (ppm) Predicted Mean Residue[1]
Short grass	240	85
Tall grass	110	36
Broadleaf/forage plants, and small insects	135	45
Fruits, pods, seeds, and large insects	15	7

[1] Predicted maximum and mean residues are based upon a 1 lb ai/a application rate and are based on Hoerger and Kenaga (1973) as modified by Fletcher et al (1994).

Table 1 provides the predicted 0-day maximum and mean residues of a pesticide that may be expected to occur on selected avian, mammalian, reptilian or terrestrial-phase amphibian food items immediately following a direct single application at a 1 lb ai/acre application rate. Although not currently validated for this use, Hoerger-Kenaga estimates are employed to predict the 0-day maximum and mean residue values on exposed insects.

Additional testing of the validity of the Hoerger-Kenaga simple linear model was also performed by Pfleeger, Fong, Hayes, Ratsch and Wickliff (1995) using field data. Regarding a simple linear relationship between application rate and residue level, Pflegger and et al. concluded that this assumption is questionable, rather the relationship between the application rate (x) and pesticide residue (y) is a polynomial function with a degree of 2, $y=Ax^2+Bx+C$, where A, B and C are coefficients of the various vegetation categories.[8] Therefore, the Hoerger-Kenaga simple linear model should be modified as recommended by Fletcher, and these values would be predictive of 90 percent of the residues ranging from 0.05 to 2.5 lb ai/acre. However, at rates greater than 2.5 lb ai/acre, the modified Hoerger-Kenaga values could be underestimates, especially for tall grass. Pflegger's research team performed regression analyses on the collected field data. As the regression lines were extrapolated out to represent increasing rates of application, tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.

In addition, the modified Hoerger-Kenaga linear model does not contain information on expected residues after day 0. The model assumes that residues will degrade, and the maximum residue levels will occur on the day of application. Overall, Pfleeger's data supported this assumption with a few exceptions, one exception being systemic pesticides. Fletcher and his research team also investigated pesticide residue decay over time for a number of pesticides applied at rates between 0.5 and 1.5 lb ai/acre. Decay occurred exponentially after day 0, with the exception of systemic pesticides. Maximum and mean predictive residues *on* food items, would be a result of spray drift from a ground application of the emulsifiable concentrate, Nemacur 3. Tables 2 and 3 on the following pages list predicted residues of fenamiphos on food items of terrestrial vertebrates based on current Nemacur 3 labeled rates.

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8 T.G. Pflegger, A. Fong, R. Hayes, H. Ratsch, and C. Wickliff, U.S. EPA, Environmental Research Laboratory, Corvallis, Oregon and ManTech Environmental Research Services Corporation, Corvallis, Oregon.

For cotton, strawberry, eggplant, table beets, and non-bell peppers, the Nemacur label rate is by linear feet of row. Thus, the distance between the rows significantly influences the amount of Nemacur applied per acre. Unless specified otherwise on the label, the application rate will increase as row spacing decreases. For example, without the maximum single/seasonal application rate specified on the label, ultra-narrow row cotton with 7-inch row spacing could have an application rate as high as 15.6 lb ai/acre. Currently about two percent of the cotton grown in the United States is planted in ultra-narrow rows spaced 7- to 10-inches apart. See calculations below.

Assuming 7-inch row spacing: 8.9 fl oz of Nemacur 3/1,000 ft of row length X 1 gal/128 fl oz X 3 lb ai/gal X [43,560 sq ft/acre/(7 in of row width X 1 ft/12 in)] = 15.576, rounded = 15.6 lb ai/acre

In the following table, the Environmental Fate and Effects Division (EFED) is conservatively representing the EEC's for cotton using a maximum rate of 3 lb ai/acre regardless of row spacing.

Peanuts are typically planted with the same equipment used to sow upland cotton; as a result, the pre-set 36- or 38-inch single-row spacing of upland cotton will dictate the row spacing for peanuts. Over 90 percent of the peanuts grown are planted in this manner. In the table above, the first set of acute and chronic EEC's for peanuts are indicative of 36-inch, single-row spacing and a maximum single application rate of 2.5 lb ai/acre. Less than 10 percent of the peanuts grown are planted in double-row beds, with 28 inches between the rows and 6 feet between bed centers. By modifying the above equation to include 2 rows and 72-inch spacing, the maximum application rate for double-row peanuts is calculated to be 1.2 lb ai/acre. The second set of acute and chronic EEC's represent 72-inch bed center spacing and double-row beds.

Table 2: Estimated Environmental Concentration of Fenamiphos on Food Items of Terrestrial Vertebrates (ppm)

Crop/ Formulation	Maximum Single Application Rate (lb ai/acre)	Maximum Seasonal Application Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)
Cotton/ Nemacur 3EC	3.0	Not Always Specified But Assumed 3.0	Short grass	720.0	255.0
			Tall grass	>330.0	>108.0
			Broadleaf/forage plants, and small insects	405.0	135.0
			Fruits, pods, seeds, and large insects	45.0	21.0
Peanuts/ Nemacur 3EC	2.5 (2nd set 1.2)	Not Specified But Assumed 2.5 (2nd set 1.2)	Short grass	624.0, 288	221, 102
			Tall grass	>286, 132	>93.6, 43.2
			Broadleaf/forage plants, and small insects	351, 162	117, 54
			Fruits, pods, seeds, and large insects	39, 18	18.2, 8.4
Stone Fruits (peaches, cherries and nectarines)/ Apple Nemacur 3EC	7.5	7.5	Short grass	>1800.0	>637.5
			Tall grass	>825.0	>270.0
			Broadleaf/forage plants, & small insects	>1012.5	>337.5
			Fruits, pods, seeds, and large insects	112.5	52.5
Tobacco/ Nemacur 3EC	6.0	Not Specified But Assumed 6.0	Short grass	1440.0	510.0
			Tall grass	>660.0	>216.0
			Broadleaf/forage plants, and small insects	>810.0	>270.0

Table 2: Estimated Environmental Concentration of Fenamiphos on Food Items of Terrestrial Vertebrates (ppm)

Crop/ Formulation	Maximum Single Application Rate (lb ai/acre)	Maximum Seasonal Application Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)
			Fruits, pods, seeds, and large insects	90.0	42.0
Eggplant/ Nemacur 3EC	2.0	Not Specified But Assumed 2.0	Short grass	480.0	170.0
			Tall grass	220.0	72.0
			Broadleaf/forage plants, and small insects	270.0	90.0
			Fruits, pods, seeds, and large insects	30.0	14.0
Asparagus (CT, DE, ME, MA, NH, NJ, NY, PA, and RI only)/ Nemacur 3EC	2.0	2.0	Short grass	480.0	170.0
			Tall grass	220.0	72.0
			Broadleaf/forage plants, and small insects	270.0	90.0
			Fruits, pods, seeds, and large insects	30.0	14.0
Turf/ Nemacur 3EC	9.9	19.8 (2 applications)	Short grass	2376.0	841.5
			Tall grass	1089.0	356.4
			Broadleaf/forage plants, and small insects	1336.5	445.5
			Fruits, pods, seeds, and large insects	148.5	69.3

> means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.

For eggplant, the acute and chronic EEC's are based on a 2.0 lb ai/acre rate, with 36-inch row spacing, as stated on the label. However, in Florida, where a large portion of the U.S. crop is grown, eggplants are staked in single rows with each row spaced 6 feet apart. Hence, the application rate and resulting EEC's would be cut in half. Because, at this time, it is not known how much of the U.S. crop is grown at 36-inch versus 72-inch row spacing, the environmental risk assessment has been completed using the maximum exposure values that can be generated.

Table 3: Estimated Environmental Concentration of Fenamiphos on Food Items of Terrestrial Vertebrates (ppm)

Crop/ Formulation	Maximum Single Application Rate (lb ai/acre)	Maximum Seasonal Application Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)
Strawberries/ Nemacur 3EC	4.5	7.0	Short grass	1080.0	382.5
			Tall grass	>495.0	>162.0
			Broadleaf/forage plants, and small insects	>607.5	>202.5
			Fruits, pods, seeds, and large insects	67.5	31.5
Table Beets (IL, IN, MI, NY, OH and PA only)/ Nemacur 3EC	3.1	3.1	Short grass	744.0	263.5
			Tall grass	>341.0	>111.6
			Broadleaf/forage plants, and small insects	418.5	139.5
			Fruits, pods, seeds, and large insects	46.5	21.7

Crop/ Formulation	Maximum Single Application Rate (lb ai/acre)	Maximum Seasonal Application Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)
Citrus (except Florida, except Kumquat, Tangelo, and Citrus Hybrids in California) Nemacur 3EC	7.5	7.5	Short grass	1800.0	637.5
			Tall grass	>825.0	>270.0
			Broadleaf/forage plants, and small insects	>1012.5	>337.5
			Fruits, pods, seeds, and large insects	112.5	52.5
Citrus (Certain Florida Counties) Nemacur 3EC	5.0	10.0	Short grass	1200.0	425.0
			Tall grass	>550.0	>180.0
			Broadleaf/forage plants, and small insects	>675.0	>225.0
			Fruits, pods, seeds, and large insects	75.0	35.0
Kiwi Fruit (California only), Raspberries & Grapes/ Nemacur 3EC	6.0	6.0	Short grass	1440.0	510.0
			Tall grass	>660.0	>216.0
			Broadleaf/forage plants, and small insects	>810.0	>270.0
			Fruits, pods, seeds, and large insects	90.0	42.0
Pineapple/ Nemacur 3EC	9.0	24.0	Short grass	>2160.0	>765.0
			Tall grass	>990.0	>324.0
			Broadleaf/forage plants, and small insects	>1215.0	>405.0
			Fruits, pods, seeds, and large insects	135.0	63.0

>means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.

Table beets, grown in northern states, such as Michigan and New York, are seeded in clusters, which are spread over bands 4-inches wide, with each band of rows spaced 2 feet apart.[9] When grown in this fashion, the maximum single application rate is 3.1 lb ai/acre.

Commercially produced strawberries are planted in double-row beds, spaced 11 inches apart with 4 feet of spacing from bed center to bed center. The maximum single and seasonal application rates are 4.5 and 7.0 lb ai/acre which results in acute and chronic EEC's indicated in Table 3.

(2) Fenamiphos Residues from Nemacur 3, 10G & 15G in Plants & Insects

Residues *in* food items (e.g., plants and insects) is the result of uptake and systemic translocation throughout exposed plants and insects after application of Nemacur 3, and after application and "watering in" of Nemacur 10G and 15G. According to Fletcher and Pfleeger's research, exponential decay does not occur over the first 30-to-40 days following application of systemic pesticides.[10] Therefore, systemic pesticides may accumulate in particular plant parts at higher concentrations, especially after irrigation or a rain event. To confirm these findings, EFED is requesting additional

9 Dr. Vince Rubatzky, Horticultural Research, University of California at Davis.

10 J. S. Fletcher, J. E. Nellessen and T.G. Pfleeger, Department of Botany and Microbiology, University of Oklahoma, Norman Oklahoma, and U.S. EPA, Environmental Research Laboratory, Corvallis, Oregon.

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plant residue data on the following crops for the parent and degradates collected on Day-0 and at regular intervals post-application because HED's current plant residue study used to establish tolerances does not provide adequate information to assess risks to wildlife during this time interval: cherry, peach, orange, strawberry, cotton, banana and peanut.

(3) Fenamiphos Soil Residues

For the granular products, Nemacur 10G and 15G, the amount of active ingredient per unit area is used to determine the hazard to nontarget wildlife. In 1966, DeWitt and other researchers performed field studies on granular pesticides that related the hazard to birds to the quantity of pesticide active ingredient deposited per unit area. Similarly, for the emulsifiable concentrate, Nemacur 3, the amount of active ingredient per unit area of soil is used to estimate the exposure to wildlife. The following formulae are used to calculate the predicted maximum residues in milligrams of active ingredient per square foot (mg ai/ft^2 rounded to one decimal place) on fenamiphos-laden soil based on current maximum single application rates:

Soil Surface EEC, Banded = __ oz. ai/1000 ft row X 28,349 mg/oz X __% Unincorp./bandwidth (ft) X 1000 ft
Soil Surface EEC, Broadcast = __lb ai/acre X 1 acre/43,560 sq ft X 454,000 mg/lb X __% Unincorporated

Standard values of 100 percent for broadcast, unincorporated; 15 percent for banded, incorporated; and 1 percent for in-furrow, incorporated applications are used to indicate the amount of fenamiphos remaining on the soil surface.[11] Grams per production unit per acre is the application method for the Special Local Need (SLN) registration of Nemacur 15G on bananas and plantains. Similar to in-furrow, incorporated treatment, a 1-percent value will be assumed for this application method.

Table 4: Soil Surface Estimated Environmental Concentrations (EEC's) of Fenamiphos (mg ai/ft^2)

Crop	Maximum Single Application Rate (lb ai/acre)	Nemacur Form-ulation	Application Method	Percent (%) Unincor-porated	Soil Surface EEC Predicted Maximum Residue (mg ai/ft^2)
Cotton	3.0, 1.6	3 EC, 15G	In-Furrow Soil Injected, 12-Inch Band	1.0, 15.0	0.3, 2.5
Grapes	6.0	3 EC	Banded, In-Furrow	15.0, 1.0	9.4, 0.6
Peanuts	2.5, 2.6	3 EC, 15G	12-Inch Band	15.0, 15.0	3.9, 4.1
Stone Fruits (peaches, cherries and nectarines) & Apple	7.5	3 EC	Tree-Row Band	15.0	11.7
Tobacco & Kiwi Fruit (California only)	6.0	3 EC	Broadcast	100.0	62.5
Turf	10.0, 9.9	10G, 3EC	Broadcast	100.0	104.2, 103.2
Citrus (except Florida, except Kumquat, Tangelo & Citrus Hybrids)	7.5	3 EC	Tree-Row Band	15.0	11.7
Citrus, Certain Florida Counties	5.0	3 EC	Tree-Row Band	15.0	7.8
Pineapple	9.0	3 EC	Banded	15.0	14.1
Raspberries	6.0	3 EC	Banded	15.0	9.4

11 "Comparative Analysis of Acute Avian Risk from Granular Pesticides," Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, D.C., March, 1992.

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Table 4: Soil Surface Estimated Environmental Concentrations (EEC's) of Fenamiphos (mg ai/ft^2)

Crop	Maximum Single Application Rate (lb ai/acre)	Nemacur Formulation	Application Method	Percent (%) Unincorporated	Soil Surface EEC Predicted Maximum Residue (mg ai/ft^2)
Strawberries	4.5	3 EC, 15G	18-Inch Band	15.0	7.0
Bok Choy, Brussel Sprouts, & Cabbage	4.5	15G	15-Inch Band	15.0	7.0
Asparagus (CT, DE, ME, MD, MA, NH, NJ, NY, PA, and RI only)	2.0	3 EC	Banded	15.0	3.1
Eggplant	2.0	3 EC, 15G	12-Inch Band	15.0	3.1
Table Beets (IL, IN, MI, NY, OH and PA only)	3.1	3 EC	12-Inch Band	15.0	4.8
Iris, Lily & Narcissus bulbs	10.5	10G	In-Furrow	1.0	1.1
Protea	9.8	10G	Broadcast	100.0	102.2
Leatherleaf Fern, Anthurium & Nursery Stock	10.0	10G	Broadcast	100.0	104.2
Garlic	4.5	15G	In-Furrow	1.0	0.5
Okra	2.3	15G	15-Inch Band	15.0	3.6
Non-bell Peppers (CA, GA, and PR only)	2.0	15G	12-Inch Band	15.0	3.1
Bananas & Plantains (SLN for Puerto Rico only)	6.8	15G	Grams/ Production Unit	1.0	0.7

d. Water Resources Exposure Assessment

(1) Surface-Water

Fenamiphos has the potential to contaminate surface water via spray drift from ground application and runoff. The typical incorporation of fenamiphos into the soil should limit the fraction available for runoff. However, relatively high application rates coupled with only moderate susceptibility to biodegradation may make substantial quantities of fenamiphos within approximately the top one cm remain available for runoff for several weeks post-application (aerobic soil metabolism half-life of 16 days). Although fenamiphos is susceptible to rapid photodegradation on soil, only approximately the top one millimeter of soil is typically exposed to solar irradiation. The rest of the chemical in the top centimeter and below will not be exposed.

The susceptibility of fenamiphos to rapid direct aqueous photolysis (0 % dissipation times of 2-4 hours) should greatly limit its persistence in clear, shallow water. However, its resistance to abiotic hydrolysis, its low potential for volatilization from surface water (Henry's Law constant = 1.0 X 10-9 atm * m^3/mol), and only a moderate susceptibility to biodegradation should make its persistence longer in deeper and/or unclear waters, particularly those with low microbiological activities and long hydrologic residence time. An anaerobic soil metabolism half-life of greater than 60 days indicates that it may be substantially more persistent in typically anaerobic sediment of the lower water column than in the typically aerobic upper water column.

The sulfoxide and sulfone degradates are reported to be at least as persistent as fenamiphos in soil (with half-lives of 62 and 29 days, respectively) and more mobile as indicated by degradates found in ground water and by greater vertical mobility in terrestrial field dissipation studies than fenamiphos. Consequently, they will be available for runoff at least as long as the parent compound. Like

fenamiphos, they will probably also tend to partition into surface water with dissolved concentrations comparable to and possibly greater than concentrations adsorbed to suspended and bottom sediment. The relatively low soil/water partitioning of fenamiphos and its sulfoxide and sulfone degradates indicate that their bioaccumulation potential is probably relatively low.

EFED has only limited data on the concentrations of fenamiphos in surface water. Water supply systems are not required to sample and analyze for fenamiphos because it is not currently regulated under the Safe Drinking Water Act (SDWA). Available monitoring data and modeling are summarized below.

(a) Florida

A compilation of monitoring data by Miles and Pfeuffer (1994) from in the South Florida Water Management District (SFWMD) is one of two monitoring data sources reviewed for this assessment. That report summarizes the results of monitoring by multiple investigators at 27 sites in the region around Lake Okeechobee, the Everglades National Park, the Caloosahatchee river, and in other "Water Conservation Areas" within the boundaries of the SFWMD. A total of 28 sampling events were documented over a 4.5-year period. Sampling was quarterly from June 1989 through October 1990; which subsequently increased to six times per year through November 1993. The chemical analyses were done by multiple laboratories for parent fenamiphos only, with variable detection limits (range 0.2 to 1.63 ppb; the majority at the upper range). No detections of fenamiphos were reported.

The dominant crops in the SFWMD are reported to be citrus, sugar cane, and turf; although, the study authors state that pesticide use estimates reported are approximate, and were only used to identify potential areas of concern. The reports states that the major use of fenamiphos in the SFWMD is on turf (golf courses), but that the turf usage estimates are "very crude". There is no characterization of the sampling locations and sample handling procedures other than, a statement that these were "grab samples and analysis was not completed for about two months". Thus, although Florida is one of the major fenamiphos use states, the monitoring reported was not targeted to fenamiphos use and does not provide much useful information about the impact of fenamiphos use on surface-water quality.

It should also be noted that, in general, monitoring data is difficult to use to estimate a maximum concentration even under the best of circumstance because sampling frequencies are usually inadequate. In the case of this monitoring in the South Florida Water Management District, quarterly or bi-monthly sampling was far too infrequent to characterize the maximum concentration that might have occurred with any degree of certainty. Although fenamiphos has been measured in surface water, peak concentrations are expected to be of short duration. Thus, it is highly unlikely, given the nature of these monitoring data, that a peak concentration of fenamiphos would have been detected, even if the degradates had been included as analytes.

(b) STORET

A STORET search resulted in a listing of 37 samples from more than 20 sites in three states. Fenamiphos was not detected in any of the samples at detection limits ranging from 0.04 to 0.75 ppb. No information is provided in STORET about whether samples were taken from fenamiphos

use areas. In this particular case, it is not possible to draw reliable conclusions about this monitoring data set.

(c) Modeling Assessment

Tier I GENEEC modeling was completed for all crops on which fenamiphos is used. GENEEC (EPA, 1995) is a screening model designed to estimate surface-water concentrations to use in ecological risk assessments. As such, it provides upper-bound concentrations that might be found in ecologically sensitive environments because of the use of a pesticide. GENEEC is a single runoff event model that can account for spray drift from multiple applications. ·The GENEEC model was constructed to represent a 10-hectare field immediately adjacent to a 1-hectare pond that is two meters deep with no outlet. The pond receives a spray drift event from each application plus one runoff event. The runoff event moves a maximum of 10 percent of the applied pesticide into the pond. This amount can be reduced by degradation and soil binding in the field. Spray drift is equal to 1 percent of the applied rate for a ground spray application.

GENEEC provides an upper bound on the concentration of pesticide that could be found in drinking water and, therefore, can be appropriately used in screening calculations. If a risk assessment performed using GENEEC output does not exceed the level of concern, then one can be reasonably confident that the risk will also be below the level of concern. However, since GENEEC can substantially overestimate true drinking water concentrations, it will be necessary to refine the GENEEC estimate if the level of concern is exceeded. The EEC'S do not reflect the concentration of any fenamiphos degradates. These modeling results are not used to quantitatively assess the potential drinking water exposure to these compounds.

Because fenamiphos is used on several crops with large acreages in the United States, Tier II PRZM/EXAMS modeling was also completed for these major crops, with the exception of turf. These major crop groupings are cotton, grapes, peanuts, stone fruits and tobacco. Tier II EEC's were not calculated for fenamiphos application to turf because the PRZM 2 model cannot account for the effect of thatch on fate and transport properties of pesticides applied to turf.

Nemacur 3 is registered for use on three stone fruits: cherries, nectarines, and peaches. Peaches have been selected to represent the refined exposure scenario for all three stone fruits because the Tier II EEC's for peaches would be expected to be larger than those for cherries and nectarines. The vast majority of nectarines grown in the United States are from the Central Valley of California where little rainfall occurs during the growing season, so runoff is almost nil. In addition to California, cherries tend to be grown in the northern states of Washington and Michigan. While runoff from these northern areas is anticipated to be significant, it is still expected to be less than runoff from the peach growing areas of Georgia and South Carolina where a significant portion of the United States peach crop is grown.

Use of fenamiphos on apples, citrus, cotton, and turf could have potentially significant impacts on surface water used for drinking because of hydro-geophysical characteristics of the soil in the regions where these crops are grown. Although fenamiphos is not widely used on some of these crops, the correlation between high use and detections in water resources is very tenuous and,

therefore, the impact could be high although the use is low. The estimated acute and chronic concentrations of fenamiphos in surface water for the following crops are indicated in Table 5 below.

Table 5: Estimated Environmental Concentrations (EEC'S) in Parts Per Billion (ppb) of Fenamiphos

Crop	Maximum Single Application Rate (lb ai/acre)	Maximum Seasonal Application Rate (lb ai/acre)	Model	Acute Concentration (ppb)	21-Day Concentration (ppb)	60-Day Concentration (ppb)
Cotton	3.0	Not Always Specified But Assumed 3.0	PRZM/EXAMS	112.0	92.1	62.4
Grapes	6.0	6.0	PRZM/EXAMS	6.5	5.0	3.6
Peanuts	2.5	Not Specified But Assumed 2.5	PRZM/EXAMS	12.4	11.3	6.1
Stone Fruits (peaches, cherries and nectarines)	7.5	7.5	PRZM/EXAMS	18.2	14.8	10.6
Tobacco	6.0	Not Specified But Assumed 6.0	PRZM/EXAMS	60.7	47.8	31.4
Turf	10.0	20.0	GENEEC	651.0	495.0	329.0
Citrus (except Florida, except Kumquat, Tangelo, and Citrus Hybrids)	7.5	10.0	GENEEC	105.4	80.0	53.0
Citrus, Certain Counties in Florida	5.0	10.0	GENEEC	105.4	80.0	53.0
Apple	7.5	7.5	GENEEC	105.4	80.0	53.0
Kiwi Fruit (California only)	6.0	6.0	GENEEC	116.5	88.5	57.0
Pineapple	9.0	24.0	GENEEC	370.0	282.0	188.0
Raspberries	6.0	6.0	GENEEC	86.4	65.7	43.6
Strawberries	4.5	7.0	GENEEC	64.2	48.8	33.2
Asparagus (CT, DE, ME, MD, MA, NH, NJ, NY, PA, and RI only)	2.0	2.0	GENEEC	74.3	56.2	37.1
Eggplant	2.0	Not Specified But Assumed 2.0	GENEEC	38.4	28.8	18.8
Table Beets (IL, IN, MI, NY, OH and PA only)	3.1	Not Specified But Assumed 3.1	GENEEC	87.3	66.3	43.9
Iris, Lily & Narcissus bulbs	10.5	Not Specified Not Specified But Assumed 10.5	GENEEC	203.6	152.8	99.8
Leatherleaf Fern	10.0	Not Specified But Assumed 10.0	GENEEC	607.0	462.0	307.0
Protea	9.8	19.5	GENEEC	501.0	380.0	252.0
Anthurium & Nursery Stock	10.0	20.0	GENEEC	529.0	403.0	268.0
Bok Choy, Cabbage, Brussel Sprouts & Garlic	4.5	Not Specified But Assumed 4.5	GENEEC	86.6	65.0	42.4
Okra	2.3	Not Specified But Assumed 2.3	GENEEC	44.3	33.2	21.7
Non-bell Peppers (CA, GA, and PR only)	2.0	Not Specified But Assumed 2.0	GENEEC	38.1	28.6	18.6
Bananas & Plantains (SLN for Puerto Rico only)	6.8	13.6	GENEEC	137.4	103.4	67.8
Citrus (in California, except Kumquat, Tangelo, and Citrus Hybrids)	10.0	10.0	GENEEC	105.4	80.0	53.0

(2) Ground-Water

Because of its chemical characteristics, fenamiphos and its major degradates have the potential to leach to ground water in vulnerable areas. Evidence of leaching in the field exists but it is limited since monitoring for fenamiphos is available only from six states and often does not coincide with fenamiphos use areas. Because a Maximum Contaminant Level (MCL) has not been established for fenamiphos and its degradates, no monitoring is required under the Safe Drinking Water Act. The two major fenamiphos use states, California and Florida have monitored for this pesticide but fenamiphos is also used in 27 other states where no reliable monitoring data are available. The most extensive ground-water monitoring studies for fenamiphos presently available have been conducted in Florida by the registrant at the request of USEPA and the State of Florida.

(a) Occurrence in Ground Water

The information presented in Table 6 is from several sources including registrant-conducted studies, U.S. Geological Survey (USGS) monitoring, and state monitoring information. The prospective and retrospective studies conducted by the registrant, and other studies conducted by the USGS, and the State of California are of high quality. The other monitoring studies are of lesser quality, primarily because use areas did not necessarily coincide with monitoring sites.

Data from monitoring in Florida confirmed that fenamiphos and its degradates leach to ground water at high levels, based on detections of fenamiphos in the prospective study on sandy soils at a citrus use site in the Central Ridge of Florida (Dyer, D. G., et al., 1998). Total residues in one sample ranged up to 87.2 ppb, which greatly exceeded the 2 ppb adult lifetime Health Advisory. As a result of this study, fenamiphos is no longer registered for use on citrus in that area. This study is the Agency's only controlled field study investigating the impact of a one-time application of fenamiphos on ground-water quality in an area overlain by sandy soils. It is a suitable surrogate for other areas where sandy soils occur and ground-water tables are shallow, particularly in the south-east portion of the country.

An earlier retrospective monitoring study (Lenz, M.F., 1997) documents the impact of multiple years of fenamiphos use on Florida citrus had similar results, with a high total residue concentration of 252.8 ppb. The Agency required that a ground-water label advisory be placed on the fenamiphos label as a result of this retrospective study, and along with the State of Florida, further required additional prospective studies be conducted to more clearly establish the relationship between use according to the label and ground-water quality.

In California, fenamiphos is on the Ground Water Protection List, indicating that there is a concern for ground-water contamination in the State (Segawa, 1996). The List was created so that monitoring could be conducted for certain pesticides for which there was a ground-water concern. Ground-water monitoring has been conducted for fenamiphos (parent) in drinking water wells in the fenamiphos use area and in other wells. To date, no fenamiphos has been reported.

Other states including Mississippi, Oregon, Texas, and Washington have done some limited ground-water monitoring for fenamiphos. Results from these studies are inconclusive because

fenamiphos use areas did not necessarily coincide with monitoring sites and generally only parent fenamiphos was analyzed. No residues were reported in any of the wells in these states.

Table 6: Ground-Water Monitoring Data for Fenamiphos and Degradates

Study	Well Type	Number of Wells Sampled	Minimum Detection Limit (ppb)	Number of Wells with Detections	Concentration Range (ppb)
FL retrospective (1989-1992)	monitoring	12	0.1 (all analytes)	12	0.1-24.0 (parent) 0.2-218.0 (sulfoxide) 0.1-27.0(sulfone)
FL prospective (1995-1996)	monitoring	16	0.1 (all analytes)	9	0.10-0.58 (parent) 0.13-83.31 (sulfoxide) 0.14-3.32 (sulfone)
USGS FL golf course study (1992-1994)	monitoring/irrigation	41	0.03 (parent) 0.2 (sulfoxide) 0.1 (sulfone)	8	0.03-0.71 (parent) 0.2-0.75 (sulfoxide) 0.1 (sulfone)
CA monitoring program (1985-1994)	drinking water	803	0.05-100 (parent) 0.05-57 (sulfoxide, sulfone)	0	none detected
MS monitoring program (1989-1995)	drinking water	348	5.0 (parent)	0	none detected
OR monitoring program (1986-1995)	drinking water	1000 samples	0.2 (parent)	0	none detected
TX monitoring program (1987-1988)	drinking water	188	immunoassay	0	none detected
WA monitoring program (1988-1995)	drinking water	248	0.12-0.3 (parent)	0	none detected

(b) Small-Scale Prospective Monitoring

In 1992, the registrant agreed to conduct three prospective studies in major use areas: the Florida study began in 1995 and ended in 1996; the Georgia study on tobacco began in 1996 and was terminated recently; the California study on grapes began in October 1997 and is ongoing (only preliminary data has been received to date (August 1999)). The Agency worked with the State of Florida to design the prospective ground water study in that state, in accordance with OPP requirements and requirements of Florida's Ground Water Management Plan.

Florida. Detections of fenamiphos in this prospective study on sandy soils at a citrus use site in the Central Ridge of Florida confirmed that fenamiphos and its degradates leach to ground water at high levels (Dyer. D. G., et al., 1998). The study tracked the impact of a one-time use of Nemacur 3 on citrus, applied at an actual rate of 4.1 lb. a.i./acre to the study site and monitored over a 2-year period. Fenamiphos residues were detected in all onsite lysimeters, all nine onsite wells and all six offsite wells. Onsite residues at 489 DAT were 0.16 ppb for parent, 0.18 ppb for sulfoxide and at 518 DAT, sulfone was recovered at 0.2 ppb. In the offsite wells, fenamiphos and sulfoxide were recovered at 0.17 ppb and 0.22 ppb, respectively at 489 DAT while fenamiphos sulfone was recovered at 1.93 ppb at 553 DAT. Using a Limit of Quantitation of 0.1 ppb for all pesticide analytes, maximum concentrations of fenamiphos, fenamiphos sulfoxide, and fenamiphos sulfone ranged up to 0.58, 83.31 and 3.32 ppb, respectively, in the surficial aquifer at 183 days after application. Total residues in one sample ranged up to 87.2 ppb, which greatly exceeded the 2 ppb adult lifetime Health Advisory. As a

result of this study, fenamiphos is no longer registered for use on citrus in that area. In an April, 1997 review by the Agency (EPA ref. D233970), the registrant was requested to identify other locations in the fenamiphos use area that are similarly vulnerable, but they have not done so to date (8/99).

Although fenamiphos is no longer used on citrus in the Central Ridge area of Florida (as a result of the results of this prospective study) fenamiphos is still currently labeled for use on citrus in Florida and is used on other use sites where soils are sandy and ground-water tables are shallow. Sandy soils are commonly used for agriculture and are the dominant type of soil to which nematicides are applied. The Central Ridge study is the Agency's only controlled field study investigating the impact of fenamiphos use on ground-water quality in an area overlain by sandy soils. It is a suitable surrogate for other areas where sandy soils occur and ground-water tables are shallow, particularly in the south-east portion of the country, despite the fact that fenamiphos can no longer be used in the Central Ridge of Florida.

Georgia. Fenamiphos was applied on June 5, 1996 to a 5-acre tobacco plot in Dooly County, Georgia. Depth to ground water at the site varies from approximately 27 to 32 feet below the surface. Study results through June 2, 1998 indicate that fenamiphos and its sulfone and sulfoxide metabolites were found only sporadically in soil-pore water and ground water, at concentrations up to 0.2 ppb. Data indicated that rather than leaching substantially, residues were primarily retained in the upper 12 inches of soil, where detectable levels have persisted over a two-year duration. Total soil residues (fenamiphos + sulfone + sulfoxide) on the day of application were 3.19 mg/kg in the 0-6 inch soil depth, or ~97% of the theoretically applied amount, based on the target application rate of 6.6 lb a.i./Acre.

Concentrations at this depth fluctuated, but declined to 1.04 mg/kg by DAT 34, and were at 0.17 mg/kg on DAT 727. In the 6-12 inch depth, total residues reached a maximum of 0.29 mg/kg on DAT 119, and declined to 0.07 mg/kg on DAT 727. In all samples, most of the total residue was in the form of fenamiphos sulfoxide. Total residues remaining in the top 12 inches at DAT 362 and 727 were 0.42 mg/kg and 0.24 mg/kg, or 13.2% and 7.5% of the amount applied, respectively. The importance of irrigation or rainfall during the first few weeks or months after application, was demonstrated in the Florida PGW study, and is a difference between the Georgia and Florida study designs. Persistence of residues for the duration seen in the Georgia study implies that in the absence of leaching, fenamiphos residues can accumulate in the soil column over years of repeated applications. The registrant has been asked to model the impact of initial water input, as specified in the meteorological record, on water quality at this site with annual repeated applications.

California. The site selection report and monitoring plan for a small-scale prospective ground-water monitoring study for fenamiphos was reviewed by the Agency. The California study on grapes began in October 1997, and only preliminary data has been received to date which do suggest a pattern of movement to ground water (August 1999).

(c) Small-Scale Retrospective Monitoring

In 1989, a small-scale retrospective study was requested by the State of Florida to support the registration of fenamiphos on citrus. The retrospective study was conducted by the registrant in Lake Placid, FL using fenamiphos (Nemacur 3) at a rate of 9.9 lb a.i./acre in three separate applications from 1990 - 1992. Fenamiphos had been applied annually to the grove at a rate of 3.0 - 4.5 lb a.i./acre from 1985 - 1989. Twelve monitoring wells were installed at the 10-acre test site: six on-site and six down-gradient and off the treated site. The highest concentrations in the retrospective study were measured in the six wells located on the treated site, although fenamiphos and/or its two degradates were found in all wells monitored. The maximum concentrations of total fenamiphos reported in each of the six wells located on the treated site were: 142, 65.5, 10.5, 2.7, 252.8, and 94.7 $\mu g \bullet L^{-1}$. The Agency required that a ground-water label advisory be placed on the fenamiphos label as a result of this retrospective study, and along with the State of Florida, further required additional prospective studies be conducted to more clearly establish the relationship between use according to the label and ground-water quality.

(d) General Monitoring Studies

Florida. Fenamiphos residues were detected in ground water on five out of seven golf courses in a study conducted by the U.S. Geological Survey. Soils varied from fine sands with good drainage (citrus-growing soils) to Flatwoods soils with poor drainage. Maximum concentrations in ground water were 0.71, 0.75, and 0.10 ppb for fenamiphos, fenamiphos sulfoxide, and fenamiphos sulfone, respectively (higher concentrations were found in the poorly-drained soils; Swancar, 1996). Ground water here would not be used for drinking water but persistent contaminants (such as the fenamiphos degradates) could eventually find their way into drinking water supplies.

California. Fenamiphos is on California's Ground Water Protection List (Segawa, 1996). The List was created so that monitoring could be conducted for certain pesticides for which there was a ground-water concern. Samples were collected from 40 drinking water wells in six counties in the fenamiphos use area in 1990 to 1991 and 1993 to 1994. Using a detection limit of 0.1 ppb, no fenamiphos residues were detected. Other monitoring has been conducted from the mid-1980s to the present. No detections were seen in any of these wells; detection limits varied from 0.05 to 100 ppb.

Mississippi. A statewide ground-water monitoring survey was designed to sample for pesticides in major crops such as cotton and soybeans. Fenamiphos is not widely used in the State and the primary crops are turf and ornamentals (Barnett, 1996). Almost all of the reported monitoring has been conducted in areas where fenamiphos has not been used. To date, 348 wells have been sampled and analyzed for fenamiphos and its degradates. No residues have been detected using a detection limit of 5.0 ppb for the parent.

Oregon. Since 1986, approximately 1,000 ground-water samples from public and private wells have been analyzed for parent fenamiphos only. Using a 0.2 ppb detection limit, no residues have been found (McLaughlin, 1996).

Texas. From 1987 to 1988, 188 rural wells in eight counties were sampled. The analyses were made using an immunoassay screen for organophosphates including fenamiphos - no organophosphates were detected. Wells may have been near fenamiphos use areas in some counties but this cannot be confirmed (O'Hare, 1996).

Washington. Since 1988, 248 private drinking water wells in eight study areas have been sampled. Using a detection limit that varied from 0.12 to 0.3 ppb, samples were analyzed for parent fenamiphos only. No parent residues have been detected but it is not known whether there is any connection between the sampled wells and the fenamiphos use area (Erickson, 1996).

(3) Drinking-Water

(a) Surface Water

It is not possible to derive reliable conclusions from available monitoring data in the South Florida Water Management District to use to characterize fenamiphos concentrations in drinking water. Sampling was too infrequent, sample locations were not characterized overall or with respect to documented fenamiphos use, analytical method detection limits were too high, and degradates were not analyzed. A STORET search resulted in a listing of 37 samples over 20 sites in three states. Fenamiphos was not detected in any of the samples at detection limits ranging from 0.04 to 0.75 ppb. No information is provided in STORET about whether samples were taken from fenamiphos use areas,a nd it is not possible to draw reliable conclusions from these data.

Tier I GENEEC modeling was done for 25 crops on which fenamiphos is used. Tier II PRZM/EXAMS was run for the five additional major fenamiphos use crops. Tier II EEC's were not calculated for fenamiphos application to turf because the PRZM 2 model cannot account for the effect of thatch on fate and transport properties of pesticides applied to turf.

Turf was identified as the crop with the greatest potential impact to surface water from fenamiphos use. The acute high value (initial peak from GENEEC) was 651 ppb and the chronic value (90-day average from GENEEC) was 329 ppb. Note that these modeling data are used for screening purposes only, not in quantitative risk assessment.

(b) Ground Water

Ground-water monitoring data available to the Agency for fenamiphos are not extensive. The two major use states, California and Florida have monitored for this pesticide but fenamiphos is also used in 27 other states where no monitoring data are available. Fenamiphos and its degradates are not regulated under the Safe Drinking Water Act.

Use of fenamiphos in most states is relatively low and does not exceed about 4,400 lbs/county. Use in certain counties of California, Florida, Virginia, Georgia, and Alabama can be as high as 96,000 lbs/county (Miles, 1994). In one high-use county of Florida (Highlands County), fenamiphos and its degradates leached to ground water at high concentrations in both prospective and retrospective studies. Fenamiphos residues also moved in ground water laterally at least 100 feet from the test site. As a result of these studies, the citrus use of fenamiphos was banned on the Central Ridge of Florida. The acute concentrations reported in that prospective study are the highest levels seen in any well during the Florida study. These are: 0.6 ppb, 3.3 ppb, and 83.3 ppb for parent fenamiphos, fenamiphos sulfone, and fenamiphos sulfoxide, respectively. Total fenamiphos residues reached 87.2 ppb in monitoring wells located on the treated site. Fenamiphos is also used in vulnerable areas in the south-east, in Suffolk County, New York, and in parts of the Delmarva peninsula (DE, MD, VA). In these regions, where hydrogeologic and/or environmental conditions are similar to those on the central Ridge of Florida, fenamiphos residues may also leach to ground water at levels similar to those seen in Florida. For this reason, the residue levels seen in Florida are used in this assessment even though the use there has been discontinued.

To determine the chronic concentrations, all values from all the onsite wells in the Florida prospective study during a 90-day monitoring period were used to calculate a 90-day average concentration. The time frame was selected from all monitoring study results after determining the 90-day period when the highest concentrations were seen. In calculating the average concentrations, we ascribed 0.5 ppb to those values reported as "less than 0.1 ppb" in the monitoring study report. Concentrations for fenamiphos, fenamiphos sulfone, and fenamiphos sulfoxide are 0.1 ppb, 0.4 ppb, 8.7 ppb, respectively. The total for these analytes is 9.2 ppb.

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4. Ecological Effects Characterization

The Agency's fenamiphos toxicological database is inadequate to assess the hazards to freshwater and estuarine/marine organisms and nontarget plants, and hazards resulting from degradates of toxicological concern. The Agency's database is also inadequate to assess the exposure to honey bees and other beneficial insects from fenamiphos residues on flowering weeds and in nectar or pollen of flowering crops or weeds in and around the treatment area.

Desisopropyl fenamiphos sulfoxide and fenamiphos sulfone are metabolites and degradates of toxicological concern. The Health Effects Division (HED) required and reviewed acute mammalian toxicity data on these degradates. Desisopropyl fenamiphos sulfoxide and fenamiphos sulfone degradates are cholinesterase-inhibiting metabolites. They are *very highly toxic* to mammals with acute oral LD_{50} values of 3.7 and 2.6 mg/kg, respectively. Because of similar metabolic pathways and because birds are typically more sensitive, these degradates are presumed to be very highly toxic to birds (reptiles and terrestrial-phase amphibians[12]). To more precisely determine acute risks, acute toxicity testing on the two degradates for avian species is required (acute oral and dietary subacute 71-1 and -2). Chronic avian toxicity testing (71-4) of desisopropyl fenamiphos sulfoxide and fenamiphos sulfone is reserved pending results of the avian acute oral and subacute dietary tests.

Fenamiphos sulfone phenol is a degradate of fenamiphos that HED is currently evaluating to determine if it is a metabolite of mammalian toxicological concern. If HED determines that fenamiphos sulfone phenol is of toxicological concern, then EFED will be requesting additional fate and ecotoxicity data on this degradate as well.

Aquatic species are *not* significantly similar to mammals such that toxicity inferences can be made. Desisopropyl fenamiphos sulfoxide's and fenamiphos sulfone's were determined to be moderately toxic to freshwater fish on an acute basis, based on the submitted data. Chronic testing of the two degradates is also required; freshwater fish early life-stage toxicity tests (guideline 72-4) should be submitted using desisopropyl fenamiphos sulfoxide and fenamiphos sulfone as the test substances. The guideline (72-4) is partially fulfilled. Additional chronic testing on the two degradates is reserved pending results of the early life-stage tests.

A freshwater fish life-cycle test using fenamiphos technical is required because (1) the end-use product is expected to be transported to water from the intended use site, (2) fenamiphos is persistent in water with a hydrolysis half-life greater than 234 days, (3) the results in

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12 OPP Corn Cluster Document, A Special Review of 4 Corn Insecticides, Chapter 7, pages 148-149, April 1994. (Toxicity testing using bird test species as surrogates and indicators of the pesticide's toxicity to reptiles and terrestrial-phase amphibians and freshwater fish as surrogates and indicators of the pesticide's toxicity to aquatic-phase amphibians.)

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freshwater fish early life-stage toxicity test indicate that fish reproductive physiology may be affected by fenamiphos exposure, and (4) the estimated environmental concentration is greater than one-tenth the NOEC value of 3.8 ppb in the freshwater fish early life-stage toxicity test. As indicated in the Water Resources section of the EFED Environmental Risk Assessment, acute EEC values range from 6.5 to 651 ppb, which exceed the NOEC from 1.7-to-171 times. The preferred test species is Fathead Minnow. The guideline (72-5) is not fulfilled.

Based on the submitted data, fenamiphos technical and its end-use formulation, Nemacur 3, and one of its degradate products, fenamiphos sulfoxide, are very highly toxic to freshwater invertebrates on an acute basis. However, the test using fenamiphos sulfoxide was classified supplemental because the raw data was not submitted, and the reported dissolved oxygen levels and pH measurements were inaccurately measured. If the raw data were submitted, then the study potentially could be upgraded; otherwise, the study should be repeated. In addition, acute freshwater invertebrate testing should be required on fenamiphos sulfone because it has been identified as a degradate of toxicological concern. In the future, if HED identifies fenamiphos phenol as a degradate of toxicological concern, then acute freshwater invertebrate testing should be required on it as well. The guideline (72-2) is only partially fulfilled.

Chronic testing with fenamiphos technical for estuarine/marine organisms (72-4) has not been submitted and is requested. Based on the submitted freshwater toxicity information, chronic risks to estuarine/marine organisms are anticipated. In addition, because they have been identified as degradates of toxicological concern, acute estuarine/marine testing are required for desisopropyl fenamiphos sulfoxide and fenamiphos sulfone (72-3). These degradates have also been identified as equally mobile as the parent, and therefore, subject to moving offsite in ground and surface waters. In the future, if fenamiphos phenol is identified as a degradate of toxicological concern, then acute estuarine/marine testing using this test substance will also be required. Chronic testing of the degradates is reserved pending results of acute estuarine/marine testing.

Plant data are also necessary to evaluate the risks to nontarget terrestrial, semi-aquatic and aquatic plants because fenamiphos labeling bears phytotoxicity warnings and is expected to move offsite (nontarget plants, 123-1 and -2, Tier II). In addition, Tier I testing of the degradates, desisopropyl fenamiphos sulfoxide and fenamiphos sulfone, is necessary to determine the toxicity of these persistent and mobile compounds to plants.

A systemic pesticide, fenamiphos, will be translocated post-application throughout the plant crop and weeds growing in or around the treatment area. Residue data (HED's 1994 Fenamiphos RED Chapter) provided to the Agency to assess tolerances provides some insight into the time intervals required for residues to decline post-application to be within maximum

allowable limits. Therefore, honey bees and other nontargets may have greater potential for extended exposures to fenamiphos through exposure to fenamiphos-laden nectar, pollen and other plant parts of blooming plants growing in and around the treated area. To determine the residues in nectar, pollen and other plant parts used as food items by nontargets, EFED requests that the registrant collect and submit nectar, pollen and plant residue data on the following insect/bird/bat-pollinated food crops at full bloom in fenamiphos treated areas: cherry, peach, orange, strawberry, cotton, banana and peanut. In addition, a honey bee toxicity of residues on foliage is required using Nemacur 3 at the typical end-use product (141-2).

In the 1987 Fenamiphos Registration Standard, a honey bee toxicity of residues on foliage was required for the Typical End-use Product (TEP). This study is still required for the emulsifiable concentrate formulation, Nemacur 3. Nemacur 3 has the following risk reduction statements on its label: "Do not use mini- sprinklers. Use only coarse sprays directed at soil to eliminate spray drift. Aerial application of this product is prohibited." Although it is anticipated that these statements will reduce spray drift, they will not eliminate it; honey bees and other beneficial insects still may be exposed to Nemacur 3 residues on blooming weeds growing in and around the treatment area; therefore, a honey bee toxicity of residues on foliage is required (141-2). In the sections following are terrestrial and aquatic data that have been submitted and reviewed by the Agency.

a. Terrestrial Hazard Assessment

(1) Birds, Acute and Subacute (TGAI and Degradates)

An acute oral toxicity study using the technical grade of the active ingredient (TGAI) is required to establish the toxicity of fenamiphos to birds. The avian oral LD_{50} is an acute, single-dose laboratory study designed to estimate the quantity of toxicant required to cause fifty percent mortality in a test population of birds. The preferred test species is either the Mallard Duck, a waterfowl, or Bobwhite quail, an upland gamebird. The TGAI is administered by oral intubation to adult birds, and the results are expressed as LD_{50} milligrams (mg) active ingredient (a.i.) per kilogram (kg). Toxicity category descriptions are the following:

If the LD_{50} is *less than 10 mg a.i./kg*, then the test substance is *very highly toxic*.
If the LD_{50} is *10-to-50 mg a.i./kg*, then the test substance is *highly toxic*.
If the LD_{50} is *51-to-500 mg a.i./kg*, then the test substance is *moderately toxic*.
If the LD_{50} is *501-to-2,000 mg a.i./kg*, then the test substance is *slightly toxic*.
If the LD_{50} is *greater than 2,000 mg a.i./kg*, then the test substance is *practically nontoxic*.

Table 7: Avian Acute Oral Toxicity Findings (LD_{50}) **Fenamiphos Technical**

Surrogate Species	% A.I.	LD_{50} (mg a.i./kg)	Toxicity Category	MRID No. Author/Year	Study Classification[1]
Canary *(Serinus canarius)*	81.6	0.5 to 1.0	very highly toxic	ACC 120301/Inst. for Toxicology/Leverkusen-Bayerwerk,W. Germany/1968	Supplemental
Pigeon *(Columba livia)*	81.6	0.5 to 1.0	very highly toxic	ACC 120301/Inst. for Toxicology/Leverkusen-Bayerwerk,W. Germany/1968	Supplemental
Mallard Duck *(Anas platyrhynchos)*	81.0	1.68	very highly toxic	ACC 091689/R. H. Hudson/ Denver Wildlife Research Center/1972	Supplemental
Domestic Chicken (species unknown)	80.0	10.0 to 15.0	highly toxic	001310 & 00154492/Bayer Agricultural Inst./1992	Supplemental
Domestic Chicken (species unknown)	Technical, % Not Reported	5.31, female	very highly toxic	112414/Bayer Agricultural Inst./1992	Supplemental
Ring-necked Peasant *(Phasianus colchicus)*	81.0	0.5 to 1.0	very highly toxic	ACC 091689/R. H. Hudson/ Denver Wildlife Research Center/1972	Supplemental
				Nemacur 3 End-Use Formulation	
Mallard Duck *(Anas platyrhynchos)*	35.0	2.5 to 3.0 male & female	very highly toxic	ACC 091689/ Keichline & Bradburn/1969	Supplemental
Bobwhite Quail *(Colinus virginianus)*	35.0	0.8, male 0.9, female	very highly toxic	ACC 091689/ Keichline & Bradburn/1969	Supplemental

[1]Core means the study satisfies guidelines. Supplemental means the study is scientifically sound but does not satisfy guidelines.

Results of testing with the TGAI are presented in Table 7. The toxicity value (LD_{50}) appearing in the shaded area of the table will be used to calculate the acute avian risk quotients (RQ's) in subsequent sections. These results indicate that fenamiphos and its end-use formulation, Nemacur 3, are very highly toxic to birds. Dose related intoxication reactions consisted of tremors, convulsions, frothy nasal discharge, and loss of balance. The supplemental studies were not conducted according to acceptable protocols: too few of birds were tested at each dose level, the test material was impure, test duration was too short or the surrogate test subjects were too young or unacceptable. The core studies were scientifically sound and met protocol requirements. The guideline (71-1) is fulfilled (MRID 00121289).

Two subacute studies using the TGAI are required to establish the toxicity of fenamiphos to birds. These avian dietary LC_{50} tests, using the Mallard Duck and Bobwhite Quail, are acute,

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eight-day dietary laboratory studies designed to estimate the quantities of toxicant required to cause fifty percent mortality in the two respective test populations of birds. The TGAI is administered by mixture to juvenile birds' diets for five days followed by three days of "clean" diet, and the results are expressed as LC_{50} parts per million (ppm) active ingredient (a.i.) in the diet. Toxicity category descriptions are the following:

If the LC_{50} is *less than 50 ppm a.i.*, then the test substance is *very highly toxic.*
If the LC_{50} is *50-to-500 ppm a.i.*, then the test substance is *highly toxic.*
If the LC_{50} is *501-to-1,000 ppm a.i.*, then the test substance is *moderately toxic.*
If the LC_{50} is *1,001-to-5,000 ppm a.i.*, then the test substance is *slightly toxic.*
If the LC_{50} is *greater than 5,000 ppm a.i.*, then the test substance is *practically nontoxic.*

Results are presented in Table 8 below. The toxicity value (LC_{50}) appearing in the shaded area of the table will be used to calculate the acute avian risk quotients (RQ) in following sections.

Table 8: Avian Subacute Dietary Toxicity Findings (LC_{50}) Fenamiphos Technical

Surrogate Species	% A.I.	LC_{50} (ppm)	Toxicity Category	MRID No. Author/Year	Study Classification
Northern Bobwhite Quail *(Colinus virginianus)*	88.0	38	very highly toxic	0025959/ Nelson & Burke/ 1977	Core
Mallard Duck *(Anas platyrhynchos)*	88.0	316	highly toxic	0025958/ J. B. Beavers, Fink & Brown/1977	Core
Japanese Quail	Not Reported	59	highly toxic	0022923/ Hill, Heath, Spann & et al/1975	Supplemental

On a subacute dietary basis, fenamiphos is very highly toxic to birds. The guideline (71-2) is fulfilled (MRIDs 00025959, 00025958, and 0022923).

Sulfoxide and Sulfone Acute Toxicity Testing. Avian testing with degradates may be required if the parent material is short-lived and if a large percentage of any degradate is formed. Desisopropyl fenamiphos sulfoxide and fenamiphos sulfone are primary degradates and have been identified as very highly toxic to mammals. In 1986, a submitted acute oral toxicity study using Nemacur technical and the metabolites, sulfone and sulfoxide, was classified invalid (MRID 0025963). The two degradate avian acute and subacute dietary toxicity studies need to be repeated. However, note that HED is currently evaluating another degradate, fenamiphos phenol. If HED determines it to be of toxicological concern, then avian acute and subacute dietary toxicity studies will needed on the fenamiphos phenol as well.

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(2) Birds, Chronic (TGAI and Degradates)

Avian reproduction studies using the Bobwhite Quail and Mallard duck are laboratory tests designed to estimate the quantity of toxicant required to adversely affect the reproductive capabilities of a test population of birds. The TGAI is administered by mixture to breeding birds' diets throughout their breeding cycle. Test birds are approaching their first breeding season and, generally, are 18-to-23 weeks old. The onset of the exposure period is at least 10 weeks prior to egg laying. Exposure period during egg laying is generally 10 weeks with a withdrawal period of three additional weeks if reduced egg laying is noted. Results are expressed as No Observed Effect Level (NOEL) and various observable effect levels, such as the Lowest Observable Effect Level (LOEL), quantified in units of parts per million of active ingredient (ppm a.i.) in the diet.

These studies, using the TGAI as the test substance, are required for fenamiphos because the following conditions are met: (1) birds may be subject to repeated exposure to the pesticide, especially preceding or during the breeding season, and (2) information derived from mammalian reproduction studies indicates reproduction in terrestrial vertebrates may be adversely affected by the anticipated use of the product (HED's 1994 Fenamiphos RED Chapter). Results of these tests are tabulated Table 9 below. The toxicity value (NOEL) appearing in the shaded area of the table will be used to calculate the chronic avian risk quotients (RQ) in following sections.

Table 9: Avian Reproduction Fenamiphos Technical

Surrogate Species/ Study Duration	% ai	NOEL/LOEL (ppm)	LOEL Endpoints	MRID No. Author/Year	Study Classification
Northern Bobwhite Quail *(Colinus virginianus)*/ 25 weeks	90.0	2.0/8.0	14-Day Hatchling Survival	121291/ ACC 071291 D. W. Lamb & M. A. Carsel/1982	Core
Mallard Duck *(Anas platyrhynchos)*/ 14 weeks	90.0	8.0/16.0	Egg Shell Thickness, Egg Production, Embryo & 14- Day Hatchling Survival	121290/ ACC 071291 D. W. Lamb & M. A. Carsel/1982	Core

Statistically significant reduction in the number of eggs laid/set, viable embryos, hatchlings, and survivors occurred when Mallard Duck mated pairs were fed diets containing 16.0 ppm or greater of fenamiphos. The most sensitive endpoint was the number of 14-Day hatchlings. Similarly, a statistically significant decrease in normal hatchlings and survivors was observed when Bobwhite Quail mated pairs were fed diets containing 8 ppm or more of fenamiphos. Therefore, outdoor use resulting in exposure to birds at the NOEL of 2.0 ppm or greater preceding or during the breeding season may cause reproductive effects. The guideline (71-4) is fulfilled (MRID 121290, 121291).

Sulfoxide and Sulfone Chronic Toxicity Testing. Chronic avian toxicity testing (71-4) of desisopropyl fenamiphos sulfoxide and fenamiphos sulfone is reserved pending results of the avian acute oral and subacute dietary tests.

(3) Birds and Mammals, Simulated and Actual Field (TEP)

Bird and mammal simulated and actual field tests are required on a case-by-case basis depending on the results of the lower tiered, acute and subacute toxicity tests, intended use pattern and pertinent environmental fate characteristics. See Table 10.

Table 10: Simulated and Actual Field Nemacur 3, 10G, and 15G

Surrogate Species/ Study Duration /Formulation	% ai	NOEL Endpoints	LOEL Endpoints	MRID No. Author/Year	Study Classification
Northern Bobwhite Quail *(Colinus virginianus)*/ 14-Day Simulated Field/ Nemacur 3	35.0	Weight Gain, No Clinical Signs, No Gross Lesions, No Brain Cholinesterase Activity	Mortality	121291 & 121292 /ACC 071291 D. W. Lamb & M. A. Carsel/1982	Supplemental
Mixed Avian and Mammalian Species 41-Day Actual Field Study/Orchard/ Nemacur 3	35.0	---	Mortality	121293/ ACC 071291 S. C. Carlisle/ D. W. Lamb/1982	Supplemental
Mixed Avian Species Actual Field Study/ Golf Course Sites Nemacur 10G	10.0	---	Mortality, Loss of Balance, Outstretched Wings, Tucking the Head Inward, Limping, Salivating	41012902/Mobay Chemical Company/ 1988	Supplemental
Vertebrate Species/ Actual Field Study/ Tobacco/ Nemacur 3	35.0	---	Mortality	42029903, 42029904 &42029905/ Mobay Chemical Company/1989-1990	Supplemental
Vertebrate Species/ Actual Field Study/ Citrus Grove/ Nemacur 15G	15.0	---	Mortality	42029901, 42029902/ Mobay Chemical Company/	Supplemental

The submitted field studies had many deficiencies as indicated below and, therefore, failed to refute EFED's conclusions of high risks to terrestrial vertebrates.

Nemacur 3 Simulated Field Study, Bare Soil. Fenamiphos was applied to bare soil at the rate of 6, 10, 20 lb ai/acre and immediately incorporated to a depth of 2-to-3 inches. Under the conditions of the study, Nemacur 3 had no significant effect on mortality, weight gain, clinical signs, gross lesions or brain cholinesterase activity on the test species, Northern Bobwhite Quail. All study mortalities were limited to day 1. No further signs of intoxication were observed. The

study was found to be scientifically sound but did not meet current guideline requirements (MRID 121291).

Nemacur 3 Actual Field Study, Orchard. Twenty-six acres of orchard (apple and cherry) were sprayed at the rate of 23.8 lb ai/acre in the late spring of 1982. Under these conditions, Nemacur 3 was associated with significant avian (Robins, Sparrows and Starlings) and mammalian (Rabbits and Woodchucks) mortalities over the next five days. Then it rained; the hazard to nontarget wildlife was apparently eliminated by 0.9 inches of rainfall. Repopulation of the treated orchard was nearly complete by one-month post-application. The study was found to be scientifically sound but did not meet current guideline requirements (MRID 121290 and 121293).

Nemacur 10G Actual Field Study, Turf Use on Golf Course Sites. Treatment-related avian mortalities were documented at six different golf courses when Nemacur 3 was applied to control mole crickets. In addition, some birds showed symptoms of behavioral impairment. In a bird census study, several instances of mortality and/or behavioral deficits were observed after Nemacur 10G was applied according to label directions on golf courses.

Birds were caught using 15-to-30 foot mist nets. All captured birds were marked with a colored, plastic leg-band and palatial tags. Mist nets were set up each day at daybreak and removed prior to dark. Only birds with small territories, such as Mocking Birds, Brown Thrashers, Common Ground Doves and Cardinals, were tagged. The rationale of the study's cooperators was that only birds with small territories would most likely be exposed to fenamiphos, and captured migratory birds and/or wide-ranging species would move offsite and be impossible to recapture. Due to scavenging of the carcasses by other species, intensive observations should occur within the first 48 hours after application. These observations of birds feeding on the fairway or adjacent water were compiled from 9 fairways and represent 31.5 observation hours occurring over a 2.5 day period.

Of the species listed in Table 11, Common and Boat-tailed Grackles, Northern Mockingbirds and European Starlings were observed consuming mole crickets on the fairways. Nemacur residues in dead or dying mole crickets on the day of application averaged 96.27 ppm in those sampled. According to the report, golf course personnel find most often the carcasses of Cattle Egrets and various Grackles after Nemacur 10G application. Of the 158 birds observed, 14 displayed signs of intoxication such as limping, salivating and loss of balance, and 13 were found dead after exposure to Nemacur 10G.

This study records observations of deficit behavior and the number of dead birds found over a 2.5 day period posttreatment; however, birds taking flight and moving offsite after feeding were not monitored; therefore, the number of intoxicated and dead birds is potentially much higher than that observed. Flocking birds such as most blackbirds, and/or birds that roost such as mourning doves may also utilize habitat that is well away from the treatment area. Unless the areas are thoroughly searched, the impact to certain species may go unnoticed. Therefore, the magnitude and significance of adverse effects to native bird populations resulting from an

application of Nemacur 10G to turf cannot be assessed given the limitations of this study (MRID 41012902).

Table 11: Observed Bird Deficit Behavior & Death After Nemacur 10G Application to Selected Golf Course Sites

Bird Species	Number Observed Feeding	Number Observed with Deficit Behavior	Number of Deaths
Fish Crow, *Corvus ossifragus*	39	5	2
European Starling, *Sturnus vulgaris*	26	1	0
Northern Mockingbird, *Mimus polyglottos*	26	2	5
Boat-tailed Grackle, *Quiscalus mexicanus*	20	2	2
Common Grackle, *Quiscalus quiscula*	11	0	0
Blue Jay, *Cyanocitta cristata*	12	3	1
Ground Dove, *Columbina passerina*	4	0	0
Northern Cardinal, *Cardinalis cardinalis*	4	0	0
Brown Thrasher, *Toxostoma rufum*	4	1	1
Great Horned Owl, *Bubo virginianus*	2	0	0
Common Bobwhite Quail, *Colinus virginianus*	2	0	0
Red-Winged Blackbird, *Agelaius phoeniceus*	2	0	0
Red-Bellied Woodpecker, *Melanerpes carolinus*	1	0	0
Killdeer, *Charadrius vociferus*	1	0	0
Great Crested Flycatcher, *Myiarchus crinitus*	1	0	0
Osprey, *Pandion haliaetus*	1	0	0
Great Blue Heron, *Ardea herodias*	1	0	0
Downy Woodpecker, *Picoides pubescens*	1	0	0
Loggerhead Shrike, *Lanius ludovicianus*	0	0	2
Totals	158	14	13

Nemacur 3 Actual Field Study, Tobacco Field. The terrestrial field study was submitted to evaluated the effects of Nemacur 3 on birds and other wildlife under actual field conditions. The study occurred over a two-year period on tobacco field plots in Pitt and Greene Counties of North Carolina, a major tobacco growing region of the United States. Fenamiphos, formulated as Nemacur 3, was applied at 6 lb ai/acre to each of the three treated fields using ground sprayers followed by soil incorporation.

A total of 114 species of birds were observed in the study area. Thirty-five of these species were observed foraging in or over the test fields during or immediately following application. Some of the species observed were Killdeer (*Charadrius vociferus*), Ring-Billed Gulls (*Larus delawarensis*), Fish Crows (*Corvus ossifragus*) and American Crows (*Corvus brachyrhynchos*), Horned Larks

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(*Eremophila alpestris*), American Robins (*Turdus migratorius*), European Starlings (*Sturnus vulgaris*), Northern Cardinals (*Cardinalis cardinalis*), and White-Throated Sparrows (*Zontrichia albicollis*). All of the aforementioned species are known to eat insects, seeds and berries, but Killdeer and Ring-Billed Gulls are also known to consume small marine life and carrion (dead animals). Therefore, fenamiphos induced primary poisoning may also lead to secondary poisonings.

In the first year of the study, bird, mammal, reptile and amphibian carcasses were found at study sites after fenamiphos application. The dead birds found were all domestic poultry located solely in the treatment areas. Of six dead mammals found, three were in the control and three were in the treatment areas. Two dead reptiles and four dead amphibians, all in the treatment areas, were also found.

In the second year of the study, a total of 73 vertebrate mortalities were documented. Of these, 22 carcasses were found on treated plots, and 27 carcasses were found on control plots prior to application. After application of Nemacur 3 to the tobacco field, 12 carcasses were found on treatment plots and 12 were found on control plots. Although the number of casualties on treatment plots was not greater than the number on control plots, Nemacur 3 cannot be ruled out as the possible cause of death. Exposed vertebrates could have migrated from the treatment plots to control plots prior to death, and it was not reported whether tissue sample analyses were conducted on the carcasses that were found. But Nemacur residues were detected in all matrices sampled: soil (0.13 to 12.88 ppm in top one-tenth inch) , water (0.07 to 2.02 ppm), and invertebrate carcasses (0.10 to 0.12 ppm).

This study demonstrates that a high survival pressure already exists on various terrestrial vertebrates which utilize agricultural areas for food or shelter. However, due the manner the study was conducted, one cannot determine whether incorporating Nemacur 3 directly after applying it at a rate of 6 lb ai/ace will reduce or eliminate fenamiphos exposure and resultant adverse effects to wildlife (MRID 42029903).

Nemacur 15G Actual Field Study, Florida Citrus Grove. The application of Nemacur 15G to Florida citrus groves resulted in depressed plasma cholinesterase levels in nearly one third of the avian local species for approximately 30 days post-treatment. Cholinesterase levels were lowest between 7-to-10 days post-application.

Birds were caught using 15-to-30 foot mist nets. All captured birds were marked with a colored, plastic leg-band and palatial tags. Mist nets were set up each day at daybreak and removed prior to dark. Only birds with small territories, such as Mocking Birds, Brown Thrashers, Common Ground Doves and Cardinals, were tagged. The rationale of the study's cooperators was that only birds with small territories would most likely be exposed to fenamiphos, and captured migratory birds and or wide-ranging species would move offsite and be impossible to recapture. Of those recaptured and tested, cholinesterase levels returned to normal 30 days after initial application. The Nemacur mean residue level on soil and vegetation samples taken directly after application were 29.41 and 0.72 ppm, respectively. The mean residue on/in invertebrate species collected the day after application was 15.89 ppm.

A bird and mammal census characterization report submitted by the registrant contained the following information about each study site: surrounding wildlife and aquatic habitats, species use and abundance of these citrus groves, soil-type descriptions, pest management history, and nearest weather recording stations. The census report documented bird and mammal abundance in the middle of the grove, at the edge of the grove, and at the edge of the surrounding wildlife habitat. In the middle of the grove, 26 different bird species numbering from 136 to 1,000 birds per 100 acres was recorded. At the grove's perimeter, 27 different bird species numbering from 56 to 265 birds per 100 acres was recorded. In the surrounding wildlife habitat, 47 different bird species numbering from 113 to 354 birds per 100 acres was recorded. The mammalian species sighted were the Eastern Cottontail Rabbit (*Sylvilagus floridanus*), Raccoon (*Procyon lotor*), Opossum (*Didelphis marsupialis*), Armadillo (*Dasypus novemcinctus*), Eastern Gray Squirrel (*Sciurus carolinensis)*, River Otter (*Lutra canadensis*), Wild Boar (*Sus scrofa*), and Bobcat (*Lynx rufus*).

Scavenger rates were also recorded and were very high. Over 75 percent of the dead birds recorded through searches were scavenged by other birds, fire ants, and mammals within 12 hours of pesticide exposure, and all were scavenged within 2.5 days. EFED staff visited this field site and were informed that carcass searches were conducted at each site; however, on some days searches were conducted by one individual searching alone for 6 hours over these large acreages. Hence the number of birds killed from fenamiphos exposure is potentially much higher, but carcasses were simply not found due to inadequate monitoring and high scavenging rates.

In addition to visiting the sites, EFED staff also traveled and consulted with local experts in the areas of Polk, Orange, and Osceola counties to better understand the topography, geography and ecology of central Florida. This area is characterized by shallow, sandy soils. The water table is typically less than 10 feet from the soil surface, and in many localities, less than 5 feet. Citrus groves typically have interconnected systems of irrigation canals, drainage ditches, and/or holding ponds, to control surface water. This elaborate system of water control is required because it is not only important to irrigate citrus but also to remove excess water. These irrigation canals and drainage ditches are teaming with aquatic life and are utilized extensively by avian, mammalian and reptilian species. Applied pesticides can also readily enter these habitats through drift, run-off or even direct application.

Regarding this specific study, the number of treated sites was too few to determine whether an "effect" or "no effect" occurred using the binomial theorem (Fite et al., 1988), and true carcass searches were not conducted. Due to these study limitations, the magnitude and significance of the adverse effects from an application of Nemacur 15G at a rate of 20 lb ai/acre to native bird populations living in and around citrus groves cannot be fully assessed. Yet, this field study did confirm that adverse effects to nontarget birds living in and around citrus groves can be expected from a single application of Nemacur 15G. In addition to increased acute mortality, the local bird population (and other exposed terrestrial vertebrates) will be negatively affected by depressed blood cholinesterase levels for up to 30 days posttreatment. Debilitated birds (and other terrestrial vertebrates) are more susceptible to predation and will have less chance of survival due to fenamiphos exposure (MRID 42029901 and 42029902).

Nemacur 3 Simulated Field Study, Pineapple Field. Ring-necked Pheasants *(Phasianus colchicus)* and Rice Birds *(Lonchura punctulata)* were exposed to a pineapple field sprayed with Nemacur 3. The birds were held in cages positioned over a treated area to give 0, 50 and 100 percent exposure for a 14-day period. Approximately 25% mortality occurred among Rice Birds in the 100 percent exposure area. At 50 percent exposure, Rice Birds experienced no behavioral differences, toxic symptoms or deaths. At 50 and 100 percent exposure, Ring-neck Pheasants demonstrated no behavioral differences, toxic symptoms or deaths.

The application rate was 5 lb of fenamiphos in 250 gallons of water per acre. The test birds were provided 327 square feet of pen area in the treated field one hour after application. The 327 square foot area received 47.3 ml of the formulation or 17 grams of the active ingredient in 1.9 gallons of water by means of a hand spray boom. The amount of fenamiphos in the pen area equated to 52 milligrams per square foot. See Table 12.

Table 12: Simulated and Actual Field Nemacur 3, 10G, and 15G

Surrogate Species/ Study Duration /Formulation	% ai	NOEL Endpoints	LOEL Endpoints	MRID No. Author/Year	Study Classification
Rice Bird*(Lonchura punctulata)* Ring-necked Pheasant *(Phasianus colchicus)* Nemacur 3	35.0	No Behavioral Deficits, Weight Decrease & Cholinesterase Decrease	Mortality	ACC 120301/ Lamb & Nelson/ 1971	Supplemental
Rice Bird*(Lonchura punctulata)* Ring-necked Pheasant *(Phasianus colchicus)* Nemacur 15G	15.0	No Behavioral Deficits, Weight Decrease & Cholinesterase Decrease	Mortality	ACC 120301/ Lamb, Mcleod & Zeck/ 1971	Supplemental
English Sparrow *(Passer domesticus)* Bobwhite Quail *(Colinus virginianus)* New Zealand Rabbit (species unknown) Nemacur 15G	15.0	Weight Gain	Mortality, Weight Loss	ACC 120301/ Lamb & Jones/ 1972	Supplemental

Several major problems with the test design of this study affect the reliability of its results. The study should have measured the magnitude of adverse affects to wild birds after foraging on resident food items in a fenamiphos treated field. However, test birds were supplementally fed cracked corn, their typical diet. In addition, the number of test birds and dosing levels were too few, the pens were not moved daily, and carcasses of Rice Birds were not necrosied to determine cause of death (ACC 120301).

Nemacur 15G Simulated Field Study, Pineapple Field. Ring-necked Pheasants and Rice Birds were exposed to a pineapple field treated with Nemacur 15G. The birds were held in cages positioned over a treated area to give 0, 50 and 100 percent exposure for a 14-day period. Approximately 10% of the Rice Birds and 20% of the Ring-necked Pheasants died at 100 percent exposure. At 50 percent exposure, Rice Birds experienced no behavioral differences, toxic symptoms or deaths. At 50 and 100 percent exposure, Ring-neck Pheasants demonstrated no behavioral differences, toxic symptoms or deaths. The application rate was 40 lb of fenamiphos per acre. The test birds were penned in eight cages whose base dimensions when collectively added would comprise a total of 200 square feet of exposure area. These cages were then placed on a 327 square foot surface of treated field one hour after application. The amount of fenamiphos in the exposure area equated to 416.5 milligrams per square foot when unincorporated. The Nemacur 15G was

incorporated 4-to-6 inches with a tractor-mounted roto-tiller. In addition, the field study discusses laying a 24-inch plastic mulch strip, covering the edges with soil and planting the pineapple through the plastic. Therefore, the granular material potentially could have been fully unavailable to the test birds.

In summary, several major problems with the test design of this study affect the reliability of its results. Test birds were supplementally fed cracked corn, their typical diet; therefore, test birds could successfully feed and potentially never be exposed to the toxicant. In addition, the number of test birds and dosing levels were too few, the pens were not moved daily, and carcasses of Rice Birds and Ring-necked Pheasant were not necrosied to determine cause of death. It was also unclear as to how much of the soil remain uncovered by plastic mulch, making it difficult to determine whether exposure to the toxicant occurred (ACC 120301).

Nemacur 15G Simulated Field Study, Irrigated and Nonirrigated Fields. Nemacur 15G was applied at the rate of 20 lb ai/acre. The residue in ppm would be approximately 441 ppm before watering in. The control plot and the two treated plots were each 660 square feet in size. Each treated plot received an application followed by wetting the area with 0.5 inches of water.

Several major problems with the test design of this study affect the reliability of its results. Cages were placed in the treated areas after the initial application and were never moved again throughout the study. The test birds' diets were supplemented on a daily basis thereby reducing their consumption of field resident food items, and as a consequence, fenamiphos exposure. Notwithstanding, English Sparrows suffered higher mortality in treated areas where Nemacur 15G was not watered in, than in the control or the treated and irrigated areas. In the nonirrigated pens, where feed was withheld for 8 hours, mortality was highest. The mortality in all pens decreased as the study progressed, and with the occurrence of two rain events, the incidence of mortality appeared to decline. In the Bobwhite Quail pens, two birds died in the treated, nonirrigated area. All birds, however, lost weight during the study with birds in the treated, irrigated areas averaging a weight loss of 4 grams; birds in the treated, nonirrigated areas averaging a weight loss of 14 grams; and birds in the control averaging a weight loss of 8 grams. No deaths occurred in the test population of rabbits. Weight gain was greatest in the control group; weight gain was average in the group penned in the treated, irrigated area; and weight gain was least in the group penned in the treated, nonirrigated area (ACC 120301).

Nemacur 3, An Evaluation of its Effects Upon Avian Species in and Around Citrus Groves on the Central Florida Ridge. The study was submitted for review in support of the reregistration of the pesticide, Nemacur 3, containing the active ingredient, Fenamiphos. This study evaluated the use of Nemacur 3 on citrus in Florida's Central Ridge--a use that EPA had determined would likely result in adverse effects to nontarget terrestrial wildlife. The study was conducted, primarily, to determine the magnitude of exposure and acute hazard to birds caused by applications of Nemacur 3 to citrus groves using chemigation, and, secondarily, to determine the magnitude of exposure and acute hazard to other wildlife. The specific objectives were to (1) document the number and kinds of birds exposed to Nemacur 3 and the magnitude and duration of this exposure, (2) document the numbers and kinds of birds dying as a result of exposure to Nemacur 3, (3) estimate the impact of Nemacur 3 applications on the survival of selected resident species, and (4) determine environmental

concentrations of fenamiphos in soil and ground-dwelling invertebrates. The report indicates that 69 avian, 12 mammalian, 6 reptilian, and 4 amphibian species were observed in the study area; of these 54 avian, 12 mammalian, 4 reptilian, and 2 amphibian species were observed in the citrus groves.

Totals of 1,165 and 1,835 avian captures occurred on treated and control replicates, respectively. More birds were captured on control than treated replicates at pre- and post-application; however, the difference in the mean number of captures per session was not significant ($a = 0.05$, $t = 2.28$, $p > 0.05$).

Ten focal species (those species determined to be at potentially high risk) were blood cholinesterase monitored. These focal species comprised 72.6 percent of all captures. There was no significant difference between the number of focal species captured between pre- and post-application periods either on treated replicates ($t = 1.12$, $p > 0.05$) or on control replicates ($t = 0.86$, $p > 0.05$).

A total of 1,936 blood samples were collected from ten focal species during the study: 796 from birds on treated replicates (mean = 132.7 samples/replicate) and 1,140 from birds on control replicates (mean = 190 samples/replicate); the difference in the mean number between these groups was not significant ($t = 1.67$, $p > 0.05$).

The report's authors have presented the following arguments and conclusions:

1. Blood cholinesterase values for each pre-application and post-application individual were compared to the diagnostic threshold of significant exposure, which is defined as one-half the overall mean blood cholinesterase value for each control and pre-application individual of that species;

2. Only birds with blood cholinesterase levels above the diagnostic threshold were assumed to survive;

3. The proportion of birds sampled after application of Nemacur 3 having blood cholinesterase less than or equal to the diagnostic threshold was 16.05 for treated replicates and 2.7 percent for control replicates; hence, the report suggests that approximately 13 percent of the birds at treated sites were exposed to a significant dose of the test substance; and

4. A conservative avian survival index for each replicate was calculated based on the proportion of birds with blood cholinesterase levels above the diagnostic threshold (mean survival pre- and post application indices were 0.98 and 0.85 on treated replicates, and 0. 96 and 0.97 on control replicates.

Therefore, based on these results, the authors concluded that the null hypothesis--treatment with Nemacur 3 results in an avian survival index less than or equal to 80 percent of the control ($t = 2.65$, $df = 5$, $p < 0.05$)--was rejected.

Additional Observations Reported in the Study:

Eighty-five vertebrate mortalities were found during the field portion of the study. Of these 33 (39%) were found on treated replicates (mean = 5.5/replicate, consisting of means of 3.0 birds, 1.3 mammals, one reptile and 0.17 amphibian) and 52 (61%) were found on control replicates (mean = 8.7/replicate, consisting of means of 4.8 birds, 2.5 mammals, 1.0 reptile and 0.33 amphibian). Twenty-four of the mortalities found on treated replicates were found after application, while 33 mortalities were found during an equivalent time period on the control replicates.

Avian capture data were summarized using SPSS/PC+. Diversity of the bird community on each replicate was calculated using the Brillouin Index, for describing diversity of small, censused communities. The mean number of mortalities found on the treated replicates was compared to the mean number of mortalities found on control replicates using a one-sided standard paired t-test to assess if significantly more mortalities occurred due to treatment. A classical null hypothesis of no effect was considered against the one-sided alternative.

Birds which died or were injured during the trapping process were not included in the statistically considered data. Forty-six mortalities were considered attributable to trapping. Forty-one were analyzed for Nemacur 3 residues in the GI tract and liver. The report indicates that only two individuals had detectable residues of Nemacur 3.

On page 25 of the submitted report, the authors have explained that they designed the field portion of the study. The specific test design was to ensure that at least an 80 percent probability that a 20 percent reduction in avian survival if caused by fenamiphos application to the citrus grove would be detected. The authors mistakenly conclude, "This implies that a pesticide-induced decrease in survival of 20% or more is unacceptable, whereas a smaller impact may be acceptable." The particular guidance the authors are citing was EPA's *Guidance Document for Conducting Terrestrial Field Studies.* However, on page 7 of EPA's guidance document, these percentages are provided only as an *example* on how to calculate the number of sites that would be needed using the binomial theorem. These values do not reflect any EPA acceptable levels of avian mortality.

Moreover, the study authors chose a survival index of 50 percent cut-off between survivors and nonsurvivors, referred to as the diagnostic threshold. This presumes that cholinesterase inhibition at less than 50 percent does not affect the exposed individual's ability to survive; however, many sublethal impacts to birds from organophosphate applications have been documented in recent years which cause bird population declines. Sublethal doses of organophosphate pesticides have been documented to affect learning ability and altered reproductive capability of Bobwhite Quail, at doses well below those causing outward signs of toxicity. Altered reproductive capability was characterized by impaired development of ovarian follicles, cessation of egg production, and reduced blood levels of reproductive hormones. [13] Research conducted on another organophosphate pesticide,

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[13] Fleming, W. James, "Summaries of Selected Studies on Wildlife Pollution, Progress Reports from the Patuxent Wildlife Research Center for the Year 1981," U.S. Department of Interior, Fish and Wildlife Service, Patuxent Wildlife Research Center, Laurel, Maryland 20708.

Methyl Parathion (MeP), concluded that Northern Bobwhites that received 6 mg/kg of MeP had a lower survival rate than control birds. Laboratory studies have indicated that administration of 6 mg/kg MeP to pen-reared bobwhite would result in approximately 40% depression of brain cholinesterase 4 hours posttreatment. The decreased survivability was primarily due to increased avian predation, possibly resulting from subtle behavioral impairments rather than the overt toxic effects of the OP chemical. [14] Long-term disruption of bird feeding and breeding due to conditioned taste aversion (CTA) to food items tainted with an organophosphate pesticide also will contribute to a reduction in avian diversity.[15]

A ten-year comparative study on the "Lethal Dietary Toxicities of Environmental Pollutants to Birds," concluded that species sensitivity to organophosphorous compounds with the three species tested was first, Bobwhite Quail; second, Ring-necked Pheasant; and third, Mallard Duck, suggesting greater susceptibility with decreasing size.[16] One would then conclude that songbirds, due to their smaller size, would be even more sensitive to organophosphate pesticide poisoning.

The ten focal species indicated in the study were selected based on nine being predominantly ground foragers and would likely be exposed to the microjet ground applications of Nemacur 3, and one species was selected as the control, White-eyed Vireo, because it is a canopy forager, presumably less likely to be exposed to Nemacur 3 residues. The other nine focal species are Mourning Dove, Common Ground Dove, Northern Cardinal, Rufous-Sided Towhee, Brown Thrasher, Northern Mockingbird, Northern Bobwhite, Blue Jay and Red-Winged Blackbird. A study completed in 1991 entitled, "Routes of Uptake and Their Relative Contribution to the Toxicologic Response of Northern Bobwhite (*Colinus Virginianus*) to an Organophosphate Pesticide," considered also dermal, preening, and respiratory pathways to the exposure of birds to pesticides under ecological conditions. The study's conclusions were that all four routes, oral, dermal, preening and respiratory pathways contributed to the inhibition of brain cholinesterase at different post-spray periods. Dermal uptake and preening were major contributors to the overall dose and toxic response of birds to methyl parathion. Inhalation was the major route of exposure at one hour post-spray. At 4 hours post-spray, uptake through preening caused the greatest inhibition of brain cholinesterase activity. Oral ingestion resulted in less than 20 percent inhibition of brain cholinesterase during the test. Routes of uptake in

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14 Buerger, Theodore T., Ronald J. Kendall, Brad S. Mueller, Theodore DeVos, and Bill A. Williams, "Effects of Methyl Parathion on Northern Bobwhite Survivability," Environmental Toxicology and Chemistry, Volume 10, pp. 527-532, 1991.

15 Nicolaus, Lowell K. and Hansoo Lee,"The First Evidence of Long-Term Changes in Bird Behavior Produced by Low Acute Exposure to Organophosphate," 1998, Department of Biological Sciences, Northern Illinois University, DeKalb, Illinois 60115.

16 Hill, Elwood F., Robert G. Heath, James W. Spann, and Joseph D. Williams, "Lethal Dietary Toxicities of Environmental Pollutants to Birds," U.S. Fish and Wildlife Service, Special Scientific Report–Wildlife No. 191, Washington, D.C. 1975.

order of contribution to toxicologic response from 8 to 48 hours post-spray were > dermal > preening ≥ oral > inhalation.[17]

In Appendix XIV, Capture Record for Focal Species and ChE Values (IU/ml), the White-Eyed Vireo data indicate depression of some individuals in the treated replicates such that exposure is occurring; therefore, the White Eyed Vireo could not serve as a control. In addition, based on the submitted spraying regime for the test groves the individuals in Control groups 1 and 7, were exposed to other cholinesterase inhibiting insecticides. These data and their associated treatment replicates should be removed from consideration in the analyses.

The study does demonstrate that birds exposed to low-volume microjet ground applications of Nemacur 3 have significantly depressed brain cholinesterase activity; however, the reviewer does not agree with the underlying assumptions regarding setting the diagnostic threshold at 50% for acute mortality. This presumes that cholinesterase inhibition at less than 50 percent does not affect the exposed individual's ability to survive; however, many sublethal impacts to birds from organophosphate applications which resulted in population declines were documented in the early 1990's (See cited references below). A major uncertainty, which this study does not address, is to what extent are these sublethal effects causing reductions in bird density and diversity at citrus use sites. Additional uncertainties are the differences in interspecies sensitivity and what role these differences play in population changes.

In addition, the reviewer does not agree with the inclusion of Groups 1 and 7 in the statistical analyses, when the control sites of these areas received applications of other cholinesterase inhibiting chemicals.

One can conclude that birds (and other terrestrial vertebrates) exposed to single or sequential low-volume microjet ground applications of Nemacur 3 at citrus use sites will result in impairment, acute mortality, and population reductions at levels which are statistically significant, but the magnitude and extent of the acute risks to birds (and other terrestrial vertebrates) cannot be quantified from the results of this study. Reoccurring bird mortalities and population reductions, which will occur from applications of Nemacur 3 to citrus use sites, have been defined by the Avian Effects Dialogue Group as impacts of concern[18] (MRID 437379-01).

Nemacur 10G , An Evaluation of the Effects Upon Birds at Golf Courses in Florida. The study was submitted for review in support of the reregistration of the pesticide, Nemacur 10 % Granules, containing the active ingredient, Fenamiphos. This study was conducted to evaluate the effects of Nemacur 10% Granular on birds when applied to golf course turf at the highest labeled application rate of 10 lbs a.i./acre. As stated in the report, "based on the high acute oral toxicity of fenamiphos,

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17 Driver, Crystal J., Michael W. Ligotke, peter Van Voris, Bruce D. McVeety, Bernard J. Greenspan, and David B. Drown, "Routes of Uptake and Their Relative Contribution to the Toxicologic Response of Northern Bobwhite *(Colinus Virginianus)* to an Organosphate Pesticide, " Environmental Toxicology and Chemistry, Volume 10, pp. 21-33, 1991.

18 Assessing Pesticide Impacts on Birds: Final Report of the Avian Effects Dialogue Group, 1988-1993, Resolve Inc. 1994, 1250 24th Street NW /Suite 500, Washington, D.C. 20037.

there appears to be a potential for direct mortality to birds and to a less extent, mammals, that feed in areas treated with Nemacur 10G. The most hazardous route of exposure is direct ingestion of the granules." The study only attempts to evaluate population effects on one endpoint, acute mortality. In addition, the study indicates that reductions in the focal bird population were not significant when comparing treatment areas to controls; however, Tables 9 and 10 of the report indicate a significant drop in the number of alive birds in the focal population when compared to the number of marked birds (in some instances at almost 50 percent) such that the focal population may have been significantly impacted by the marking procedure. With additional declines in individual focal species from pre-application to Day 3, both in the controls and treatment levels, of approximately 10-to-30 percent, one can conclude that adverse impacts are occurring at statistically significant levels but one cannot conclude from the study the causal relationship.

For example, according to the report, "use of the treated turf areas by birds was monitored during two one-hour periods the day of application and during a one-hour period the morning after application. The number of birds sighted foraging on treated turf during or immediately following application ranged from 5 at Grenelefe to 112 at Killearn golf course." The most frequently observed focal species in the fairway was the Northern Mockingbird. The average percentage of Northern Mockingbird observations in the fairway was 2.8 percent (range 0.0 - 5.5%) for control plots and 3.3 percent (range 0.7 -5.4%) for treatment plots. Table 9 indicates that at Killearn Country Club the number marked Northern Mockingbirds was 30 in the control and 22 in the treatment group. The number alive prior to application was 10 and 7, respectively. The number alive at Day 3+ was 4 and 6, respectively. Fenamiphos, however, is contributing to the cause of death (ten of the 25 intact carcassses had detectable residues), but the magnitude and extent of the acute risks to birds (and other terrestrial vertebrates) from Nemacur 10G use at golf course use sites cannot be quantified based on the results of this study.

In addition, blood cholinestrase levels were not monitored such that sublethal exposures to the resident population are not known. Many sublethal impacts to birds from organophosphate applications which have resulted in population declines were documented in the early 1990's (See cited references below.). A major uncertainty, which this study does not address, is to what extent are these sublethal effects causing reductions in bird density and diversity at golf course use sites. Additional uncertainties are the differences in interspecies sensitivity to the toxicant and what role these differences play in population changes.

The report states that all golf courses were very similar in species diversity between control and treatment plots. The total number of species observed for the six golf courses was (control/treatment) Capital City–60/55, Seminole–45/51, Killearn–46/51, Mountain Lake–57/62, Lake Region–57/67, and Grenelefe–49/53. The Blue Jay was the most abundant focal species, with an average relative abundance of 16 percent (range 7.6 - 30.1%) for control and treatment plots. The Northern Mockingbird and Northern Cardinal were also among the most relatively abundant species.

According to the report, "use of the treated turf areas by birds was monitored during two one-hour periods the day of application and during a one-hour period the morning after application. The number of birds sighted foraging on treated turf during or immediately following application ranged from 5 at Grenelefe to 112 at Killearn golf course." The most frequently observed focal species in the

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fairway was the Northern Mockingbird. The average percentage of Northern Mockingbird observations in the fairway was 2.8 percent (range 0.0 - 5.5%) for control plots and 3.3 percent (range 0.7 -5.4%) for treatment plots.

According to the report, the most common nonfocal species observed in the fairway were the European Starling, *Sturnus vulgaris;* Common Grackle, *Quiscalus quiscula;* and Boat-Tailed Grackle, *Quiscalus major.*

According to the report, population estimates for all focal species combined ranged from 135-to-1,021 birds for control plots and 114-to-728 birds for treated plots. The Blue Jay had the greatest average population, with a mean population of 95 birds (range 44-to-246) on control plots and 77 (range 32-to-162) on treated plots. Visual censuses indicated an average of 38% (range 14-to-54%) of the individuals of the focal species were marked. Population estimates for all focal species combined ranged from 114-to-1,021 birds per plot.

The report states that "two birds were found dead (1 European Starling and 1 Loggerhead Shrike) during the exposure monitoring periods after application. The starling was first noticed immobile in the rough next to a fairway and later died. Seven other birds (2 American Robins, 2 Blue Jays, 1 Brown-Headed Cowbird, 1 Fish Crow, and 1 Orchard Oriole) were observed with symptoms of toxicity during the exposure monitoring periods. The symptoms noted were ataxia, immobility, salivation, and convulsions. These birds all recovered. All birds showing symptoms, except the 2 robins, were noted during the day of application. The two robins were observed with symptoms the morning after application."

In addition, the report indicates that carcasses of unidentified mammals, reptiles and amphibians were also found on Day 0, 1,2,3, 5, and 7 post-application.

The report stated that the first 48 hours post-application is the period considered to be of greatest risk to the focal population. To determine the survival index, birds resighted either Day 3 or Day 1 were considered to be part of the population at risk. Of these individuals, those which were resighted on or after day 3 post-application were considered "survivors." The proportion surviving on control and treatment plots were compared using a standard one-sided t-test on the mean difference of these pairs.

According to the report, the null hypothesis for analysis of survival data was one of assumed effect, and the null hypothesis for analysis of mortality data was the classical null hypothesis of no effect, mortality of wildlife at pesticide treated sites would be equal to the mortality of wildlife at control sites during the post-application period.

On page 14 of the submitted report, the authors have explained that they designed the field portion of the study. The specific test design was to ensure that at least an 80 percent probability that a 20 percent reduction in avian survival if caused by fenamiphos application to the golf course would be detected. The particular guidance the authors are citing was EPA's *Guidance Document for Conducting Terrestrial Field Studies.* According to the report, the experimental design of the study was based on the following:

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(1) Use of the survival data from visual resightings in order to test the scientific hypothesis of an assumed effect:

$H_{o:}$ Survival of birds on pesticide treated sites is reduced by 20 percent or more in comparison to control sites during the post-application period, versus

$H_{1:}$ Survival of birds on pesticide treated sites is not reduced by 20 percent or more, if at all, in comparison to control sites, and

(2) Use of the carcass search data in order to test the scientific hypothesis of no effect:

$H_{0:}$ Mortality of wildlife on pesticide treated sites is equal to the mortality of wildlife on control sites during the post-application period, versus

$H_{1:}$ Mortality of wildlife on pesticide treated sites is greater than at control sites.

Based on the manner carcass searching and observations were collected, the authors concluded that the null hypothesis was rejected. The authors conclusions are "There was no evidence that pesticide treatment increased bird mortality. In fact, more carcasses were found at control sites than at treatment sites." The authors also concluded regarding "the null hypothesis that survival of focal species on sites treated with Nemacur 10G was reduced by 20 percent or more in comparison to untreated control sites was rejected. Average bird survival rates were essentially equal at control and treatment sites."

Monitoring ChE Activity. This study did not monitor blood cholinesterase (ChE) level's which can indicate the degree that the population of resident birds is affected. ChE concentrations can be used to indicate exposure.

A ten-year comparative study on the "Lethal Dietary Toxicities of Environmental Pollutants to Birds," concluded that species sensitivity to organophosphorous compounds with the three species tested was first, Bobwhite Quail; second, Ring-necked Pheasant; and third, Mallard Duck, suggesting greater susceptibility with decreasing size.[19] One would then conclude that songbirds, due to their smaller size, would be even more sensitive to organophosphate pesticide poisoning.

A study completed in 1991 entitled, "Routes of Uptake and Their Relative Contribution to the Toxicologic Response of Northern Bobwhite (*Colinus Virginianus*) to an Organophosphate Pesticide," considered dermal, preening, and respiratory pathways of exposure of birds to pesticides under ecological conditions. The study's conclusions were that all four routes, oral, dermal, preening and respiratory pathways contributed to the inhibition of brain cholinesterase at different post-spray periods. Dermal uptake and preening were major contributors to the overall dose and toxic response of birds to methyl parathion. Inhalation was the major route of exposure at one hour post-spray. At 4

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19 Hill, Elwood F., Robert G. Heath, James W. Spann, and Joseph D. Williams, "Lethal Dietary Toxicities of Environmental Pollutants to Birds," U.S. Fish and Wildlife Service, Special Scientific Report–Wildlife No. 191, Washington, D.C. 1975.

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hours post-spray, uptake through preening caused the greatest inhibition of brain cholinesterase activity. Oral ingestion resulted in less than 20 percent inhibition of brain cholinesterase during the test. Routes of uptake in order of contribution to toxicologic response from 8 to 48 hours post-spray were > dermal > preening ≥ oral > inhalation.[20]

Nest Monitoring and Behavioral Observations. Because this study was conducted during the breeding period, nest monitoring would have been useful to evaluate the effect of Nemacur 10G on breeding birds. The report states that "two birds were found dead (1 European Starling and 1 Loggerhead Shrike) during the exposure monitoring periods after application. The starling was first noticed immobile in the rough next to a fairway and later died. Seven other birds (2 American Robins, 2 Blue Jays, 1 Brown-Headed Cowbird, 1 Fish Crow, and 1 Orchard Oriole) were observed with symptoms of toxicity during the exposure monitoring periods. The symptoms noted were ataxia, immobility, salivation, and convulsions. These birds all recovered. All birds showing symptoms, except the 2 robins, were noted during the day of application. The two robins were observed with symptoms the morning after application." However, many sublethal impacts to birds from organophosphate applications have been documented in recent years which cause bird population declines. Sublethal doses of organophosphate pesticides have been documented to affect learning ability and altered reproductive capability of Bobwhite Quail, at doses well below those causing outward signs of toxicity. Altered reproductive capability was characterized by impaired development of ovarian follicles, cessation of egg production, and reduced blood levels of reproductive hormones. [21] Research conducted on another organophosphate pesticide, Methyl Parathion (MeP), concluded that Northern Bobwhites that received 6 mg/kg of MeP had a lower survival rate than control birds. Laboratory studies have indicated that administration of 6 mg/kg MeP to pen-reared bobwhite would result in approximately 40% depression of brain cholinesterase 4 hours posttreatment. The decreased survivability was primarily due to increased avian predation, possibly resulting from subtle behavioral impairments rather than the overt toxic effects of the OP chemical. [22] Long-term disruption of bird feeding and breeding due to conditioned taste aversion (CTA) to food items tainted with an organophosphate pesticide also will contribute to a reduction in avian diversity [23] (MRID 438721-01).

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20 Driver, Crystal J., Michael W. Ligotke, peter Van Voris, Bruce D. McVeety, Bernard J. Greenspan, and David B. Drown, "Routes of Uptake and Their Relative Contribution to the Toxicologic Response of Northern Bobwhite *(Colinus Virginianus)* to an Organophosphate Pesticide, " Environmental Toxicology and Chemistry, Volume 10, pp. 21-33, 1991.

21 Fleming, W. James, "Summaries of Selected Studies on Wildlife Pollution, Progress Reports from the Patuxent Wildlife Research Center for the Year 1981," U.S. Department of Interior, Fish and Wildlife Service, Patuxent Wildlife Research Center, Laurel, Maryland 20708.

22 Buerger, Theodore T., Ronald J. Kendall, Brad S. Mueller, Theodore DeVos, and Bill A. Williams, "Effects of Methyl Parathion on Northern Bobwhite Survivability," Environmental Toxicology and Chemistry, Volume 10, pp. 527-532, 1991.

23 Nicolaus, Lowell K. and Hansoo Lee,"The First Evidence of Long-Term Changes in Bird Behavior Produced by Low Acute Exposure to Organophosphate," 1998, Department of Biological Sciences, Northern Illinois University, DeKalb, Illinois 60115.

(4) Mammals, Acute and Chronic (TGAI and Degradates)

Wild mammal testing is required on a case-by-case basis, depending on the results of the lower tier studies (acute and subacute testing) intended use pattern and pertinent environmental fate characteristics. In lieu of wild mammal testing, results of mammalian tests submitted to the Agency to extrapolate fenamiphos' toxicity to humans are also being used to indicate the effects to wild mammals. The acute toxicity category descriptions for wild mammals are the same as those for birds. The toxicity value (LD_{50}) appearing in the shaded area of the tables will be used to calculate the acute mammalian risk quotients (RQ) in subsequent sections.

Table 13: Mammalian Acute Oral Toxicity Findings (LD_{50}) Fenamiphos Technical

Surrogate Species	% A.I.	LD_{50} (mg/kg)	Toxicity Category	MRID No.	Study Classification
Laboratory Rat (*Rattus norvegicus*)	99.7	3.15, male 2.38, female	very highly toxic	06F1693	Core
Laboratory Rat (*Rattus norvegicus*)	85	8.1, male 4.75, female	very highly toxic	0001308 & 0001310/Bayer Agricultural Inst./1992	Core
Laboratory Rat (*Rattus norvegicus*)	88.0	2.7, male 3.0, female	very highly toxic	00033831/ACC 099496/Mobay Chemical Company/1975	Core
Laboratory Rat (*Rattus norvegicus*)	88.0	2.4, male 3.3, female	very highly toxic	00052532/Mobay Chemical Company/1974	Core
Laboratory Rat (*Rattus norvegicus*)	80.0	8.1, male 9.6, female	very highly toxic	0001308 & 0001310/Bayer Agricultural Inst./1992	Core
Laboratory Mouse (*Mus musculus*)	80.0	8.3, female	very highly toxic	0001308/Bayer Agricultural Inst./1992	Core
Guinea pig (*Cavia porcellus*)	80.0	>75.0 and <100.0	highly toxic	00154492/Bayer Agricultural Inst./1992	Supplemental
Guinea pig (*Cavia porcellus*)	80.0	55.90	highly toxic	00154492/Bayer Agricultural Inst./1992	Supplemental
Laboratory Rabbit (*Sylvivlagus sp.*)	80.0	5.00	very highly toxic	00154492/Bayer Agricultural Inst./1992	Supplemental
Domestic Cat (*Felis domestica*)	80.0	2.5 to 10.0	very highly toxic	00154492/Bayer Agricultural Inst./1992	Supplemental
Domestic Dog (*Canis familiaris*)	80.0	>2.5	very highly toxic	00154492/Bayer Agricultural Inst./1992	Supplemental

The results indicate that fenamiphos is very highly toxic to mammals on an acute oral basis. In the table above, the surrogate test species listed in the upper portion represent the order, Rodentia, small to medium-sized gnawing mammals, and in the lower portion represent the orders, Lagomorpha and Carnivora, plant-eating and flesh-eating mammals (MRIDs 06F1693, 00154492, 001310, 005722, and 00154492).

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Table 14: Mammalian Acute Oral Toxicity Findings (LD_{50}) Nemacur 3, 10G & 15G End-Use Formulations

Surrogate Species/ Formulation	% A.I.	LD_{50} (mg/kg)	Toxicity Category	MRID No.	Study Classification
Laboratory Rat (*Rattus norvegicus*) Nemacur 15G	15.0	10.0, male fasted 45.0, male nonfasted 14.0, female fasted 61.0, female nonfasted	very highly to highly toxic	099496/Mobay Chemical Company/1974	Core
Laboratory Rat (*Rattus norvegicus*) Nemacur 3	35.6	25.0, female	very highly toxic	0064611/Bayer AG Institute/1992	Core
Laboratory Rat (*Rattus norvegicus*) Nemacur 3	35.0	24.8, male	very highly toxic	001311/Univ. of Chicago/1989	Supplemental
Laboratory Rat (*Rattus norvegicus*) Nemacur 15G	15.0	66.6, male 62.7, female	highly toxic	001311/Univ. of Chicago/1989	Supplemental
Laboratory Rat (*Rattus norvegicus*) Nemacur 10G	10.0	100.0	highly toxic	00154492 and 001310/Bayer AG Institute/1992	Supplemental

Mammalian Acute Toxicity Testing on Fenamiphos Degradates and/or Metabolites. The results in Table 15 below indicate that the fenamiphos metabolites, MTMC Sulfoxide, MTMC Sulfone and 4-Methyl-mercapto-m-cresol, are slightly toxic to mammals on an acute oral basis. However, the metabolites, fenamiphos sulfone and sulfoxide, are very highly toxic to mammals on an acute oral basis.

In addition, fenamiphos sulfone and sulfoxide have been identified as byproducts of environmental degradation of the parent compound. Test species were observed experiencing increased salivation, urination, diarrhea, tremors and convulsions prior to death (MRID 00099496, 00052532, 00040215, and 00039700).

Table 15: Mammalian Acute Oral Toxicity Findings (LD_{50}) Environmental Degradates/Mammal Metabolites

Surrogate Species/ Metabolite/Degadate	% A.I.	LD_{50} (mg/kg)	Toxicity Category	MRID No.	Study Classification
Laboratory Rat (*Rattus norvegicus*) MTMC Sulfoxide Metabolite	% Not Reported	1418, male 1175, female	slightly toxic	00052532/Mobay Chemical Company/1974	Core
Laboratory Rat (*Rattus norvegicus*) MTMC Sulfone Metabolite	95.0	1250, male 1854, female	slightly toxic	00052532/Mobay Chemical Company/1974	Core
Laboratory Rat (*Rattus norvegicus*) Desisopropyl Fenamiphos Sulfoxide Metabolite & Environmental Degradate	95.0	4.1, male 3.7, female	very highly toxic	00099496/Mobay Chemical Company/1975	Core
Laboratory Rat (*Rattus norvegicus*) Fenamiphos Sulfone Metabolite & Environmental Degradate	% Not Reported	2.6, male	very highly toxic	00040215/Mobay Chemical Company/ Date Not Reported	Core
Laboratory Rat (*Rattus norvegicus*) 4-Methyl-mercapto-m-cresol Metabolite	% Not Reported	1,418, male 1,333, female	slightly toxic	00039700/Mobay Chemical Company/1974	Core

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Acute Dermal and Inhalation Toxicity Testing. In addition to acute oral routes of exposure, terrestrial vertebrates entering the field after treatment may be acutely exposed to fenamiphos and its degradates dermally and/or through inhalation. Toxicity category descriptions associated with dermal routes of exposure the following:

If the LD_{50} is *less than or equal to 200 mg a.i./kg*, then the test substance is *very highly toxic*.
If the LD_{50} is *greater than 200 through 2,000 mg a.i./kg*, then the test substance is *highly toxic*.
If the LD_{50} is *greater than 2,000 through 20,000 mg a.i./kg*, then the test substance is *moderately to slightly toxic*.
If the LD_{50} is *greater than 20,000 mg a.i./kg*, then the test substance is *practically nontoxic*.

Table 16: Mammalian Dermal Toxicity (LD_{50}) Fenamiphos Technical & End-Use Formulations

Surrogate Species/ Formulation	% A.I.	LD_{50} (mg/kg)	Toxicity Category	MRID No.	Study Classification
Laboratory Rabbit (*Sylvivlagus sp.*)/ Technical	% Not Reported	225, male 178.8, female	very highly to highly toxic	00037962/Mobay Chemical./1972	Core
Laboratory Rat (*Rattus norvegicus*)/ Technical	80.0	72.9, male 84.3, female	very highly toxic	00001310 & 0000154492 /Bayer AG Institute/1992	Supplemental
Laboratory Rat (*Rattus norvegicus*)/ Nemacur 3	35.6	154.2, male 119.4, female	very highly toxic	00001310 & 0000154492 /Bayer AG Institute/1992	Supplemental
Laboratory Rabbit (*Sylvivlagus sp.*)/ Nemacur 15G	15.0	>1,000	highly toxic	001G1168 & ACC 005722 /Mobay Chemical Company/1974	Supplemental
Laboratory Rat (*Rattus norvegicus*)/ Nemacur 15G	15.0	>2,000, male & female	moderately to slightly toxic	42476001/Miles Laboratories/1992	Core

Dermal toxicities of fenamiphos and its end-use formulations are represented in Table 16. The results indicate that fenamiphos and its formulations, Nemacur 3 and 15G, are very highly to highly toxic to mammals on an acute dermal basis (MRID 00037962, 0000154492, 00001310, 001G1168, and 42476001).

The acute inhalation toxicity results for technical fenamiphos and Nemacur 3 and 15G are indicated in Table 17 below. Toxicity category descriptions associated with inhalation routes of exposure the following:

If the LC_{50} is *less than or equal to 0.2 mg a.i./liter*, then the test substance is *very highly toxic*.
If the LC_{50} is *greater than 0.2 through 2 mg a.i./liter*, then the test substance is *highly toxic*.
If the LC_{50} is *greater than 2 through 20 mg a.i./liter*, then the test substance is *moderately to slightly toxic*.
If the LC_{50} is *greater than 20 mg a.i./liter*, then the test substance is *practically nontoxic*.

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Table 17: Mammalian Inhalation Toxicity (LC_{50}) Fenamiphos Technical & End-Use Formulations

Surrogate Species/ Formulation	% A.I.	LC_{50} (mg/L/1hr and mg/L/4 hr)	Toxicity Category	MRID No.	Study Classification
Laboratory Rat (*Rattus norvegicus*)/Technical	80.00	0.18 mg/L/1 hr	very highly toxic	00001310 & 0000154492/ Bayer AG Institute/1992	Supplemental
Laboratory Rat (*Rattus norvegicus*)/Technical	80.00	0.15 mg/L/1 hr	very highly toxic	00001310 & 0000154492/ Bayer AG Institute/1992	Supplemental
Laboratory Rat (*Rattus norvegicus*)/Technical	80.00	0.02 mg/L/4 hr	very highly toxic	00001310 & 0000154492/ Bayer AG Institute/1992	Supplemental
Laboratory Rabbit (*Sylvivlagus sp.*)/Technical	80.00	>0.23 mg/L/1 hr	highly toxic	0000154492/Bayer AG Institute/1992	Supplemental
Laboratory Rabbit (*Sylvivlagus sp.*)/Technical	80.00	>0.02 mg/L/4 hr	very highly toxic	0000154492/Bayer AG Institute/1992	Supplemental
Guinea pig (*Cavia porcellus*)/Technical	80.0	>0.23 mg/L/1 hr	highly toxic	00154492/Bayer Agricultural Inst./1992	Supplemental
Guinea pig (*Cavia porcellus*)/Technical	80.0	0.02 mg/L/4 hr	very highly toxic	00154492/Bayer AG Inst./1992	Supplemental
Laboratory Mouse (*Mus musculus*)/Technical	80.0	0.15 mg/L/1 hr	very highly toxic	00154492/Bayer Agricultural Inst./1992	Supplemental
Laboratory Mouse (*Mus musculus*)/Technical	80.0	0.02 mg/L/4 hr	very highly toxic	00154492/Bayer Agricultural Inst./1992	Supplemental
Laboratory Rat (*Rattus norvegicus*)/ Nemacur 3	35.00	1.7 mg/L/1 hr	highly toxic	001G1168/Univ. of Chicago/1989	Supplemental
Laboratory Rat (*Rattus norvegicus*)/ Nemacur 15G	15.00	> 20 mg/L/1 hr	slightly toxic	00001311/Chemgro /1990	Supplemental

Fenamiphos is very highly to highly toxic to mammals, when fumes[24] are inhaled at very low levels (<0.2 mg/L/1 hr) directly after application. In addition, fenamiphos will be very highly toxic to many mammals who receive minuscule but prolonged levels of exposure (0.02 mg/L/4 hr). One study indicated that Nemacur 15G may be only slightly toxic to mammals when fumes are inhaled directly after and up-to-1 hour post-application (>20 mg/L/1hr, MRID 00001311). All of these studies were deemed scientifically sound; however, certain studies did not meet minimum guideline requirements and were classified supplemental.

Mammalian Subchronic Toxicity Testing. The submitted mammalian subchronic feeding studies indicate that extended exposure to fenamiphos residues via the diet at levels greater than 10 ppm will cause increased mortality and lung and thyroid gland weights in mammals. However depressed blood levels will occur at levels greater than 1 ppm. See Table 18 below (MRID 0012414). The toxicity value (NOEL) appearing in the shaded area of the table following will be used to calculate the mammalian chronic risk quotients (RQ's) in subsequent sections.

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Fumes: Pesticides in the air space just above the air/soil interface are present in high concentrations. As one moves vertical through the air in treated fields, the concentration decreases due to dilution. Hence, a concentration gradient is formed above the treated field from highest (at the interfacial boundary) to lower concentrations with height.

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Table 18: Mammalian Subchronic Toxicity Findings Fenamiphos Technical

Surrogate Species/ Exposure Duration	% ai	NOEL/LOEL (ppm)	LOEL Endpoints	MRID No. Author/Year	Study Classification
Laboratory rat (*Rattus norvegicus*)/ 2 years	78	10.0/30.0 for Systemic Effects	Increased mortality, Increased lung and thyroid gland weights	00112414/Bayer AG Institute/1972	Core
		3.0/10.0 for Cholinesterase Depression	Cholinesterase inhibition		
Domestic Dog (*Canis familiaris*)	78	>10.0/Not Recorded for Systemic Effects	Anemia in males	00112414/Bayer AG Institute/1972	Core
		1.0/2.0 for Cholinesterase Depression	Cholinesterase inhibition		

Table 19: Mammalian Developmental and Reproductive Toxicity Findings Fenamiphos Technical

Surrogate Species/ Exposure Duration	%ai	NOEL/LOEL (ppm)	LOEL Endpoints	MRID No. Author/Year	Study Classification
			Developmental Effects		
Laboratory Rabbit (*Sylvivlagus sp.*)	91.0	0.5/2.5	Fused ribs, abnormally shaped sternebrae, absence of rib # 3	40347602/ Research & Consulting	Core
Laboratory Rabbit (*Sylvivlagus sp.*)	88.0	0.3/1.0	Chained fused sternabrae and mortality	00071290/Hazelton Raltech/1982	Core
Laboratory Rat (*Rattus norvegicus*)	88.7	3.0/Not Recorded	Not Recorded/Maternal LEL is 3.0 with weight loss and signs of toxicity.	41225401/Miles Laboratories/1989	Core
			Reproductive Effects		
Laboratory Rat (*Rattus norvegicus*)/ 3-generation	78.8	10 ppm / 30 ppm	Systemic NOEL = 10 ppm, with Systemic LEL = 30 ppm, decreased weight gain in F2 generation males.	00112414/Bayer Ag Institute/1972	Core
Laboratory Rat (*Rattus norvegicus*)/ 2-generation	89.0	2.5 ppm/ 10 ppm	Reduced body weight gain in FO and F1 rats. Significant cholinesterase depression in parents and offspring at 10 and 40	42491701/Mobay Chemical Company/1991	Core

Mammalian Reproductive and Developmental Toxicity Testing. As indicated in Table 19, treatment-related effects involved fused of the sternebrae and increased mortality in the offspring when the mother rabbit was exposed to daily doses of 0.3 milligrams per kilogram of her body weight (mg/kg/day) for 10 days during gestation (pregnancy). Pup observations were not recorded for the rat study; however, the maternal NOEL is 3.0 mg/kg/day due to weight loss, cholinesterase depression, loss of balance, and increased mortality. The submitted mammalian 2-generation reproduction study using laboratory rats as the test subjects indicates dose-related decreases in pup body weight. Cholinesterase depression also occurred in both the parents and offspring at the parent's dietary intake levels which exceeded 2.5 ppm (MRID 403476020, 00071290, 41225401, 00112414, and 41908901).

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(5) Beneficial Insects (TGAI)

A honey bee acute contact LD_{50} study using the technical grade of the active ingredient is required if the proposed use will result in exposure to honey bees. The purpose of this study is to develop data on the acute contact toxicity to honey bees. The Agency uses this data assess the acute hazards to bees and other beneficial insects. The acute contact LD_{50}, using the honey bee, *Apis mellifera*, is an acute single-dose laboratory study designed to estimate the quantity of toxicant required to cause fifty percent mortality in a test population of bees. The TGAI is administered by one of two methods: whole body exposure to technical pesticide in a nontoxic dust diluent; or, topical exposure to technical pesticide via microapplicator. The median lethal dose (LD_{50}) is expressed in micrograms of active ingredient per bee (µg a.i./bee). Results of this test are tabulated below. Toxicity category descriptions are the following:

If the LD_{50} is *less than 2*, then the test substance is *highly toxic*.
If the LD_{50} is *2-to-10.99*, then the test substance is *moderately toxic*.
If the LD_{50} is *greater than 11*, then the test substance is *practically nontoxic*.

Table 20: Nontarget Insect Acute Contact Toxicity Findings Fenamiphos Technical

Surrogate Species	% A.I.	LD_{50} (µg/bee)	Toxicity Category	MRID No. Author/Year	Study Classification
Domesticated Honey Bee (*Apis mellifera*)	Not Reported	1.87	Highly toxic	Atkins et al./1975 /00036935	Core

The results indicate that fenamiphos is highly toxic to honey bees and other beneficial insects on an acute contact basis. The guideline (141-1) is fulfilled (MRID 00036935). As indicated in the 1987 Fenamiphos Registration Standard, a honey bee toxicity of residues on foliage study was required for the typical end-use product (TEP) if exposures are anticipated. A honey bee residue study (141-2) is required for the emulsifiable concentrate formulation, Nemacur 3, for its fruit and vegetable crop uses. Banded and broadcast applications to these crops are anticipated to result in contact exposure to honey bees.

A systemic pesticide, fenamiphos, will be translocated post-application throughout the plant crop and weeds growing in or around the treatment area. Residue data (HED's 1994 Fenamiphos RED Chapter) provided to the Agency to assess tolerances provides some insight into the time intervals required for residues to decline post-application to be within maximum allowable limits. Therefore, honey bees and other nontargets may have greater potential for extended exposures to fenamiphos through exposure to fenamiphos-laden nectar, pollen and other plant parts of blooming plants growing in and around the treated area. To determine the residues in nectar, pollen and other plant parts used as food items by nontargets, EFED requests that the registrant collect and submit nectar, pollen and plant residue data on the following insect/bird/bat-pollinated food crops at full bloom in fenamiphos treated areas: cherry, peach, orange, strawberry, cotton, banana and peanut.

In the table below are reported observations on the impacts to nontarget beneficial insects from exposure to fenamiphos end-use products applied to various orchard and field crops.

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Table 21: Beneficial Nontarget Insect Toxicity Findings Fenamiphos End-Use Formulations

Species/Formulation	% A.I.	Rate and Method of Application	Reported Observations	MRID No. Author/Year	Study Classification
Predatory Mites (Order *Acarina*)/ Nemacur 3EC	35.0	0.5 lb ai/100 gallons of foliar spray on apple trees	Treatments were highly toxic to 2 predatory mite species	ACC 120301/ Lamb & Nelson/1971	Supplemental
Predators Nemacur 3EC	35.0	1 lb ai/acre on dry field beans	Treatments were highly toxic to predators	ACC 120301/ Lamb & Nelson/1971	Supplemental
Parasites and Predators/ Nemacur 10G, 15G, 3EC	10.0, 15.0, 35.0	6 lb ai/acre broadcast in potato fields	Beneficial insects were reduced in Nemacur plots, although populations were also low in untreated plots. Post-treatment population counts 1.5, 2.5 and 3 months were equal to untreated plots.	ACC 120301/ Lamb & Nelson/1971	Supplemental
Mites (*Typhlodromus sp.)* Nemacur 3EC	35.0	1.1 and 1.7 lbs ai/acre foliar spray, 3 applications at 21-day intervals	Treatments caused 82% reduction in predatory mites.	ACC 120301/ Lamb & Nelson/1971	Supplemental
Domesticated Honey Bee (*Apis mellifera*)	10.0, 35.0	5 lb ai/acre foliar spray on alfalfa	Nemacur 10G application resulted in 7% mortality when caged bees were exposed to treatment, and 2% and 0% mortality when bees were placed in a cage with treated foliage at 3 and 24 hours post application, respectively. Nemacur 3EC caused 100% mortality at all intervals tested.	ACC 120301/ Lamb & Nelson/1971	Supplemental

(6) Terrestrial Plants

Terrestrial plant seedling emergence and vegetative vigor tests are required for herbicides and other pesticides, on a case-by-case basis. Terrestrial plant testing is required for fenamiphos because of its terrestrial outdoor use pattern; its ability to move offsite in both surface and ground water; and its phytotoxicity warnings on its Nemacur labels. In addition, endangered or threatened plant species are associated with many fenamiphos use sites, and therefore, may be affected.

Plant protection data requirements follow an ordered testing scheme, consisting of Tiers I, II and III. Tier I tests measure the response of plants, relative to a control, at a test level that is equal to the highest use rate (expressed as lbs ai/A). Tier II phytotoxicity testing measures the response of plants, relative to a control, at five or more test concentrations. For Tier I and II seedling emergence and vegetative vigor trials, the following plant species and groups should be tested: (1) six species of at least four dicotyledonous families, one species of which is soybean (*Glycine max*), and the second of which is a root crop, and (2) four species of at least two monocotyledonous families, one of which is corn (*Zea mays*). Tier III, a terrestrial field study, evaluates the Typical End-Use Product (TEP) in the environment and is triggered when a detrimental effect occurs at 25 percent or greater to one or more of the plant test species in the lower tiers.

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Because fenamiphos bears phytotoxic warnings on the Nemacur labels, testing should begin at Tier II. The registrant should submit for EPA review a Tier II seedling emergence and vegetative vigor study (123-1) using the technical, fenamiphos, as the test substance. The degradates, fenamiphos sulfone and sulfoxide, should also be tested beginning at Tier I.

b. Aquatic Hazard Assessment

(1) Freshwater Fish, Acute (TGAI and Degradates)

Two freshwater fish toxicity studies using fenamiphos technical are required to establish the toxicity of a pesticide to freshwater fish. The preferred test species are Rainbow Trout, a coldwater fish, and Bluegill Sunfish, a warmwater fish. Degradate testing may also be required if the parent material is short-lived and any degradate is formed in large percentage. Fenamiphos sulfone and sulfoxide metabolites and environmental degradates, have been identified by HED's TB II and metabolism committee as metabolites of human (mammalian) toxicological concern. Another degradate, fenamiphos phenol, is currently under evaluation by HED. In the future, if HED determines fenamiphos phenol to be of toxicological concern, then toxicity data should be submitted on this degradate as well. The metabolic pathways of aquatic species are not significantly similar to mammals such that toxicity inferences can be made. Therefore, additional toxicity data was required to address fenamiphos sulfone's and sulfoxide's potential hazards to aquatic life. Results of the freshwater fish acute toxicity tests using fenamiphos technical, Nemacur 3 and 15G formulations, and the degradates, fenamiphos sulfone and sulfoxide, are tabulated in Table 22 below.
The toxicity category descriptions for freshwater and estuarine/marine fish and aquatic invertebrates, are defined below in parts per million (ppm), the standard units of measure; however, due to the extreme toxicity of fenamiphos to aquatic animals, the LC_{50} values and the Confidence Intervals (C.I.) represented in the following tables are in units of parts per billion (ppb). One ppm equals 1,000 ppb. The toxicity values (LC_{50}) appearing in the shaded area of the tables will be used to calculate the acute aquatic risk quotients (RQ's) in subsequent sections.

If the LC_{50} is *less than 0.1 ppm a.i.*, then the test substance is *very highly toxic*.
If the LC_{50} is *0.1-to-1.0 ppm a.i.*, then the test substance is *highly toxic*.
If the LC_{50} is *greater than 1 and up through 10 ppm a.i.*, then the test substance is *moderately toxic*.
If the LC_{50} is *greater than 10 and up through 100 ppm a.i.*, then the test substance is *slightly toxic*.
If the LC_{50} is *greater than 100 ppm a.i.*, then the test substance is practically nontoxic.

The results indicate that fenamiphos technical and its formulations, Nemacur 3 and 15G, are very highly toxic to freshwater fish on an acute basis. The degradates, fenamiphos sulfone and sulfoxide, are moderately toxic to freshwater fish on an acute basis. The supplemental study testing the fenamiphos sulfoxide was scientifically sound but deviated from protocol requirements. Only four concentrations were tested; pH and dissolved oxygen level were not reported; temperature was not adequately monitored, hardness, alkalinity, and conductivity of diluent were not reported; and acclimation procedures were not described. With the core studies, the guideline (72-1) is fulfilled for acute toxicity testing with the TGAI and the degradates, fenamiphos sulfone and sulfoxide (MRIDs 00025962, 00114012, 40799704, 40799701, and 00114015).

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Table 22: Freshwater Fish Acute Toxicity Findings Fenamiphos Technical

Surrogate Species/ Formulation	% A.I.	LC_{50} (ppb) / (C.I.)	Toxicity Category	MRID No. Author/Year	Study Classification
Bluegill Sunfish *(Lepomis macrochirus)*/Technical	88.0	9.5 (6.8-15.0)	very highly toxic	00025962/Lamb & Roney/1977	Core
Bluegill Sunfish *(Lepomis macrochirus)*/Technical	81.0	17.7 (14.4-21.6)	very highly toxic	00114012/Lamb & Roney/1972	Core
Rainbow Trout*(Oncorhynchus sp.)*/ Technical	81.0	72.1 (61.2-84.7)	very highly toxic	00114012/Lamb & Roney/1972	Core
Nemacur 3 and 15G					
Surrogate Species/ Formulation	% A.I.	LC_{50} (ppb) / (C.I.)	Toxicity Category	MRID No. Author/Year	Study Classification
Bluegill Sunfish *(Lepomis macrochirus)*/ Nemacur 3	36.0	4.5 (3.9-5.1) NOEC = 1.7	very highly toxic	40799704/D. Surprenant/1988	Core
Rainbow Trout*(Salmo gairdneri)*/ Nemacur 3	36.0	68.0 (59.6-77.1)	very highly toxic	40799701/D. Surprenant/1988	Core
Bluegill Sunfish *(Lepomis macrochirus)*/Nemacur 15G	15.0	151 (114-201)	highly toxic	00114012/ Lamb & Roney/1972	Core
Rainbow Trout *(Oncorhynchus sp.)*/ Nemacur 15G	15.0	563 (454-698)	very highly toxic	00114012/ Lamb & Roney/1972	Core
Degradates/Metabolites					
Bluegill Sunfish *(Lepomis macrochirus)*/Fenamiphos sulfone	%Not Reported	1,173 / (1,000-1,500)	moderately toxic	00025962/Lamb & Roney/1977	Supplemental
Bluegill Sunfish *(Lepomis macrochirus)*/Fenamiphos sulfoxide	% Not Reported	2,653/ (1,000-4,600)	moderately toxic	00025962/Lamb & Roney/1977	Supplemental
Bluegill Sunfish*(Lepomis macrochirus)*/Fenamiphos sulfoxide	99.0	2,000/ (1,800-2,300)	moderately toxic	00114015/Lamb & Roney/1972	Supplemental

(C.I.) = Confidence Intervals 1 ppm = 1,000 ppb

(2) Freshwater Fish, Chronic (TGAI and Degradates)

A freshwater fish early life-stage test using fenamiphos technical is required because the end-use product is expected to be transported to water from ground applications such that its presence in water is likely to be recurrent regardless of its toxicity. In addition, the actual or estimated environmental concentration in surface water resulting from use is less than one percent of any acute LC_{50} or EC_{50} value, and the pesticide is persistent in water with a hydrolysis half-life greater than 234 days.

The fish early life-stage is a laboratory test designed to estimate the quantity of toxicant required to adversely effect the reproductive capabilities of a test population of fish. The test should be performed using flow-through conditions. The preferred test species is Rainbow Trout. The TGAI is administered into water containing Rainbow Trout, providing exposure throughout a critical life-stage, and the results, generally, are expressed as a No Observed Effect Level, in parts per million of active

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ingredient (NOEL in ppm a.i.). However, due to fenamiphos's extreme toxicity, the NOEL and LOEL units shall be expressed in parts per billion a.i., where 1,000 ppb = 1ppm.

Chronic testing on the degradates, fenamiphos sulfone and sulfoxide, is reserved pending results of the acute freshwater fish test. Results of the fish early life-stage test using fenamiphos technical are tabulated in Table 23 below. The toxicity value (NOEL) appearing in the shaded area of the table will be used to calculate the chronic risk quotients (RQ's) in subsequent sections.

Table 23: Freshwater Fish Early Life-Stage Toxicity Under Flow-through Conditions Fenamiphos Technical

Species/Study Duration	% ai	NOEC/LOEC (ppb)	Endpoints Affected	MRID No. Author/Year	Study Classification
Rainbow Trout *(Salmo gairdneri)*	88.7	3.8/7.4	larval length and weight	41064301/D. Surprnant/1989	Core

The NOEC and LOEC were determined to be 0.0038 and 0.0074 ppm (3.8 and 7.4 ppb), respectively. However, delays in growth and development of fry were demonstrated to occur at concentrations of fenamiphos in water as low as 0.0039 ppm (3.9 ppb). Chronic testing of the two degradates is also required; freshwater fish early life-stage toxicity tests (72-4) should be submitted using desisopropyl fenamiphos sulfoxide and fenamiphos sulfone as the test substances. Additional chronic testing on the two degradates is reserved pending results of the early life-stage tests. The guideline (72-4) is partially fulfilled (MRID 41064301).

A freshwater fish life-cycle test using fenamiphos technical is required because (1) the end-use product is expected to be transported to water from the intended use site, (2) fenamiphos is persistent in water with a hydrolysis half-life greater than 234 days, (3) the results in freshwater fish early life-stage toxicity test indicate that fish reproductive physiology may be affected by fenamiphos exposure, and (4) the estimated environmental concentration is greater than one-tenth (0.1) the NOEC value of 3.8 ppb in the freshwater fish early life-stage toxicity test. As indicated in the Water Resources section of this document, 60-Day EEC values range from 3.6 to 329.0 ppb, which are from 0.95 of to 86.5 times the NOEC. The preferred test species is Fathead Minnow. The guideline (72-5) is not fulfilled.

(3) Freshwater Invertebrates, Acute (TGAI and Degradates)

A freshwater aquatic invertebrate toxicity test using fenamiphos technical is required to assess the toxicity of a pesticide to freshwater invertebrates. The preferred test organism is Daphnia magna, but early instar amphipods, stoneflies, mayflies, or midges may also be used. Results of this test are tabulated in Table 24 below. The toxicity value (EC_{50}) appearing in the shaded area of the table will be used to calculate the acute risk quotients (RQ's) in subsequent sections.

The results indicate that fenamiphos technical and its end-use formulation, Nemacur 3, and one of its degradate products, fenamiphos sulfoxide, are very highly toxic to freshwater invertebrates on an acute basis. However, the test using fenamiphos sulfoxide was classified supplemental because the raw data was not submitted, and the reported dissolved oxygen levels and pH measurements were inaccurately measured. If the raw data were submitted, then the study potentially could be upgraded;

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otherwise, the study should be repeated. In addition, acute freshwater invertebrate testing should be required on fenamiphos sulfone because it has been identified as a degradate of toxicological concern. In the future, if HED identifies fenamiphos phenol as a degradate of toxicological concern, then acute freshwater invertebrate testing should be required on it as well. The guideline (72-2) is only partially fulfilled (MRIDs 40799706, 43183501, and 41497701).

Table 24: Acute Freshwater Invertebrate Toxicity Findings **Fenamiphos Technical and Nemacur 3**

Surrogate Species	% A.I.	LC_{50}/ EC_{50} (ppb)	Toxicity Category	MRID No. Author/Year	Study Classification
Daphnid *(Daphnia magna)* Technical	88.7	1.9 (1.7-2.1) NOEC < 1.0	very highly toxic	40799706/D. Surprenant/1988	Core
Daphnid *(Daphnia magna)* Nemacur 3	36	1.3 NOEC = 0.8	very highly toxic	43183501/ D. Surprenant/1990	Core
				Degradates/Metabolites	
Daphnid *(Daphnia magna)* Fenamiphos sulfoxide	% Not Reported	7.5 (6.0-14.4)	very highly toxic	41497701/ Mobay Chemical Company/1990	Supplemental

(C.I.) = Confidence Intervals 1 ppm = 1, 000 ppb

(4) Freshwater Invertebrate, Chronic (TGAI and Degradates)

A freshwater aquatic invertebrate life-cycle test using fenamiphos technical is required is required because (1) the end-use product is expected to be transported to water from the intended use site, (2) fenamiphos is persistent in water with a hydrolysis half-life greater than 234 days, and (3) the estimated environmental concentration is greater than one-tenth (0.1) any aquatic acute EC_{50} or LC_{50} value in the freshwater invertebrate tests. As indicated in the Water Resources section of this document, 21-Day EEC values range from 5.0 to 495.0 ppb, which exceed the NOEC from 1.3-to-130.3 times. The preferred test species is *Daphnia magna*. Results of this test are tabulated in Table 25 below. The toxicity value (NOEC) appearing in the shaded area of the table will be used to calculate the chronic risk quotients (RQ's) in subsequent sections.

Table 25: Freshwater Aquatic Invertebrate Life-Cycle Toxicity **Fenamiphos Technical**

Species/Static Renewal	% ai	21-day NOEC/ LOEC (ppb)	Endpoints Affected	MRID No. Author/Year	Study Classification
Waterflea *(Daphnia magna)*	99.6	0.12/0.24	Reproduction (Number of neonates/reproductive day and mean body length.)	43121401 & 40922201/D. Surprenant/1988 & 1994	Core

This study is scientifically sound and fulfills the guideline (72-4) requirements for a daphnid life-cycle test. Based on the most sensitive endpoints, number of neonates produced per reproductive day and mean body length, the NOEC is 0.12 ppb (MRID 43121401). Chronic testing of fenamiphos

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sulfoxide should be submitted. Chronic testing is reserved for fenamiphos sulfone pending results of the acute freshwater invertebrate test.

(5) Freshwater Field Studies

A simulated field study was submitted for review which utilized an artificial pond system to assess the potential for ecological and biological effects resulting from fenamiphos. Also called a mesocosm, this simulated aquatic pond system study's findings suggested that adverse ecological effects to aquatic organisms will occur if the use of fenamiphos results in exposure levels greater than 3.5 ppb, the No Observed Effect Concentration (NOEC). As indicated in the Water Resources section of this document, estimated acute EEC values range from 6.5 to 651 ppb, a level 1.7 to 171 times greater.

The study used a series of 12 ponds. The test animals were fish and aquatic invertebrates. Zooplanton, macroinvertebrates and fish were identified to genus and quantified for number and species richness prior to exposure. The dosing regime was 1.0, 3.5 and 12.5 ppb. The zooplankton groups were affected by Nemacur at the 12.5 ppb level. The primary effects were population declines in several species of rotifers and an increase in copepoda. Macroinvertebrates were most affected both in species number and richness at the 3.5 and 12.5 ppb levels. The two orders most negatively affected were Ephemeroptera and Trichoptera, of which Mayflies and Caddisflies are members. No acute effects were observed in the adult fish at the 1.0 and 3.5 ppb levels; however, within 24 hours of application, acute effects were observed at the 12.5 ppb in both adult and young fish. Species number and richness declined. In addition, by study completion, statistically significant increases in weight and length of fish surviving occurred, due perhaps to reduced competion for available food and other resources.

The physio-chemical parameters of the water such as dissolved oxygen, temperature, pH, alkalinity, hardness, total suspended solids, organic carbon and nitrogen, were, generally, unchanged by the Nemacur application. Turbidity appeared to be lower in the treatment ponds than in the controls. This guideline study (72-7a) was scientifically sound and conducted in accordance with good laboratory practice (MRID 42029906).

Nemacur 3 Use on Tobacco, Incorporation of Remote Sensing/GIS Evaluation into an Aquatic Exposure Assessment. Although the submitted study does not represent all tobacco growing areas, the GIS/Remote Sensing approach taken by the author has merit. Using the "windshield survey", the data submitter attempted to reduce many uncertainties associated with geographic information systems such as positional inaccuracy, sampling and scale.

However the following should also be considered:

The Remote Sensing/GIS evaluation took into account only lentic water bodies with dimensions of these water bodies calculated only during the month of July. The remote sensing results should have been captured instead at two different time periods and overlayed for comparative results: the first snapshot should have been when Nemacur 3 is surface broadcast to the tobacco field and "disked in" in order to capture peak surface-area measurements of surrounding ephimeral and nonephimeral streams and lentic bodies, and the second snapshot should be when tobacco is at maturity, to identify where tobacco was

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grown. This approach would better quantify the number and total area of water bodies that could be potentially affected by pesticides applied on a tobacco crop in Wayne County, North Carolina.

Lastly, EPA uses the PIRANHA and PRZM/EXMS models because of the wealth of environmental input values they contain rather than information about only one site. These data bases better represent the tremendous biogeographic, climatological, and physiographic diversity in aquatic environments and agricultural sites throughout the United States where tobacco potentially may be grown (MRID 434151-01).

(6) Estuarine/Marine Animals, Acute (TGAI and Degradates)

Acute toxicity testing with estuarine and marine organisms (fish, shrimp and oyster embryo-larvae or shell deposition) using fenamiphos technical is required because fenamiphos is expected to reach the estuarine/marine environment in significant concentrations because it is very mobile in soil and very soluble in water. Therefore, fenamiphos have a high potential to leach into ground water and runoff into surface waters. The preferred test organisms are the Sheepshead Minnow, Mysid Shrimp and Eastern Oyster. Results of these tests are tabulated in Table 26 below.

Table 26: Estuarine/Marine Acute Toxicity Findings **Fenamiphos Technical**

Surrogate Species	% A.I.	LC_{50}/EC_{50} (ppb)	Toxicity Category	MRID No. Author/Year	Study Classification
Eastern Oyster (shell deposition or embryo-larvae) (Crassostrea virginica) Shell Deposition	88.7	EC_{50}=1,650 NOEC=630	moderately toxic	40799709/D. Surprenant/1988	Core
Sheepshead Minnow *(Cyprinodon variegatus)*	88.7	LC_{50}=17.0	very highly toxic	40799710/D. Surprenant/1988	Core
Mysid Shrimp *(Mysidopsis bahia)*	88.7	LC_{50}=6.2	very highly toxic	40799708/D. Surprenant/1988	Core

In addition, acute estuarine/marine testing are required for fenamiphos sulfoxide and sulfone because they have been identified as degradates of toxicological concern. These degradates have also been identified as equally mobile as the parent, and therefore, subject to moving offsite in ground and surface waters. In the future, if fenamiphos phenol is identified as a degradate of toxicological concern, then acute estuarine/marine testing using this test substance will also be required. The toxicity value (EC_{50}/LC_{50}) appearing in the shaded area of the table will be used to calculate the acute risk quotients (RQ's) in subsequent sections.

The results indicate that fenamiphos is very highly toxic to moderately toxic estuarine/marine organisms on an acute basis. The guideline (72-3) requirement is fulfilled (MRIDs 40799709, 40799710 and 40799708).

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(7) Estuarine/Marine Animals, Chronic (TGAI and Degradates)

An estuarine/marine invertebrate life-cycle toxicity test using fenamiphos technical is required because the end-use products are expected to be transported to estuarine/marine environments from the intended use site, and due to fenamiphos' mobility, field runoff containing fenamiphos may reach estuarine/marine environments. Therefore, estuarine/marine toxicity testing is required. The preferred test species is Sheepshead Minnow. Chronic testing on fenamiphos sulfone and sulfoxide is reserved pending results of acute estuarine/marine testing. The guideline (72-4) is not fulfilled.

(8) Aquatic Plants

Aquatic plant testing is required for fenamiphos because of its terrestrial outdoor use pattern; its ability to move offsite in both surface and ground water; and its phytotoxicity warnings on its Nemacur labels. In addition, endangered or threatened plant species are associated with many fenamiphos use sites, and therefore, may be affected. Like terrestrial plant testing, aquatic plant testing follows a tiered testing scheme, Tier I, II and III. The following are the recommended species that should be tested at Tier I: *Kirchneria subcapitata* and *Lemna gibba*. The following are the recommended test species that should be tested at Tier II: *Kirchneria subcapitata*, *Lemna gibba*, *Skeletonema costatum*, *Anabaena flos-aquae*, and a freshwater diatom. Testing with the fenamiphos technical should begin at Tier II. The degradates, fenamiphos sulfone and sulfoxide, should also be tested beginning at Tier I. This guideline requirement (123-2) is not fulfilled.

5. Environmental Risk Characterization

Risk Quotients (RQs) and the Levels of Concern (LOCs):

The means of integrating the results of exposure and laboratory toxicity data is called the quotient method. For this method, risk quotients are calculated by dividing exposure estimates by toxicity values, both acute and chronic.

$$\text{RISK QUOTIENT} = \frac{\text{EXPOSURE}}{\text{TOXICITY}}$$

Risk quotients are then compared to OPP established levels of concern. These LOCs are criteria used by OPP to indicate potential risk to nontarget organisms and the need to consider regulatory action. More specifically, the criteria indicate that a pesticide, when used as directed, has the potential to cause adverse effects on nontarget organisms. LOCs currently address the following risk presumption categories:

- **acute high risk** - potential for acute risk is high; regulatory action may be warranted in addition to restricted use classification.
- **acute restricted use** - the potential for acute risk is high, but this may be mitigated through restricted use classification.
- **acute endangered species** - the potential for acute risk to endangered species is high; regulatory action may be warranted.
- **chronic risk** - the potential for chronic risk is high; regulatory action may be warranted.

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Currently, EFED has no procedures for assessing chronic risk to plants, acute or chronic risks to nontarget insects, or chronic risk from granular/bait formulations to mammalian or avian species. The toxicity test values (i.e., measurement endpoints) used in the acute and chronic risk quotients are derived from the results of required studies. Examples of toxicity values derived from the results of short-term laboratory studies which assess acute effects are:

- LC_{50} (fish and birds)
- LD_{50} (birds and mammals)
- EC_{25} (terrestrial plants)
- EC_{50} (aquatic plants and invertebrates)
- EC_{05} or NOEC (endangered plants)

Examples of toxicity levels derived from the results of chronic exposure in laboratory studies which assess effects are:

- LOEC (birds, fish, and aquatic invertebrates)
- NOEC (birds, fish and aquatic invertebrates)

Generally, for birds, mammals, fish and aquatic invertebrates, the NOEC value is used as the toxicity test value in assessing chronic effects. Other values may be used when justified. Avian toxicity and freshwater fish toxicity values are also used as indicators of toxicity for reptiles and amphibians. [25, 26, and 27]

Risk presumptions, along with the corresponding risk quotients and levels of concern, are tabulated in the charts below and on the next page.

RISK PRESUMPTION	RISK QUOTIENT	LOC
Birds (including Reptiles & Terrestrial-Phase Amphibians)		
Acute High Risk	EEC[1]/LC_{50} or LD_{50}/ft^2 or LD_{50}/day^3	0.5
Acute Restricted Use	EEC/LC_{50} or LD_{50}/sq ft or LD_{50}/day (or LD_{50} < 50 mg/kg)	0.2
Acute Endangered Species	EEC/LC_{50} or LD50/sq ft LD_{50}/day	0.1
Chronic Risk	EEC/NOEC	1
Wild Mammals		
Acute High Risk	EEC/LC_{50} or LD50/sq ft or LD_{50}/day	0.5
Acute Restricted Use	EEC/LC_{50} or LD_{50}/sq ft or LD_{50}/day (or LD_{50} < 50 mg/kg)	0.2

25 OPP Corn Cluster Document, A Special Review of 4 Corn Insecticides, Chapter 7, pages 148-149, April 1994. (Toxicity testing using bird test species as surrogates and indicators of the pesticide's toxicity to reptiles and terrestrial-phase amphibians and freshwater fish as surrogates and indicators of the pesticide's toxicity to aquatic-phase amphibians.)

26 Tucker, R.K., and J.S. Leitzke, Comparative Toxicology of Insecticides for Vertebrate Wildlife and Fish, *Pharmacology Ther.*, Vol. 6, pp. 167-220, 1979.

27 Suter, G.W., *Pesticide Effects on Terrestrial Wildlife*, L. Somerville and C.H. Walker, Eds., Taylor & Francis, New York, 1990.

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RISK PRESUMPTION	RISK QUOTIENT	LOC
Birds (including Reptiles & Terrestrial-Phase Amphibians)		
Acute Endangered Species	EEC/LC_{50} or LD50/sq ft or LD_{50}/day	0.1
Chronic Risk	EEC/NOEC	1

[1] abbreviation for Estimated Environmental Concentration; designated ppm in avian/mammalian food items [2] mg/ft^2 [3] mg of toxicant consumed/day LD_{50} * wt. of bird.

RISK PRESUMPTION	RISK QUOTIENT	LOC
Aquatic Animals (including Aquatic-Phase Amphibians)		
Acute High Risk	EEC[1]/LC_{50} or EC_{50}	0.5
Acute Restricted Use	EEC/LC_{50} or EC_{50}	0.1
Acute Endangered Species	EEC/LC_{50} or EC_{50}	0.05
Chronic Risk	EEC/NOEC	1

[1] abbreviation for Estimated Environmental Concentration; designated ppb/ppm in water

RISK PRESUMPTION	RISK QUOTIENT	LOC
Terrestrial, Semi-Aquatic and Aquatic Plants		
Acute High Risk	EEC[1]/EC_{25}	1
Acute Endangered Species	EEC/EC_{05} or NOEC	1
Aquatic Plants		
Acute High Risk	EEC[2]/EC_{50}	1
Acute Endangered Species	EEC/EC_{05} or NOEC	1

[1] abbreviation for Estimated Environmental Concentration; designated lb ai/A [2] abbreviation for Estimated Environmental Concentration; designated ppb/ppm in water

a. Exposure and Risks to Nontarget Terrestrial Animals

(1) Birds, Reptiles and Terrestrial Phase of Amphibians

Risks from Fenamiphos Residues from Nemacur 3 on Plants and Insects. EPA uses Hoerger and Kenaga estimates (1973) as modified by Fletcher and other researchers (1994) to approximate the residues *on* plants and insects after application. These estimates can be found in Table 1 and the formulas used for calculating these estimates are as follows:

EEC Predicted Maximum Residue (ppm) = single application rate (lb ai/A) * EEC Predicted Maximum Estimate(ppm)/1.0 lb ai/A
EEC Predicted Mean Residue (ppm) = single application rate (lb ai/A) * EEC Predicted Mean Estimate(ppm)/1.0 lb ai/A

Hoerger-Kenaga categories represent preferred foods of various terrestrial vertebrates: fruits and bud and shoot tips of leafy crops are preferred by upland game birds; leaves and stems of leafy crops are consumed by hares and hoofed mammals; seeds, seed pods and grasses are consumed by rodents; and insects are consumed by various birds, mammals, reptiles and terrestrial-phase amphibians. See Tables 27 through 31 on the following pages.

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Cotton, Peanuts, Stone Fruits, Apple & Tobacco **Maximum Single Application**

The results in the table indicate that for *single* in-furrow, banded or broadcast applications of fenamiphos as the end-use formulation, Nemacur 3, the avian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded at registered maximum application rates on cotton, peanuts, stone fruits, apple and tobacco. These maximum single application rates range from 2.5 to 7.0 lbs ai/acre. The results also indicate the avian chronic levels of concern (1.0) are exceeded at the registered maximum single application rates for these crop uses and methods of application. LOC exceedances are indicated by shaded areas.

Table 27: Avian (Reptilian & Terrestrial-Phase Amphibians) Acute & Chronic Risk Quotients for Single Applications of Nemacur 3 Based on a Bobwhite Quail LC_{50} of 38 ppm & a Bobwhite Quail NOEL of 2 ppm.

Crop/ Formulation	Maximum Single Application Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)	Acute RQ (Acute EEC/ LC_{50})	Mean Acute RQ (Mean EEC/ LC_{50})	Chronic RQ (Maximum EEC/ NOEL)	Mean Chronic RQ (Mean EEC/ NOEL)
Cotton Nemacur 3EC	3.0	Short grass	720.0	255.0	18.9	6.7	360.0	127.5
		Tall grass	>330.0	>108.0	>8.7	>2.8	>165.0	>54.0
		Broadleaf/forage plants, & small insects	405.0	135.0	10.7	3.6	202.5	67.5
		Fruits, pods, seeds, & large insects	45.0	21.0	1.2	0.6	22.5	10.5
Peanuts Nemacur 3EC	2.5, 1.2	Short grass	624.0, 288	221, 102	16.4, 7.8	5.8	312.0, 144.0	110.5, 51
		Tall grass	>286, 132	>93.6, 43.2	>7.5, 3.5	>2.5	>143.0, 66.0	>46.8, 21.6
		Broadleaf/forage plants, and small insects	351, 162	117, 54	9.2, 4.3	3.1	175.5, 81.0	58.5, 27.0
		Fruits, pods, seeds, and large insects	39, 18	18.2, 8.4	1.0, 0.5	0.5	19.5, 9.0	9.1, 4.2
Stone Fruits (peaches, cherries & nectarines) Apple Nemacur 3EC	7.5	Short grass	>1800.0	>637.5	>47.4	>16.8	>900.0	>318.8
		Tall grass	>825.0	>270.0	>21.7	>7.1	>412.5	>135.0
		Broadleaf/forage plants, and small insects	>1012.5	>337.5	>26.6	>8.9	>506.3	>168.8
		Fruits, pods, seeds, and large insects	112.5	52.5	3.0	1.4	56.3	26.3
Tobacco Nemacur 3EC	6.0	Short grass	1440.0	510.0	37.9	13.4	720.0	255.0
		Tall grass	>660.0	>216.0	>17.4	>5.7	>330.0	>108.0
		Broadleaf/forage plants, and small insects	>810.0	>270.0	>21.3	>7.1	>405.0	>135.0
		Fruits, pods, seeds, and large insects	90.0	42.0	2.4	1.1	45.0	21.0

> means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.
Peanuts: The first and second sets of values represent 36-inch, single-row, and 72-inch, double-row bed spacing, respectively.

Citrus, Kiwi Fruit, Raspberry, Grapes, Pineapple, and Strawberry **Maximum Single Application**

The results in Table 28 indicate that for *single* broadcast or tree-row banded applications of fenamiphos as the end-use formulation, Nemacur 3, the avian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded at registered single maximum application rates on citrus, kiwi fruit, raspberry, grapes, pineapple, and strawberry. These maximum single application rates range from 4.5 to 9.0 lbs ai/acre. The results also indicate the avian

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chronic levels of concern (1.0) are exceeded at the registered maximum application rates for these crop uses and methods of application. LOC exceedances are indicated by shaded areas.

Table 28: Avian (Reptilian & Terrestrial-Phase Amphibians) Acute & Chronic Risk Quotients for Single Applications of Nemacur 3 Based on a Bobwhite Quail LC_{50} of 38 ppm & a Bobwhite Quail NOEL of 2 ppm.

Crop/ Formu-lation	Maximum Single Application Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)	Acute RQ (Acute EEC/ LC_{50})	Mean Acute RQ (Mean EEC/ LC_{50})	Chronic RQ (Maximum EEC/ NOEL)	Mean Chronic RQ (Mean EEC/ NOEL)
Citrus (except Florida, except Kumquat, Tangelo, and Citrus Hybrids in California) Nemacur 3EC	7.5	Short grass	1800.0	637.5	47.4	16.8	900.0	318.8
		Tall grass	>825.0	>270.0	>21.7	>7.1	>412.5	>135.0
		Broadleaf/forage plants, and small insects	>1012.5	>337.5	>26.6	>8.9	>506.3	>168.8
		Fruits, pods, seeds, and large insects	112.5	52.5	3.0	1.4	56.3	26.3
Citrus (Certain Florida Counties) Nemacur 3EC	5.0	Short grass	1200.0	425.0	31.6	11.2	600.0	17.5
		Tall grass	>550.0	>180.0	>14.5	>4.7	>275.0	>17.5
		Broadleaf/forage plants, and small insects	>675.0	>225.0	>17.8	>5.9	>337.5	>17.5
		Fruits, pods, seeds, and large insects	75.0	35.0	2.0	0.9	37.5	17.5
Kiwi Fruit (CA only), Raspberry & Grapes Nemacur 3EC	6.0	Short grass	1440.0	510.0	37.9	13.4	720.0	255.0
		Tall grass	>660.0	>216.0	>17.4	>5.7	>330.0	>108.0
		Broadleaf/forage plants, & small insects	>810.0	>270.0	>21.3	>7.1	>405.0	>135.0
		Fruits, pods, seeds, and large insects	90.0	42.0	2.4	1.1	45.0	21.0
Pineapple Nemacur 3EC	9.0	Short grass	>2160.0	>765.0	>56.8	>20.1	>1080.0	>382.5
		Tall grass	>990.0	>324.0	>26.1	>8.5	>495.0	>162.0
		Broadleaf/forage plants, & small insects	>1215.0	>405.0	>32.0	>10.7	>607.5	>202.5
		Fruits, pods, seeds, and large insects	135.0	63.0	3.6	1.7	67.5	31.5
Strawberry Nemacur 3EC	4.5	Short grass	1080.0	382.5	28.4	10.1	540.0	191.3
		Tall grass	>495.0	>162.0	>13.0	>4.3	>247.5	>81.0
		Broadleaf/forage plants, & small insects	>607.5	>202.5	>16.0	>5.3	>303.8	>101.3
		Fruits, pods, seeds, and large insects	67.5	31.5	1.8	0.8	33.8	15.8

> means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.

Asparagus, Eggplant, Table Beets and Turf **Maximum Single Application**

The results in Table 29 above indicate that for *single* banded applications of fenamiphos as the end-use formulation, Nemacur 3, the avian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded at registered single maximum application rates on asparagus, eggplant, table beets and turf. These maximum single application rates range from 2.0 to 3.1 lbs ai/acre for the row crops. The maximum single application rate for turf is 9.9 lbs ai/acre. The results also indicate the avian chronic levels of concern (1.0) are exceeded at the registered

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maximum single application rates for these use sites and methods of application. LOC exceedances are indicated by shaded areas.

Table 29: Avian (Reptilian & Terrestrial-Phase Amphibians) Acute & Chronic Risk Quotients for Single Applications of Nemacur 3 Based on a Bobwhite Quail LC_{50} of 38 ppm & a Bobwhite Quail NOEL of 2 ppm.

Crop/ Formulation	Maximum Single Application Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)	Acute RQ (Acute EEC/ LC_{50})	Mean Acute RQ (Mean EEC/ LC_{50})	Chronic RQ (Maximum EEC/ NOEL)	Mean Chronic RQ (Mean EEC/ NOEL)
Asparagus (CT, DE, ME, MA, NH, NJ, NY, PA, and RI only) Eggplant Nemacur 3EC	2.0	Short grass	480.0	170.0	12.6	4.5	240.0	85.0
		Tall grass	220.0	72.0	5.8	1.9	110.0	36.0
		Broadleaf/forage plants, and small insects	270.0	90.0	7.1	2.4	135.0	45.0
		Fruits, pods, seeds, and large insects	30.0	14.0	0.8	0.4	15.0	7.0
Table Beets (IL, IN, MI, NY, OH and PA only) Nemacur 3EC	3.1	Short grass	744.0	263.5	19.6	6.9	372.0	131.8
		Tall grass	>341.0	>111.6	>9.0	>2.9	>170.5	>55.8
		Broadleaf/forage plants, & small insects	418.5	139.5	11.0	3.7	209.3	69.8
		Fruits, pods, seeds, and large insects	46.5	21.7	1.2	0.6	23.3	10.9
Turf Nemacur 3EC	9.9	Short grass	2376.0	841.5	62.5	22.1	1188.0	420.8
		Tall grass	1089.0	356.4	28.7	9.4	544.5	178.2
		Broadleaf/forage plants, & small insects	1336.5	445.5	35.2	11.7	668.3	222.8
		Fruits, pods, seeds, and large insects	148.5	69.3	3.9	1.8	74.3	7.0

> means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.

Citrus, Strawberry and Pineapple **Multiple Applications**

The Nemacur 3 label allows multiple applications on citrus, pineapple, and strawberry. The quantifiable risks to terrestrial vertebrates resulting from exposure to fenamiphos residues on plants and insects from additional applications which are applied at intervals of greater than two days are identical to that quantified for single applications. Fenamiphos residues will be degraded via phytolysis on exposed plants and insects.

Risks from Fenamiphos Residues on/in Soil. Terrestrial vertebrates also may be exposed to pesticides applied to soil by ingesting pesticide granules and/or pesticide-laden soil when foraging. Rich in minerals, soil comprises 5-to-30 percent of dietary intake by many wildlife species.[28] They also may be exposed by drinking pesticide-contaminated water. The results in the table below indicate that for *single* broadcast and banded applications of the emulsifiable concentrate and granular formulations of fenamiphos, the avian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded at registered maximum application rates for the following crops: cotton, grapes, peanuts, stone fruits, tobacco, turf, citrus, apple, kiwi fruit, pineapple, rasberries, strawberries, bok choy, cabbage, brussel sprouts, and asparagus. For in-furrow soil injected appli-cations on cotton, and in-furrow applications on grapes, only the restricted

28 W. N. Beyer and E.E. Connor, "Estimates of Soil Ingestion by Wildlife," U.S. Fish and Wildlife Service, Patuxent Wildlife Research Center at Laurel, MD and S. Gerould, U.S. Geological Survey, Reston, VA.

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use and endangered species LOC's are exceeded. LOC exceedances are indicated by shaded areas in Table 30. Acute RQ's range from 0.2 to 65.1.

Table 30: Avian (Reptilian & Terrestrial-Phase Amphibians) Acute Risk Quotients for Single Applications of Nemacur 3, 15G, & 10G Based on a Bobwhite Quail LD_{50} of 1.6 mg ai/kg.

Crop/Formulation	Maximum Single Applica-tion Rate (lb ai/acre)	Application Method	Soil Surface EEC Predicted Maximum Residue (mg ai/ft^2)	Acute RQ (Acute EEC/LD_{50})
Cotton/Nemacur 3EC	3.0	In-Furrow Soil Injected	0.3	0.2
Cotton, Nemacur 15G	1.6	12-Inch Band	2.5	1.6
Grapes, Nemacur 3EC	6.0	Banded, In-Furrow	9.4, 0.6	5.9, 0.4
Peanuts, Nemacur 3EC	2.5	12-Inch Band	3.9	2.4
Peanuts, Nemacur 15G	2.6	12-Inch Band	4.1	2.6
Stone Fruits (peaches, cherries & nectarines), Nemacur 3EC	7.5	Tree-Row Band	11.7	7.3
Tobacco, Nemacur 3EC	6.0	Broadcast	62.5	39.1
Turf, Nemacur 10G	10.0	Broadcast	104.2	65.1
Turf, Nemacur 3EC	9.9	Broadcast	103.2	64.5
Citrus (except FL, except Kumquat, Tangelo & Citrus Hybrids), Nemacur 3EC	7.5	Tree-Row Band	11.7	7.3
Citrus (in CA, except Kumquat, Tangelo & Citrus Hybrids), Nemacur 15G	10.0	Tree-Row Band	15.6	9.8
Citrus, Certain FL Counties, Nemacur 3EC	5.0	Tree-Row Band	7.8	4.9
Apple, Nemacur 3EC	7.5	Tree-Row Band	11.7	7.3
Kiwi Fruit (CA only), Nemacur 3EC	6.0	Broadcast	62.5	39.1
Pineapple, Nemacur 3EC	9.0	Banded	14.1	8.8
Raspberries, Nemacur 3EC	6.0	Banded	9.4	5.9
Strawberries, Nemacur 3EC & 15G	4.5	18-Inch Band	7.0	4.4
Bok Choy, Cabbage &Brussel Sprouts, Nemacur 15G	4.5	15-Inch Band	7.0	4.4
Asparagus (CT, DE, ME, MD, MA, NH, NJ, NY, PA, & RI only), Nemacur 3EC	2.0	15-Inch Band	3.1	1.9

The results in the table below indicate that for *single* broadcast and banded applications of the emulsifiable concentrate and granular formulations of fenamiphos, the avian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, & 0.1, respectively) are exceeded at registered maximum application rates for the following crops: eggplant; table beets; Leatherleaf Fern; Protea; Anthurium; okra; non-bell peppers. For the in-furrow applications on Iris, Lily, and Narcissus bulb

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planting sites, the avian acute high, restricted use, and endangered species levels of concern are exceeded for the 10.5 lb ai/acre application of Nemacur 10G. For in-furrow (and grams/production unit) applications of Nemacur 15G on garlic, banana and plantain, only the restricted use and endangered species LOC's are exceeded. LOC exceedances are indicated by shaded areas in Table 31. Acute RQ's range from 0.3 to 65.1.

Grams per production unit per acre is the application method for the Special Local Need (SLN) registration of Nemacur 15G on bananas and plantains. Similar to in-furrow, incorporated treatment, a 1-percent value will be assumed for this application method.

Table 31: Avian (Reptilian & Terrestrial-Phase Amphibians) Acute Risk Quotients for Single Applications of Nemacur 3, 15G, & 10G Based on a Bobwhite Quail LD_{50} of 1.6 mg ai/kg.

Crop/Formulation	Maximum Single Application Rate (lb ai/acre)	Application Method	Soil Surface EEC Predicted Maximum Residue (mg ai/ft^2)	Acute RQ (Acute EEC/LD_{50})
Eggplant, Nemacur 3EC & 15G	2.0	12-Inch Band	3.1	1.9
Table Beets (IL, IN, MI, NY, OH & PA only), Nemacur 3EC	3.1	12-Inch Band	4.8	3.0
Iris, Lily & Narcissus bulbs, Nemacur 10G	10.5	In-Furrow	1.1	0.7
Leatherleaf Fern, Nemacur 10G	10.0	Broadcast	104.2	65.1
Protea, Nemacur 10G	9.8	Broadcast	102.2	63.9
Anthurium and Nursery Stock, Nemacur 10G	10.0	Broadcast	104.2	65.1
Garlic, Nemacur 15G	4.5	In-Furrow	0.5	0.3
Okra, Nemacur 15G	2.3	15-Inch Band	3.6	2.3
Non-bell Peppers (CA, GA, & PR only), Nemacur 15G	2.0	12-Inch Band	3.1	1.9
Bananas & Plantains (SLN for Puerto Rico only), Nemacur 15G	6.8	Grams/ Production Unit	0.7	0.4

Balcomb et al. (1984) found that 40 and 60 percent mortality occurred in red-winged blackbirds when dosed with 5 and 10 granules of Nemacur 10G, respectively. These results compare with the estimates presented in the preceeding two tables and suggest that there is little margin for safety, especially for small birds that forage for food or grit on the soil surface, from the application of granulated formu-lations of fenamiphos. Rather than irrigation, immediate soil incorporation to depths of 2-to 3 inches below the soil surface for broadcast and banded applications is is necessary to reduce the risks to song birds and other avian species.

Table 32: Number of 10 and 15G Fenamiphos Granules Equivalent to the LD50 for Six Avian Species

Species	Body Weight (G)	LD_{50} mg/Animal	No. 15G Granules	No. 10G Granules
Bobwhite	200	3.2	37	55
Robin	80	1.2	13.8	22
Mourning Dove	100	1.6	18.5	27.5
House Sparrow	20	0.32	3.7	5.5
Redwing Blackbird	50	0.80	9.0	14.0
Grasshopper Sparrow	14	0.22	2.5	3.8

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(2) Mammals

Risks from Fenamiphos Residues From Nemacur 3 on Plants and Insects. EFED will be using Hoerger and Kenaga estimates (1973) as modified by Fletcher and other researchers (1994) to approximate the residues *on* plants and insects after application. Hoerger-Kenaga categories represent preferred foods of various terrestrial vertebrates: fruits and bud and shoot tips of leafy crops are preferred by upland game birds; leaves and stems of leafy crops are consumed by hares and hoofed mammals; seeds, seed pods and grasses are consumed by rodents; and insects are consumed by various birds, mammals, reptiles and terrestrial-phase amphibians. See Tables 33 through 50 on the following pages.

The acute or mean acute and chronic RQ's are calculated by dividing the maximum or mean EEC, expressed in milligrams of active ingredient per killigram of food (mg ai/kg), by the quotient of the Lethal $Dose_{50}$ (LD_{50}) or the reproductive NOEL divided by the percent of food consumed in body weight. See the example equations for acute and mean acute and chronic RQ's below.

$$\text{Acute RQ} = \frac{\text{Acute EEC (mg/kg)}}{LD_{50}\text{ (mg/kg)/ \% Body Wt Consumed}} \qquad \text{Chronic RQ} = \frac{\text{Chronic EEC (mg/kg)}}{\text{NOEL (mg/kg)/ \% Body Wt Consumed}}$$

$$\text{Mean Acute RQ} = \frac{\text{Mean EEC (mg/kg)}}{LD_{50}\text{ (mg/kg)/ \% Body Wt Consumed}} \qquad \text{Mean Chronic RQ} = \frac{\text{Mean EEC (mg/kg)}}{\text{NOEL (mg/kg)/ \% Body Wt Consumed}}$$

Cotton **Maximum Single Application**

Table 33: Mammalian (Herbivore/Insectivore/Granivore) Acute & Chronic Risk Quotients for Single Applications of Nemacur 3EC Based on a Rat Acute Oral LD_{50} of 2.38 mg/kg & a Rat Reproductive NOEL of 2.5 ppm.

Crop/ Formu-lation	Max Single Appl. Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (mg/kg)	EEC Predicted Mean Residue (mg/kg)	Body Weight (grams)	% Body Weight Con-sumed	Acute RQ	Mean Acute RQ	Chronic RQ	Mean Chronic RQ
Cotton Nemacur 3EC	3.0	Short grass	720.0	255.0	15	95.0%	287.4	101.8	273.6	96.9
			720.0	255.0	35	66.0%	199.7	70.7	190.1	67.3
			720.0	255.0	1,000	15.0%	45.4	16.1	43.2	15.3
		Tall grass	>330.0	>108.0	15	95.0%	>131.7	>43.1	>125.4	>41.0
			>330.0	>108.0	35	66.0%	>91.5	>30.0	>87.1	>28.5
			>330.0	>108.0	1,000	15.0%	>20.8	>6.8	>19.8	>6.5
		Broadleaf/forage plants, & small insects	405.0	135.0	15	95.0%	161.7	53.9	153.9	51.3
			405.0	135.0	35	66.0%	112.3	37.4	106.9	35.6
			405.0	135.0	1,000	15.0%	25.5	8.5	24.3	8.1
		Fruits, pods, seeds, & large insects	45.0	21.0	15	95.0%	18.0	8.4	17.1	8.0
			45.0	21.0	35	66.0%	12.5	5.8	11.9	5.5
			45.0	21.0	1,000	15.0%	2.8	1.3	2.7	1.3

> means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.

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The results in Table 33 indicate that for *single* in-furrow application of fenamiphos as the end-use formulation, Nemacur 3, the mammalian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded at registered maximum application rates on cotton. The maximum single application rate is 3.0 lbs ai/acre. The results also indicate the mammalian chronic levels of concern (1.0) are exceeded at the registered maximum single application rate for cotton. LOC exceedances are indicated by shaded areas in Table 33. Herbivore acute and mean acute RQ's range from 2.8 to 287.4 and from 1.3 to 101.8 on terrestrial vertebrate food items, respectively. Herbivore chronic and mean chronic RQ's range from 2.7 to 273.6 and from 1.3 to 96.9, respectively. Insectivore acute and mean acute RQ's range from 2.8 to 161.7 and from 1.3 to 53.9, from estimated residues on insects, respectively. Insectivore chronic and mean chronic RQ's range from 2.7 to 153.9 and from 1.3 to 51.3, respectively. For granivores, acute and mean acute RQ's range from 2.8 to 18.0 and 1.3 to 8.4, respectively, from estimated residues on seeds and seed pods. Granivore chronic and mean chronic RQ's range from 2.7 to 17.1 and 1.3 to 8.0, respectively.

Kiwi Fruit (California only), Raspberries, and Grapes **Maximum Single Application**

Table 34: Mammalian (Herbivore/Insectivore/Granivore) Acute & Chronic Risk Quotients for Single Applications of Nemacur 3EC Based on a Rat Acute Oral LD_{50} of 2.38 mg/kg & a Rat Reproductive NOEL of 2.5 ppm.

Crop/ Formu-lation	Max Single Application Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)	Body Weight (grams)	% Body Weight Con-sumed	Acute RQ	Mean Acute RQ	Chronic RQ	Mean Chronic RQ
Grapes, Kiwi Fruit (CA only), and Rasp-berries Nemacur 3EC	6.0	Short grass	1440.0	510.0	15	95.0%	574.8	203.6	547.2	193.8
			1440.0	510.0	35	66.0%	399.3	141.4	380.2	134.6
			1440.0	510.0	1,000	15.0%	90.8	32.1	86.4	30.6
		Tall grass	>660.0	>216.0	15	95.0%	>263.4	>86.2	>250.8	>82.1
			>660.0	>216.0	35	66.0%	>183.0	>59.9	>174.2	>57.0
			>660.0	>216.0	1,000	15.0%	>41.6	>13.6	>39.6	>13.0
		Broadleaf/ forage plants, & small insects	>810.0	>270.0	15	95.0%	>323.3	>107.8	>307.8	>102.6
			>810.0	>270.0	35	66.0%	>224.6	>74.9	>213.8	>71.3
			>810.0	>270.0	1,000	15.0%	>51.1	>17.0	>48.6	>16.2
		Fruits, pods, seeds, and large insects	90.0	42.0	15	95.0%	35.9	16.8	34.2	16.0
			90.0	42.0	35	66.0%	25.0	11.6	23.8	11.1
			90.0	42.0	1,000	15.0%	5.7	2.6	5.4	2.5

>means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.

The results in Table 34 above indicate that for *single* in-furrow application of fenamiphos as the end-use formulation, Nemacur 3, the mammalian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded at registered maximum application rates on grapes, raspberries and kiwi fruit. The maximum single application rate is 3.0 lbs ai/acre. The results also indicate the mammalian chronic levels of concern (1.0) are exceeded at the registered maximum single application rate for grapes, raspberries and kiwi fruit. LOC exceedances are indicated by shaded areas in Table 34. Herbivore acute and mean acute RQ's

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range from 2.8 to 287.4 and from 1.3 to 101.8 on terrestrial vertebrate food items, respectively. Herbivore chronic and mean chronic RQ's range from 2.7 to 273.6 and from 1.3 to 96.9, respectively. Insectivore acute and mean acute RQ's range from 2.8 to 161.7 and from 1.3 to 53.9, from estimated residues on insects, respectively. Insectivore chronic and mean chronic RQ's range from 2.7 to 153.9 and from 1.3 to 51.3, respectively. For granivores, acute and mean acute RQ's range from 2.8 to 18.0 and 1.3 to 8.4, respectively, from estimated residues on seeds and seed pods. Granivore chronic and mean chronic RQ's range from 2.7 to 17.1 and 1.3 to 8.0, respectively.

Peanuts **Maximum Single Application**

Table 35: Mammalian (Herbivore/Insectivore/Granivore) Acute & Chronic Risk Quotients for Single Applications of Nemacur 15G Based on a Rat Acute Oral LD_{50} of 2.38 mg/kg & a Rat Reproductive NOEL of 2.5 ppm.

Crop/ Formulation	Maximum Single Application Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)	Body Weight (grams)	% Body Weight Consumed	Acute RQ	Mean Acute RQ	Chronic RQ	Mean Chronic RQ
Peanuts Nemacur 3EC	2.5, 1.2	Short grass	624.0, 288.0	221.0, 102.0	15	95.0%	249.1, 115.0	88.2 40.7	237.1, 109.4	84.0, 38.8
			624.0, 288.0	221.0, 102.0	35	66.0%	173.0, 79.9	61.3, 28.3	164.7, 76.0	58.3, 26.9
			624.0, 288.0	221.0, 102.0	1,000	15.0%	39.3, 18.2	13.9, 6.4	37.4, 17.3	13.3, 6.1
		Tall grass	>286, 132.0	>93.6, 43.2	15	95.0%	>114.2, 52.7	>37.4, 17.2	>108.7, 50.2	>35.6, 16.4
			>286, 132.0	>93.6, 43.2	35	66.0%	>79.3, 36.6	>26.0, 12.0	>75.5, 34.8	>24.7, 11.4
			>286, 132.0	>93.6, 43.2	1,000	15.0%	>18.0, 8.3	>5.9, 2.7	>17.2, 7.9	>5.8, 2.6
		Broadleaf/forage plants, and small insects	351.0, 162.0	117.0, 54.0	15	95.0%	140.1, 64.7	46.7, 21.6	133.4, 61.6	44.5, 20.5
			351.0, 162.0	117.0, 54.0	35	66.0%	97.3, 44.9	32.4, 15.0	92.7, 42.8	30.9, 14.3
			351.0, 162.0	117.0, 54.0	1,000	15.0%	22.1, 10.2	7.4, 3.4	21.1, 9.7	7.0, 3.2
		Fruits, pods, seeds, and large insects	39.0, 18.0	18.2, 8.4	15	95.0%	15.6, 7.2	7.3, 3.4	14.8, 6.8	6.9, 3.2
			39.0, 18.0	18.2, 8.4	35	66.0%	10.8, 5.0	5.0, 2.3	10.3, 4.8	4.8, 3.2
			39.0, 18.0	18.2, 8.4	1,000	15.0%	2.5, 1.1	1.1, 0.5	2.3, 1.1	1.1 0.5

>means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.
Peanuts: The first and second sets of values represent 36-inch, single-row, and 72-inch, double-row bed spacing, respectively.

The results in Table 35 indicate that for *single* banded applications of fenamiphos as the end-use formulation, Nemacur 3, the mammalian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded at registered single maximum application rates on peanuts. The maximum single application rate is 2.5 lbs ai/acre. The results also indicate the mammalian chronic levels of concern (1.0) are exceeded at the registered maximum application rate for peanut use and method of application. LOC exceedances are indicated by shaded areas.

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The first set of RQ values in Table 35 represents peanuts grown in single rows with 36-inch spacing. Herbivore acute and mean acute RQ's range from 2.5 to 249.1 and from 1.1 to 88.2 on terrestrial vertebrate food items, respectively. Herbivore chronic and mean chronic RQ's range from 2.3 to 237.1 and from 1.1 to 84.0, respectively. Insectivore acute and mean acute RQ's range from 2.5 to 140.1 and from 1.1 to 46.7, from estimated residues on insects, respectively. Insectivore chronic and mean chronic RQ's range from 2.3 to 133.4 and from 1.1 to 44.5, respectively. For granivores, acute and mean acute RQ's range from 2.5 to 15.6 and from 1.1 to 7.3, respectively, from estimated residues on seeds and seed pods. Granivore chronic and mean chronic RQ's range from 2.3 to 14.8 and from 1.1 to 6.9, respectively.

The second set of RQ values Table 35 represent peanuts grown in 72-inch double-row bed spacing. Herbivore acute and mean acute RQ's range from 1.1 to 115.0 and from 0.5 to 40.7 on terrestrial vertebrate food items, respectively. Herbivore chronic and mean chronic RQ's range from 1.1 to 109.4 and from 0.5 to 38.8, respectively. Insectivore acute and mean acute RQ's range from 1.1 to 64.7 and from 0.5 to 21.6, from estimated residues on insects, respectively. Insectivore chronic and mean chronic RQ's range from 1.1 to 61.6 and from 0.5 to 20.5, respectively. For granivores, acute and mean acute RQ's range from 1.1 to 7.2 and from 0.5 to 3.4, respectively, from estimated residues on seeds and seed pods. Granivore chronic and mean chronic RQ's range from 1.1 to 6.8 and from 0.5 to 3.2, respectively.

Stone Fruits and Apple Maximum Single Application

Table 36: Mammalian (Herbivore/Insectivore/Granivore) Acute & Chronic Risk Quotients for Single Applications of Nemacur 3EC Based on a Rat Acute Oral LD_{50} of 2.38 mg/kg & a Rat Reproductive NOEL of 2.5 ppm.

Crop/ Formulation	Maximum Single Application Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)	Body Weight (grams)	% Body Weight Consumed	Acute RQ	Mean Acute RQ	Chronic RQ	Mean Chronic RQ
Stone Fruits (peaches, cherries and nectarines) Apple Nemacur 3EC	7.5	Short grass	>1800.0	>637.5	15	95.0%	>718.5	>254.5	>684.0	>242.3
			>1800.0	>637.5	35	66.0%	>499.2	>176.8	>475.2	>168.3
			>1800.0	>637.5	1,000	15.0%	>113.4	>40.2	>108.0	>38.3
		Tall grass	>825.0	>270.0	15	95.0%	>329.3	>107.8	>313.5	>102.6
			>825.0	>270.0	35	66.0%	>228.8	>74.9	>217.8	>71.3
			>825.0	>270.0	1,000	15.0%	>52.0	>17.0	>49.5	>16.2
		Broadleaf/ forage plants, and small insects	>1012.5	>337.5	15	95.0%	>404.1	>134.7	>384.8	>128.3
			>1012.5	>337.5	35	66.0%	>280.8	>93.6	>267.3	>89.1
			>1012.5	>337.5	1,000	15.0%	>63.8	>21.3	>60.8	>20.3
		Fruits, pods, seeds, and large insects	112.5	52.5	15	95.0%	44.9	21.0	42.8	20.0
			112.5	52.5	35	66.0%	31.2	14.6	29.7	13.9
			112.5	52.5	1,000	15.0%	7.1	3.3	6.8	3.2

> means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.

The results indicate that for *single* tree-row banded applications of fenamiphos as the end-use formulation, Nemacur 3, the mammalian acute high, restricted use, and endangered species levels

of concern (0.5, 0.2, and 0.1, respectively) are exceeded at registered maximum application rates on stone fruits and apples. The maximum single application rate is 7.5 lbs ai/acre. The results also indicate the mammalian chronic levels of concern (1.0) are exceeded at the registered maximum single application rate for stone fruit use and method of application. LOC exceedances are indicated by shaded areas in Table 36. Herbivore acute and mean acute RQ's range from 7.1 to greater than 718.5 and from 3.3 to greater than 254.5 on terrestrial vertebrate food items, respectively. Herbivore chronic and mean chronic RQ's range from 6.8 to greater than 684.0 and from 3.2 to greater than 242.3, respectively. Insectivore acute and mean acute RQ's range from 7.1 to greater than 404.1 and from 3.3 to greater than 134.7, from estimated residues on insects, respectively. Insectivore chronic and mean chronic RQ's range from 6.8 to greater than 384.8 and from 3.2 to greater than 128.3, respectively. For granivores, acute and mean acute RQ's range from 7.1 to 44.9 and from 3.3 to 21.0, respectively, from estimated residues on seeds and seed pods. Granivore chronic and mean chronic RQ's range from 6.8 to 42.8 and from 3.2 to 20.0, respectively.

Tobacco **Maximum Single Application**

The results in Table 37 below indicate that for *single* broadcast applications of fenamiphos as the end-use formulation, Nemacur 3, the mammalian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded at registered maximum application rates on tobacco. The maximum single application rate is 6.0 lbs ai/acre. The results also indicate the mammalian chronic levels of concern (1.0) are exceeded at the registered maximum single application rate for tobacco use and method of application. LOC exceedances are indicated by shaded areas in Table 37. Herbivore acute and mean acute RQ's range from 5.7 to 574.8 and from 2.6 to 203.6 on terrestrial vertebrate food items, respectively. Herbivore chronic and mean chronic RQ's range from 5.4 to 547.2 and from 2.5 and 193.8, respectively. Insectivore acute and mean acute RQ's range from 5.7 to greater than 323.3 and from 2.6 to greater than 107.8, from estimated residues on insects, respectively. Insectivore chronic and mean chronic RQ's range from 5.4 to greater than 307.8 and from 2.5 to greater than 102.6, respectively. For granivores, acute and mean acute RQ's range from 5.7 to 35.9 and 2.6 to 16.8, respectively, from estimated residues on seeds and seed pods. Granivore chronic and mean chronic RQ's range from 5.4 to 34.2 and from 2.5 to 16.0, respectively.

Table 37: Mammalian (Herbivore/Insectivore/Granivore) Acute & Chronic Risk Quotients for Single Applications of Nemacur 3EC Based on a Rat Acute Oral LD_{50} of 2.38 mg/kg & a Rat Reproductive NOEL of 2.5 ppm.

Crop/ Formulation	Maximum Single Application Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)	Body Weight (grams)	% Body Weight Consumed	Acute RQ	Mean Acute RQ	Chronic RQ	Mean Chronic RQ
Tobacco Nemacur 3EC	6.0	Short grass	1440.0	510.0	15	95.0%	574.8	203.6	547.2	193.8
			1440.0	510.0	35	66.0%	399.3	141.4	380.2	134.6
			1440.0	510.0	1,000	15.0%	90.8	32.1	86.4	30.6
		Tall grass	>660.0	>216.0	15	95.0%	>263.4	>86.2	>250.8	>82.1
			>660.0	>216.0	35	66.0%	>183.0	>59.9	>174.2	>57.0
			>660.0	>216.0	1,000	15.0%	>41.6	>13.6	>39.6	>13.0
		Broadleaf/ forage plants, and small insects	>810.0	>270.0	15	95.0%	>323.3	>107.8	>307.8	>102.6
			>810.0	>270.0	35	66.0%	>224.6	>74.9	>213.8	>71.3
			>810.0	>270.0	1,000	15.0%	>51.1	>17.0	>48.6	>16.2
		Fruits, pods, seeds, and large insects	90.0	42.0	15	95.0%	35.9	16.8	34.2	16.0
			90.0	42.0	35	66.0%	25.0	11.6	23.8	11.1
			90.0	42.0	1,000	15.0%	5.7	2.6	5.4	2.5

> means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.

Pineapple **Maximum Single Application**

The results in Table 38 indicate that for *single* banded applications of fenamiphos as the end-use formulation, Nemacur 3, the mammalian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded at registered maximum application rates on pineapples. The maximum single application rate is 9.0 lbs ai/acre on pineapples. The results also indicate the mammalian chronic levels of concern (1.0) are exceeded at the registered maximum single application rate for pineapple use and method of application. LOC exceedances are indicated by shaded areas in Table 38. Herbivore acute and mean acute RQ's range from 8.5 to greater than 862.2 and from 3.8 to greater than 290.7 on terrestrial vertebrate food items, respectively. Herbivore chronic and mean chronic RQ's range from 8.1 to greater than 820.8 and from 3.8 and greater than 290.7, respectively. Insectivore acute and mean acute RQ's range from 8.5 to greater than 485.0 and from 3.8 to greater than 153.9, from estimated residues on insects, respectively. Insectivore chronic and mean chronic RQ's range from 8.1 to greater than 461.7 and from 3.8 to greater than 153.9, respectively. For granivores, acute and mean acute RQ's range from 8.5 to 53.9 and 3.8 to 23.9, respectively, from estimated residues on seeds and seed pods. Granivore chronic and mean chronic RQ's range from 8.1 to 51.3 and from 3.8 to 23.9, respectively.

Table 38: Mammalian (Herbivore/Insectivore/Granivore) Acute & Chronic Risk Quotients for Single Applications of Nemacur 3EC Based on a Rat Acute Oral LD_{50} of 2.38 mg/kg & a Rat Reproductive NOEL of 2.5 ppm.

Crop/ Formulation	Maximum Single Application Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)	Body Weight (grams)	% Body Weight Consumed	Acute RQ	Mean Acute RQ	Chronic RQ	Mean Chronic RQ
Pineapple	9.0	Short grass	>2160.0	>765.0	15	95.0%	>862.2	>290.7	>820.8	>290.7
Nemacur 3EC			>2160.0	>765.0	35	66.0%	>599.0	>202.0	>570.2	>202.0
			>2160.0	>765.0	1,000	15.0%	>136.1	>45.9	>129.6	>45.9
		Tall grass	>990.0	>324.0	15	95.0%	>395.2	>123.1	>376.2	>123.1
			>990.0	>324.0	35	66.0%	>274.5	>85.5	>261.4	>85.5
			>990.0	>324.0	1,000	15.0%	>62.4	>19.4	>59.4	>19.4
		Broadleaf/ forage plants, and small insects	>1215.0	>405.0	15	95.0%	>485.0	>153.9	>461.7	>153.9
			>1215.0	>405.0	35	66.0%	>336.9	>106.9	>320.8	>106.9
			>1215.0	>405.0	1,000	15.0%	>76.6	>24.3	>72.9	>24.3
		Fruits, pods, seeds, and large insects	135.0	63.0	15	95.0%	53.9	23.9	51.3	23.9
			135.0	63.0	35	66.0%	37.4	16.6	35.6	16.6
			135.0	63.0	1,000	15.0%	8.5	3.8	8.1	3.8

> means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.

Strawberries **Maximum Single Application**

The results in Table 39 indicate that for *single* banded applications of fenamiphos as the end-use formulations, Nemacur 3, the mammalian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded at registered maximum application rates on strawberries. The maximum single application rate is 4.5 lbs ai/acre. The results also indicate the mammalian chronic levels of concern (1.0) are exceeded at the registered maximum single application rate for strawberry use and method of application. LOC exceedances are indicated by shaded areas in Table 39. Herbivore acute and mean acute RQ's range from 4.3 to 431.1 and from 2.0 to 152.7 on terrestrial vertebrate food items, respectively. Herbivore chronic and mean chronic RQ's range from 4.1 to 410.4 and from 1.9 and 145.4, respectively. Insectivore acute and mean acute RQ's range from 4.3 to greater than 242.5 and from 2.0 to greater than 80.8, from estimated residues on insects, respectively. Insectivore chronic and mean chronic RQ's range from 4.1 to greater than 230.9 and from 1.9 to greater than 77.0, respectively. For granivores, acute and mean acute RQ's range from 4.3 to 26.9 and 2.0 to 80.8, respectively, from estimated residues on seeds and seed pods. Granivore chronic and mean chronic RQ's range from 4.1 to 25.7 and from 1.9 to 12.0, respectively.

Table 39: Mammalian (Herbivore/Insectivore/Granivore) Acute & Chronic Risk Quotients for Single Applications of Nemacur 3EC Based on a Rat Acute Oral LD_{50} of 2.38 mg/kg & a Rat Reproductive NOEL of 2.5 ppm.

Crop/ Formu-lation	Maxi-mum Single Appl. Rate (lb ai/acre)	Food Items	EEC Predicted Maxi-mum Residue (ppm)	EEC Predicted Mean Residue (ppm)	Body Weight (grams)	% Body Weight Con-sumed	Acute RQ	Mean Acute RQ	Chronic RQ	Mean Chronic RQ
Strawberries Nemacur 3EC	4.5	Short grass	1080.0	382.5	15	95.0%	431.1	152.7	410.4	145.4
			1080.0	382.5	35	66.0%	299.5	106.1	285.1	101.0
			1080.0	382.5	1,000	15.0%	68.1	24.1	64.8	23.0
		Tall grass	>495.0	>162.0	15	95.0%	>197.6	>64.7	>188.1	>61.6
			>495.0	>162.0	35	66.0%	>137.3	>44.9	>130.7	>42.8
			>495.0	>162.0	1,000	15.0%	>31.2	>10.2	>29.7	>9.7
		Broadleaf/ forage plants, and small insects	>607.5	>202.5	15	95.0%	>242.5	>80.8	>230.9	>77.0
			>607.5	>202.5	35	66.0%	>168.5	>56.2	>160.4	>53.5
			>607.5	>202.5	1,000	15.0%	>38.3	>12.8	>36.5	>12.2
		Fruits, pods, seeds, and large insects	67.5	31.5	15	95.0%	26.9	12.6	25.7	12.0
			67.5	31.8	35	66.0%	18.7	8.8	17.8	8.4
			67.5	31.8	1,000	15.0%	4.3	2.0	4.1	1.9

> means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.

Asparagus and Eggplant **Maximum Single Application**

The results in Table 40 above indicate that for *single* banded applications of fenamiphos as the end-use formulations, Nemacur 3, the mammalian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded at registered maximum application rates on asparagus and eggplant. The maximum single application rate is 2.0 lbs ai/acre. The results also indicate the mammalian chronic levels of concern (1.0) are exceeded at the registered maximum single application rate for all uses on asparagus and eggplant except for the mean chronic exposure to large granivores (1000 grams). LOC exceedances are indicated by shaded areas in Table 40. Herbivore acute and mean acute RQ's range from 1.9 to 191.6 and from 0.9 to 67.9 on terrestrial vertebrate food items, respectively. Herbivore chronic and mean chronic RQ's range from 1.8 to 182.4 and from 0.8 and 64.6, respectively. Insectivore acute and mean acute RQ's range from 1.9 to 107.8 and from 0.9 to 35.9, from estimated residues on insects, respectively. Insectivore chronic and mean chronic RQ's range from 1.8 to 102.6 and from 0.8 to 34.2, respectively. For granivores, acute and mean acute RQ's range from 1.9 to 12.0 and 0.9 to 5.6, respectively, from estimated residues on seeds and seed pods. Granivore chronic and mean chronic RQ's range from 108 to 11.4 and from 0.8 to 5.3, respectively.

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Table 40: Mammalian (Herbivore/Insectivore/Granivore) Acute & Chronic Risk Quotients for Single Applications of Nemacur 3EC Based on a Rat Acute Oral LD_{50} of 2.38 mg/kg & a Rat Reproductive NOEL of 2.5 ppm.

Crop/ Formu-lation	Maximum Single Appl. Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)	Body Weight (grams)	% Body Weight Con-sumed	Acute RQ	Mean Acute RQ	Chronic RQ	Mean Chronic RQ
Asparagus (CT, DE, ME, MA, NH, NJ, NY, PA, and RI only)	2.0	Short grass	480.0	170.0	0.0	95.0%	191.6	67.9	182.4	64.6
			480.0	170.0	35	66.0%	133.1	47.1	126.7	44.9
			480.0	170.0	1,000	15.0%	30.3	10.7	28.8	10.2
Eggplant		Tall grass	220.0	72.0	15	95.0%	87.8	28.7	83.6	27.4
			220.0	72.0	35	66.0%	61.0	20.0	58.1	19.0
Nemacur 3EC			220.0	72.0	1,000	15.0%	13.9	4.5	13.2	4.3
		Broadleaf/ forage plants, and small insects	270.0	90.0	15	95.0%	107.8	35.9	102.6	34.2
			270.0	90.0	35	66.0%	74.9	25.0	71.3	23.8
			270.0	90.0	1,000	15.0%	17.0	5.7	16.2	5.4
		Fruits, pods, seeds, and large insects	30.0	14.0	15	95.0%	12.0	5.6	11.4	5.3
			30.0	14.0	35	66.0%	8.3	3.9	7.9	3.7
			30.0	14.0	1,000	15.0%	1.9	0.9	1.8	0.8

>means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.

Citrus **Maximum Single Application**

The results in Table 41 indicate that for *single* banded applications of fenamiphos as the end-use formulations, Nemacur 3, the mammalian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded at registered maximum application rates on citrus. The maximum single application rate is 7.5 lbs ai/acre. The results also indicate the mammalian chronic levels of concern (1.0) are exceeded at the registered maximum single application rate for strawberry use and method of application. LOC exceedances are indicated by shaded areas in Table 42. Herbivore acute and mean acute RQ's range from 4.7 to greater than 718.5 and from 2.2 to greater than 254.5 on terrestrial vertebrate food items, respectively. Herbivore chronic and mean chronic RQ's range from 4.5 to greater than 684.0 and from 2.1 to greater than 242.3, respectively. Insectivore acute and mean acute RQ's range from 4.7 to greater than 404.1 and from 2.2 to greater than 134.7, from estimated residues on insects, respectively. Insectivore chronic and mean chronic RQ's range from 4.5 to greater than 384.8 and from 2.1 to greater than 128.3, respectively. For granivores, acute and mean acute RQ's range from 4.7 to 44.9 and 2.2 to 21.0, respectively, from estimated residues on seeds and seed pods. Granivore chronic and mean chronic RQ's range from 4.5 to 42.8 and from 2.1 to 20.0, respectively.

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Table 41: Mammalian (Herbivore/Insectivore/Granivore) Acute & Chronic Risk Quotients for Single Applications of Nemacur 3EC Based on a Rat Acute Oral LD_{50} of 2.38 mg/kg & a Rat Reproductive NOEL of 2.5 ppm.

Crop/ Formu-lation	Max Single Appl. Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)	Body Wt (gm)	%Body Wt Con-sumed	Acute RQ	Mean Acute RQ	Chronic RQ	Mean Chronic RQ
Citrus (Certain FL Coun-ties) Nema-cur 3EC	5.0	Short grass	1200.0	425.0	15	95.0%	479.0	169.6	456.0	161.5
			1200.0	425.0	35	66.0%	332.8	117.9	316.8	112.2
			1200.0	425.0	1,000	15.0%	75.6	26.8	72.0	25.5
		Tall grass	>550.0	>180.0	15	95.0%	>219.5	>71.8	>209.0	>68.4
			>550.0	>180.0	35	66.0%	>152.5	>49.9	>145.2	>47.5
			>550.0	>180.0	1,000	15.0%	>34.7	>11.3	>33.0	>10.8
		Broadleaf/ forage plants, & small insects	>675.0	>225.0	15	95.0%	>269.4	>89.8	>256.5	>85.5
			>675.0	>225.0	35	66.0%	>187.2	>62.4	>178.2	>59.4
			>675.0	>225.0	1,000	15.0%	>42.5	>14.2	>40.5	>13.5
		Fruits, pods, seeds, & large insects	75.0	35.0	15	95.0%	29.9	14.0	28.5	13.3
			75.0	35.0	35	66.0%	20.8	9.7	19.8	9.2
			75.0	35.0	1,000	15.0%	4.7	2.2	4.5	2.1
Citrus (except FL except Kum-quat, Tangelo, and Citrus Hybrids in CA) Nema-cur 3EC	7.5	Short grass	>1800.0	>637.5	15	95.0%	>718.5	>254.5	>684.0	>242.3
			>1800.0	>637.5	35	66.0%	>499.2	>176.8	>475.2	>168.3
			>1800.0	>637.5	1,000	15.0%	>113.4	>40.2	>108.0	>38.3
		Tall grass	>825.0	>270.0	15	95.0%	>329.3	>107.8	>313.5	>102.6
			>825.0	>270.0	35	66.0%	>228.8	>74.9	>217.8	>71.3
			>825.0	>270.0	1,000	15.0%	>52.0	>17.0	>49.5	>16.2
		Broadleaf/ forage plants, & small insects	>1012.5	>337.5	15	95.0%	>404.1	>134.7	>384.8	>128.3
			>1012.5	>337.5	35	66.0%	>280.8	>93.6	>267.3	>89.1
			>1012.5	>337.5	1,000	15.0%	>63.8	>21.3	>60.8	>20.3
		Fruits, pods, seeds, & large insects	112.5	52.5	15	95.0%	44.9	21.0	42.8	20.0
			112.5	52.5	35	66.0%	31.2	14.6	29.7	13.9
			112.5	52.5	1,000	15.0%	7.1	3.3	6.8	3.2

> means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.

Table Beets **Maximum Single Application**

The results in Table 42 indicate that for *single* banded applications of fenamiphos as the end-use formulation, Nemacur 3, the mammalian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded at registered maximum application rates on table beets. The maximum single application rate is 3.1 lbs ai/acre. The results also indicate the mammalian chronic levels of concern (1.0) are exceeded at the registered maximum single application rate for table beet use and method of application. LOC exceedances are indicated by shaded areas in Table 42. Herbivore acute and mean acute RQ's range from 2.9 to 297.0 and from 1.4 to 105.2 on terrestrial vertebrate food items, respectively. Herbivore chronic and mean chronic RQ's range from 2.8 to 282.7 and from 1.3 to 100.1, respectively. Insectivore acute and

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mean acute RQ's range from 2.9 to 167.0 and from 1.4 to 55.7, from estimated residues on insects, respectively. Insectivore chronic and mean chronic RQ's range from 2.8 to 159.0 and from 1.3 to 53.0, respectively. For granivores, acute and mean acute RQ's range from 2.9 to 18.6 and 1.4 to 8.7, respectively, from estimated residues on seeds and seed pods. Granivore chronic and mean chronic RQ's range from 2.8 to 17.7 and from 1.3 to 8.2, respectively.

Table 42: Mammalian (Herbivore/Insectivore/Granivore) Acute & Chronic Risk Quotients for Single Applications of Nemacur 3EC Based on a Rat Acute Oral LD_{50} of 2.38 mg/kg & a Rat Reproductive NOEL of 2.5 ppm.

Crop/ Formulation	Maximum Single Appl. Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)	Body Weight (grams)	% Body Weight Consumed	Acute RQ	Mean Acute RQ	Chronic RQ	Mean Chronic RQ
Table Beets (IL, IN, MI, NY, OH and PA only) Nemacur 3EC	3.1	Short grass	744.0	263.5	15	95.0%	297.0	105.2	282.7	100.1
			744.0	263.5	35	66.0%	206.3	73.1	196.4	69.6
			744.0	263.5	1,000	15.0%	46.9	16.6	44.6	15.8
		Tall grass	>341.0	>111.6	15	95.0%	>136.1	>44.5	>129.6	>42.4
			>341.0	>111.6	35	66.0%	>94.6	>30.9	>90.0	>29.5
			>341.0	>111.6	1,000	15.0%	>21.5	>7.0	>20.5	>6.7
		Broadleaf/ forage plants, and small insects	418.5	139.5	15	95.0%	167.0	55.7	159.0	53.0
			418.5	139.5	35	66.0%	116.1	38.7	110.5	36.8
			418.5	139.5	1,000	15.0%	26.4	8.8	25.1	8.4
		Fruits, pods, seeds, and large insects	46.5	21.7	15	95.0%	18.6	8.7	17.7	8.2
			46.5	21.7	35	66.0%	12.9	6.0	12.3	5.7
			46.5	21.7	1,000	15.0%	2.9	1.4	2.8	1.3

> means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.

Citrus, Strawberry, Pineapple and Turf **Multiple Applications**

The Nemacur 3 label allows multiple applications on citrus, pineapple, strawberry and turf. The quantifiable risks to terrestrial vertebrates resulting from exposure to fenamiphos residues on plants and insects from additional applications which are applied at intervals of greater than two days are identical to that quantified for single applications. Fenamiphos residues will be degraded via phytolysis on exposed plants and insects via photolysis.

Risks from Fenamiphos Soil Residues. Terrestrial vertebrates also may be exposed to pesticides applied to soil by ingesting pesticide granules and/or pesticide-laden soil when foraging. Rich in minerals, soil comprises 5-to-30 percent of dietary intake by many wildlife species.[29] They also may be exposed by drinking pesticide-contaminated water. LOC exceedances are indicated by shaded areas in Table 43. Acute RQ's range from 0.1 to 43.8.

29 W. N. Beyer and E.E. Connor, "Estimates of Soil Ingestion by Wildlife," U.S. Fish and Wildlife Service, Patuxent Wildlife Research Center at Laurel, MD and S. Gerould, U.S. Geological Survey, Reston, VA.

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The results indicate that for *single* broadcast and banded applications of the emulsifiable concentrate and granular formulations of fenamiphos, the mammalian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded at registered maximum application rates for the following crops: cotton, grapes, peanuts, stone fruits, tobacco, turf, citrus, apple, kiwi fruit, pineapple, rasberries, strawberries, bok choy, cabbage, brussel sprouts, and asparagus. For in-furrow soil injected applications on cotton, only the endangered species LOC is exceeded. For in-furrow soil injected and banded applications on grapes, only the endangered species and restricted use LOC's are exceeded.

Table 43: Mammalian (Herbivore/Insectivore/Granivore) Acute Risk Quotients for Single Applications of Nemacur 3, 15G, & 10G Based on a Rat Acute Oral LD_{50} of 2.38 mg/kg.

Crop/Formulation	Maximum Single Application Rate (lb ai/acre)	Application Method	Soil Surface EEC Predicted Maximum Residue (mg ai/ft^2)	Acute RQ (Acute EEC/LD_{50})
Cotton/Nemacur 3EC	3.0	In-Furrow Soil Injected	0.3	0.1
Cotton, Nemacur 15G	1.6	12-Inch Band	2.5	1.1
Grapes, Nemacur 3EC	6.0	Banded, In-Furrow	9.4, 0.6	4.0, 0.3
Peanuts, Nemacur 3EC	2.5	12-Inch Band	3.9	1.6
Peanuts, Nemacur 15G	2.6	12-Inch Band	4.1	1.7
Stone Fruits (peaches, cherries & nectarines), Nemacur 3EC	7.5	Tree-Row Band	11.7	4.9
Tobacco, Nemacur 3EC	6.0	Broadcast	62.5	26.3
Turf, Nemacur 10G	10.0	Broadcast	104.2	43.8
Turf, Nemacur 3EC	9.9	Broadcast	103.2	43.4
Citrus (except FL, except Kumquat, Tangelo & Citrus Hybrids), Nemacur 3EC	7.5	Tree-Row Band	11.7	4.9
Citrus (in CA, except Kumquat, Tangelo & Citrus Hybrids), Nemacur 15G	10.0	Tree-Row Band	15.6	6.6
Citrus, Certain FL Counties, Nemacur 3EC	5.0	Tree-Row Band	7.8	3.3
Apple, Nemacur 3EC	7.5	Tree-Row Band	11.7	4.9
Kiwi Fruit (CA only), Nemacur 3EC	6.0	Broadcast	62.5	26.3
Pineapple, Nemacur 3EC	9.0	Banded	14.1	5.9
Raspberries, Nemacur 3EC	6.0	Banded	9.4	4.0
Strawberries, Nemacur 3EC & 15G	4.5	18-Inch Band	7.0	2.9
Bok Choy, Cabbage &Brussel Sprouts, Nemacur 15G	4.5	15-Inch Band	7.0	2.9
Asparagus (CT, DE, ME, MD, MA, NH, NJ, NY, PA, & RI only), Nemacur 3EC	2.0	15-Inch Band	3.1	1.3

The results in the table below indicate that for *single* broadcast and banded applications of the emulsifiable concentrate and granular formulations of fenamiphos, the mammalian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded at registered maximum application rates for the following crops: eggplant; table beets; Leatherleaf Fern; Protea; Anthurium; okra; non-bell peppers. For the in-furrow applications on Iris, Lily, and Narcissus bulb planting sites, the mammalian acute high, restricted use, and endangered species levels of concern are exceeded for the 10.5 lb ai/acre application of Nemacur

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10G. For in-furrow (and grams/production unit) applications of Nemacur 15G on garlic, banana and plantain, only the
restricted use and endangered species LOC's are exceeded. LOC exceedances are indicated by shaded areas in Table 44. Acute RQ's range from 0.2 to 43.8.

Grams per production unit per acre is the application method for the Special Local Need (SLN) registration of Nemacur 15G on bananas and plantains. Similar to in-furrow, incorporated treatment, a 1-percent value will be assumed for this application method.

Table 44: Mammalian (Herbivore/Insectivore/Granivore) Acute Risk Quotients for Single Applications of Nemacur 3, 15G, & 10G Based on a Rat Acute Oral LD_{50} of 2.38 mg/kg.

Crop/Formulation	Maximum Single Application Rate (lb ai/acre)	Application Method	Soil Surface EEC Predicted Maximum Residue (mg ai/ft^2)	Acute RQ (Acute EEC/LD_{50})
Eggplant, Nemacur 3EC & 15G	2.0	12-Inch Band	3.1	1.3
Table Beets (IL, IN, MI, NY, OH & PA only), Nemacur 3EC	3.1	12-Inch Band	4.8	2.0
Iris, Lily & Narcissus bulbs, Nemacur 10G	10.5	In-Furrow	1.1	0.5
Leatherleaf Fern, Nemacur 10G	10.0	Broadcast	104.2	43.8
Protea, Nemacur 10G	9.8	Broadcast	102.2	42.9
Anthurium and Nursery Stock, Nemacur 10G	10.0	Broadcast	104.2	43.8
Garlic, Nemacur 15G	4.5	In-Furrow	0.5	0.2
Okra, Nemacur 15G	2.3	15-Inch Band	3.6	1.5
Non-bell Peppers (CA, GA, & PR only), Nemacur 15G	2.0	12-Inch Band	3.1	1.3
Bananas & Plantains (SLN for Puerto Rico only), Nemacur 15G	6.8	Grams/Production Unit	0.7	0.3

Risks from metabolite residues on/in food items. As stated in HED's plant metabolism review (dated 10/93), studies with a variety of plants including beans, cabbage, carrots, mustard, oats, peanuts, pineapples, potatoes, soybeans, sugar beets, tobacco, tomatoes, and wheat indicate that fenamiphos is readily absorbed from soils, foliage, and fruits and translocated throughout the plant. Metabolism involves the oxidation of fenamiphos to fenamiphos sulfoxide and/or fenamiphos sulfone, subsequent hydrolysis to fenamiphos sulfoxide phenol and fenamiphos sulfone phenol, and the formation of the glucoside or other conjugates. The terminal residues of concern are fenamiphos, fenamiphos sulfoxide, and fenamiphos sulfone.

<u>Fenamiphos sulfone</u>. Fenamiphos sulfone was determined to be very highly toxic to mammals on an acute oral basis (LD_{50} = 2.6 mg/kg). Acute and mean acute risk values were quantified using the following equations:

$$\text{Acute RQ} = \frac{\text{Acute EEC (mg/kg)}}{LD_{50}\text{ (mg/kg)/ \% Body Weight Consumed}} \qquad \text{Mean Acute RQ} = \frac{\text{Mean EEC (mg/kg)}}{LD_{50}\text{ (mg/kg)/ \% Body Weight Consumed}}$$

To more accurately represent the amount consumed by wild mammals, half the lethal dose (LD_{50}) is first divided by the percent of body weight typically consumed by small mammals weighing 15, 35 and 1,000 grams. Maximum and mean EEC values of fenamiphos sulfone presume a 3.5 percent conversion of parent fenamiphos to fenamiphos sulfone.

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Cotton **Maximum Single Application**

For fenamiphos sulfone resulting from a *single* in-furrow application of fenamiphos as the end-use formulation, Nemacur 3, the mammalian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded on cotton. LOC exceedances are indicated by shaded areas in Table 45.

Table 45: From a Single Application of Nemacur 3EC, the Mammalian (Herbivore/Insectivore) Acute Risk Quotients for Fenamiphos Sulfone based on a Rat Acute Oral LD_{50} of 2.6 mg/kg for Fenamiphos Sulfone.

Crop/ Formu-lation	Max Single Appl. Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (mg/kg)	EEC Predicted Mean Residue (mg/kg)	Body Wt (grams)	% Body Wt Consumed	Acute RQ	Mean Acute RQ
Cotton Nemacur 3EC	3.0	Short grass	25.2	8.9	15	95.0%	9.2	3.3
			25.2	8.9	35	66.0%	6.4	2.3
			25.2	8.9	1,000	15.0%	1.5	0.5
		Tall grass	11.6	3.8	15	95.0%	4.2	1.4
			11.6	3.8	35	66.0%	2.9	1.0
			11.6	3.8	1,000	15.0%	0.7	0.2
		Broadleaf/forage plants, & small insects	14.2	4.7	15	95.0%	5.2	1.7
			14.2	4.7	35	66.0%	3.6	1.2
			14.2	4.7	1,000	15.0%	0.8	0.3
		Fruits, pods, seeds, & large insects	1.6	0.7	15	95.0%	0.6	0.3
			1.6	0.7	35	66.0%	0.4	0.2
			1.6	0.7	1,000	15.0%	0.1	0.0

> means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.

Pineapple **Maximum Single Application**

Table 46: From a Single Applications of Nemacur 3EC, the Mammalian (Herbivore/Insectivore) Acute Risk Quotients for Fenamiphos Sulfone based on a Rat Acute Oral LD_{50} of 2.6 mg/kg for Fenamiphos Sulfone.

Crop/ Formulation	Maximum Single Application Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)	Body Weight (grams)	% Body Wt Consumed	Acute RQ	Mean Acute RQ
Pineapple Nemacur 3EC	9.0	Short grass	75.6	26.8	15	95.0%	27.6	9.8
			75.6	26.8	35	66.0%	19.2	6.8
			75.6	26.8	1,000	15.0%	4.4	1.5
		Tall grass	34.7	11.3	15	95.0%	12.7	4.1
			34.7	11.3	35	66.0%	8.8	2.9
			34.7	11.3	1,000	15.0%	2.0	0.7
		Broadleaf/ forage plants, and small insects	42.5	14.2	15	95.0%	15.5	5.2
			42.5	14.2	35	66.0%	10.8	3.6
			42.5	14.2	1,000	15.0%	2.5	0.8
		Fruits, pods, seeds, and large insects	4.7	2.2	15	95.0%	1.7	0.8
			4.7	2.2	35	66.0%	1.2	0.6
			4.7	2.2	1,000	15.0%	0.3	0.1

> means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.

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The results in Table 46 indicate that fenamiphos sulfone resulting from *single* banded applications of fenamiphos as the end-use formulation, Nemacur 3, the mammalian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded on pineapples. LOC exceedances are indicated by shaded areas.

Grapes, Tobacco, Raspberry, Kiwi Fruit, Peanuts, Stone Fruits and Apple **Maximum Single Application**

Table 47: From a Single Application of Nemacur 3EC, the Mammalian (Herbivore/Insectivore) Acute Risk Quotients for Fenamiphos Sulfone based on a Rat Acute Oral LD_{50} of 2.6 mg/kg for Fenamiphos Sulfone.

Crop/ Formulation	Maximum Rate (lb/a.i./Application	Food Items	EEC Predicted Maximum Residue(ppm)	EEC Predicted Mean Residue (ppm)	Body Wt (grams)	% Body Wt Consumed	Acute RQ	Mean Acute RQ
Grapes, Tobacco Raspberry and Kiwi Fruit (CA only) Nemacur 3EC	6.0	Short grass	50.4	17.9	15	95.0%	18.4	6.5
			50.4	17.9	35	66.0%	12.8	4.5
			50.4	17.9	1,000	15.0%	2.9	1.0
		Tall grass	23.1	7.6	15	95.0%	8.4	2.8
			23.1	7.6	35	66.0%	5.9	1.9
			23.1	7.6	1,000	15.0%	1.3	0.4
		Broadleaf/ forage plants, & small insects	28.4	9.5	15	95.0%	10.4	3.5
			28.4	9.5	35	66.0%	7.2	2.4
			28.4	9.5	1,000	15.0%	1.6	0.5
		Fruits, pods, seeds, and large insects	3.2	1.5	15	95.0%	1.2	0.5
			3.2	1.5	35	66.0%	0.8	0.4
			3.2	1.5	1,000	15.0%	0.2	0.1
Peanuts Nemacur 3EC	2.5	Short grass	21.8	7.7	15	95.0%	8.0	2.8
			21.8	7.7	35	66.0%	5.5	2.0
			21.8	7.7	1,000	15.0%	1.3	0.4
		Tall grass	10.1	3.3	15	95.0%	3.7	1.2
			10.1	3.3	35	66.0%	2.6	0.8
			10.1	3.3	1,000	15.0%	0.6	0.2
		Broadleaf/forage plants, and small insects	12.3	4.1	15	95.0%	4.5	1.5
			12.3	4.1	35	66.0%	3.1	1.0
			12.3	4.1	1,000	15.0%	0.7	0.2
		Fruits, pods, seeds, and large insects	1.4	0.6	15	95.0%	0.5	0.2
			1.4	0.6	35	66.0%	0.4	0.2
			1.4	0.6	1,000	15.0%	0.1	0.0
Stone Fruits (peaches, cherries and nectar-ines) Apple Nemacur 3EC	7.5	Short grass	63.0	22.3	15	95.0%	23.0	8.2
			63.0	22.3	35	66.0%	16.0	5.7
			63.0	22.3	1,000	15.0%	3.6	1.3
		Tall grass	28.9	9.5	15	95.0%	10.6	3.5
			28.9	9.5	35	66.0%	7.3	2.4
			28.9	9.5	1,000	15.0%	1.7	0.5
		Broadleaf/ forage plants, and small insects	35.4	11.8	15	95.0%	12.9	4.3
			35.4	11.8	35	66.0%	9.0	3.0
			35.4	11.8	1,000	15.0%	2.0	0.7

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Crop/ Formulation	Maximum Single Application	Food Items	EEC Predicted Maximum Residue(ppm)	EEC Predicted Mean Residue (ppm)	Body Wt (grams)	% Body Wt Consumed	Acute RQ	Mean Acute RQ
		Fruits, pods, seeds, and large insects	3.9	1.8	15	95.0%	1.4	0.7
			3.9	1.8	35	66.0%	1.0	0.5
			3.9	1.8	1,000	15.0%	0.2	0.1

> means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.
Peanuts: The first and second sets of values represent 36-inch, single-row, and 72-inch, double-row bed spacing, respectively.

For fenamiphos sulfone resulting from a *single* in-furrow application of fenamiphos as the end-use formulation, Nemacur 3, the mammalian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded on grapes, tobacco, raspberry, kiwi fruit, peanuts, stone fruits, and apple. LOC exceedances are indicated by shaded areas.

Citrus **Maximum Single Application**

Table 48: From a Single Applications of Nemacur 15G and 3EC, the Mammalian (Herbivore/Insectivore) Acute Risk Quotients for Fenamiphos Sulfone based on a Rat Acute Oral LD_{50} of 2.6 mg/kg for Fenamiphos Sulfone.

Crop/ Formu-lation	Maximum Single Appl. Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)	Body Wt (gm)	%Body Wt Con-sumed	Acute RQ	Mean Acute RQ
Citrus (Certain FL Coun-ties) Nema-cur 3EC	5.0	Short grass	42.0	14.9	15	95.0%	15.3	5.4
			42.0	14.9	35	66.0%	10.7	3.8
			42.0	14.9	1,000	15.0%	2.4	0.9
		Tall grass	19.3	6.3	15	95.0%	7.0	2.3
			19.3	6.3	35	66.0%	4.9	1.6
			19.3	6.3	1,000	15.0%	1.1	0.4
		Broadleaf/ forage plants, & small insects	23.6	7.9	15	95.0%	8.6	2.9
			23.6	7.9	35	66.0%	6.0	2.0
			23.6	7.9	1,000	15.0%	1.4	0.5
		Fruits, pods, seeds, & large insects	2.6	1.2	15	95.0%	1.0	0.4
			2.6	1.2	35	66.0%	0.7	0.3
			2.6	1.2	1,000	15.0%	0.2	0.1
Citrus (except FL except Kum-quat, Tangelo , and Citrus Hybrids in CA) Nemcur 3EC	7.5	Short grass	63.0	22.3	15	95.0%	23.0	8.2
			63.0	22.3	35	66.0%	16.0	5.7
			63.0	22.3	1,000	15.0%	3.6	1.3
		Tall grass	28.9	9.5	15	95.0%	10.6	3.5
			28.9	9.5	35	66.0%	7.3	2.4
			28.9	9.5	1,000	15.0%	1.7	0.5
		Broadleaf/ forage plants, & small insects	35.4	11.8	15	95.0%	12.9	4.3
			35.4	11.8	35	66.0%	9.0	3.0
			35.4	11.8	1,000	15.0%	2.0	0.7
		Fruits, pods, seeds, & large insects	3.9	1.8	15	95.0%	1.4	0.7
			3.9	1.8	35	66.0%	1.0	0.5
			3.9	1.8	1,000	15.0%	0.2	0.1

> means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.

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The results in the table above indicate that fenamiphos sulfone resulting from *single* tree-row banded applications of fenamiphos as the end-use formulation, Nemacur 3, the mammalian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded on citrus. LOC exceedances are indicated by shaded areas.

Strawberries **Maximum Single Application**

Table 49: From a Single Applications of Nemacur 3EC, the Mammalian (Herbivore/Insectivore) Acute Risk Quotients for Fenamiphos Sulfone based on a Rat Acute Oral LD_{50} of 2.6 mg/kg for Fenamiphos Sulfone.

Crop/ Formulation	Maximum Single Appl. Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)	Body Weight (grams)	% Body Weight Consumed	Acute RQ	Mean Acute RQ
Strawberries Nemacur 3EC & Nemacur 15G	4.5	Short grass	37.8	13.4	15	95.0%	13.8	4.9
			37.8	13.4	35	66.0%	9.6	3.4
			37.8	13.4	1,000	15.0%	2.2	0.8
		Tall grass	17.3	5.7	15	95.0%	6.3	2.1
			17.3	5.7	35	66.0%	4.4	1.4
			17.3	5.7	1,000	15.0%	1.0	0.3
		Broadleaf/ forage plants, and small insects	21.3	7.1	15	95.0%	7.8	2.6
			21.3	7.1	35	66.0%	5.4	1.8
			21.3	7.1	1,000	15.0%	1.2	0.4
		Fruits, pods, seeds, and large insects	2.4	1.1	15	95.0%	0.9	0.4
			2.4	1.1	35	66.0%	0.6	0.3
			2.4	1.1	1,000	15.0%	0.1	0.1
Asparagus (CT, DE, ME, MA, NH, NJ, NY, PA, and RI only) Eggplant Nemacur 3EC	2.0	Short grass	16.8	6.0	0.0	95.0%	6.1	2.2
			16.8	6.0	35	66.0%	4.3	1.5
			16.8	6.0	1,000	15.0%	1.0	0.3
		Tall grass	7.7	2.5	15	95.0%	2.8	0.9
			7.7	2.5	35	66.0%	2.0	0.6
			7.7	2.5	1,000	15.0%	0.4	0.1
		Broadleaf/forage plants, and small insects	9.5	3.2	15	95.0%	3.5	1.2
			9.5	3.2	35	66.0%	2.4	0.8
			9.5	3.2	1,000	15.0%	0.5	0.2
		Fruits, pods, seeds, and large insects	1.1	0.5	15	95.0%	0.4	1.2
			1.1	0.5	35	66.0%	0.3	0.1
			1.1	0.5	1,000	15.0%	0.1	0.0

> means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.

The results in the table above indicate that fenamiphos sulfone resulting from *single* banded applications of fenamiphos as the end-use formulations, Nemacur 3 and 15G, the mammalian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded on strawberries, asparagus and eggplant. LOC exceedances are indicated by shaded areas.

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Table Beets **Maximum Single Application**

The results in Table 50 indicate that fenamiphos sulfone resulting from *single* banded applications of fenamiphos as the end-use formulation, Nemacur 3, the mammalian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded on table beets.

Table 50: From a Single Applications of Nemacur 3EC, the Mammalian (Herbivore/Insectivore) Acute Risk Quotients for Fenamiphos Sulfone based on a Rat Acute Oral LD_{50} of 2.6 mg/kg for Fenamiphos Sulfone.

Crop/ Formulation	Maximum Single Appl. Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)	Body Weight (grams)	% Body Weight Consumed	Acute RQ	Mean Acute RQ
Table Beets (IL, IN, MI, NY, OH and PA only) Nemacur 3EC	3.1	Short grass	26.0	9.2	15	95.0%	9.5	3.4
			26.0	9.2	35	66.0%	6.6	2.3
			26.0	9.2	1,000	15.0%	1.5	0.5
		Tall grass	>341.0	3.9	15	95.0%	124.6	1.4
			>341.0	3.9	35	66.0%	86.6	1.0
			>341.0	3.9	1,000	15.0%	19.7	0.2
		Broadleaf/forage plants, and small insects	418.5	4.9	15	95.0%	152.9	1.8
			418.5	4.9	35	66.0%	106.2	1.2
			418.5	4.9	1,000	15.0%	24.1	0.3
		Fruits, pods, seeds, and large insects	46.5	0.8	15	95.0%	17.0	0.3
			46.5	0.8	35	66.0%	11.8	0.2
			46.5	0.8	1,000	15.0%	2.7	0.0

>means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.

Fenamiphos sulfoxide. Fenamiphos sulfoxide was determined to be very highly toxic to mammals on an acute oral basis (LD_{50} = 3.7 mg/kg). Calculated using the following equations, acute and mean acute risk values for fenamiphos sulfone are indicated in the shaded areas of Table 51 on the next page.

$$\text{Acute RQ} = \frac{\text{Maximum EEC (mg/kg)}}{LD_{50}\text{ (mg/kg)/ \% Body Weight Consumed}} \qquad \text{Mean Acute RQ} = \frac{\text{Mean EEC (mg/kg)}}{LD_{50}\text{ (mg/kg)/ \% Body Weight Consumed}}$$

To more accurately represent the amount consumed by wild mammals, half the lethal dose (LD_{50}) is first divided by the percent of body weight typically consumed by small mammals weighing 15, 35 and 1,000 grams. Maximum and mean EEC values of fenamiphos sulfoxide presume a 51.4 percent conversion of parent fenamiphos to fenamiphos sulfoxide.

Cotton **Maximum Single Application**

For fenamiphos sulfoxide resulting from a *single* in-furrow application of fenamiphos as the end-use formulation, Nemacur 3, the mammalian acute high, restricted use, and endangered species

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levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded on cotton. LOC exceedances are indicated by shaded areas in Table 51.

Table 51: From a Single Application of Nemacur 3EC, the Mammalian (Herbivore/Insectivore) Acute Risk Quotients for Fenamiphos Sulfoxide based on a Rat Acute Oral LD_{50} of 3.7 mg/kg for Fenamiphos Sulfoxide.

Crop/ Formu-lation	Max Single Appl. Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (mg/kg)	EEC Predicted Mean Residue (mg/kg)	Body Weight (grams)	% Body Weight Consumed	Acute RQ	Mean Acute RQ
Cotton Nemacur 3EC	3.0	Short grass	370.1	131.1	15	95.0%	95.0	33.7
			370.1	131.1	35	66.0%	66.0	23.4
			370.1	131.1	1,000	15.0%	15.0	5.3
		Tall grass	169.6	55.5	15	95.0%	43.6	14.3
			169.6	55.5	35	66.0%	30.3	9.9
			169.6	55.5	1,000	15.0%	6.9	2.3
		Broadleaf/forage plants, & small insects	208.2	69.4	15	95.0%	53.4	17.8
			208.2	69.4	35	66.0%	37.1	12.4
			208.2	69.4	1,000	15.0%	8.4	2.8
		Fruits, pods, seeds, & large insects	23.1	10.8	15	95.0%	5.9	2.8
			23.1	10.8	35	66.0%	4.1	1.9
			23.1	10.8	1,000	15.0%	0.9	0.4

> means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.

Grapes, Tobacco, Kiwi Fruit and Raspberries **Maximum Single Application**

Table 52: From a Single Application of Nemacur 3EC, the Mammalian (Herbivore/Insectivore) Acute Risk Quotients for Fenamiphos Sulfoxide based on a Rat Acute Oral LD_{50} of 3.7 mg/kg for Fenamiphos Sulfoxide.

Crop/ Formu-lation	Max Single Application Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)	Body Weight (grams)	% Body Weight Con-sumed	Acute RQ	Mean Acute RQ
Grapes, Tobacco, Kiwi Fruit, and Raspberry Nemacur 3EC	6.0	Short grass	740.2	262.1	15	95.0%	190.0	67.3
			740.2	262.1	35	66.0%	132.0	46.8
			740.2	262.1	1,000	15.0%	30.0	10.6
		Tall grass	339.2	111.0	15	95.0%	87.1	28.5
			339.2	111.0	35	66.0%	60.5	19.8
			339.2	111.0	1,000	15.0%	13.8	4.5
		Broadleaf/ forage plants, & small insects	416.3	138.8	15	95.0%	106.9	35.6
			416.3	138.8	35	66.0%	74.3	24.8
			416.3	138.8	1,000	15.0%	16.9	5.6
		Fruits, pods, seeds, and large insects	46.3	21.6	15	95.0%	11.9	5.5
			46.3	21.6	35	66.0%	8.3	3.9
			46.3	21.6	1,000	15.0%	1.9	0.9

> means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.

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For fenamiphos sulfoxide resulting from a *single* in-furrow or banded applications of fenamiphos as the end-use formulation, Nemacur 3, the mammalian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded on grapes, tobacco, kiwi fruit and raspberries. LOC exceedances are indicated by shaded areas.

Peanuts **Maximum Single Application**

For fenamiphos sulfoxide resulting from *single* banded applications of fenamiphos as the end-use formulation, Nemacur 15G, the mammalian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded on peanuts. LOC exceedances are indicated by shaded areas .

Table 53: From a Single Application of Nemacur 15G, the Mammalian (Herbivore/Insectivore) Acute Risk Quotients for Fenamiphos Sulfoxide based on a Rat Acute Oral LD_{50} of 3.7 mg/kg for Fenamiphos Sulfoxide.

Crop/ Formulation	Maximum Single Application Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)	Body Weight (grams)	% Body Weight Consumed	Acute RQ	Mean Acute RQ
Peanuts Nemacur 3EC	2.5	Short grass	624.0	221.0	15	95.0%	160.2	56.7
			624.0	221.0	35	66.0%	111.3	39.4
			624.0	221.0	1,000	15.0%	25.3	9.0
		Tall grass	>286	>93.6	15	95.0%	73.4	24.0
			>286	>93.6	35	66.0%	51.0	16.7
			>286	>93.6	1,000	15.0%	11.6	3.8
		Broadleaf/forage plants, and small insects	351.0	117.0	15	95.0%	90.1	30.0
			351.0	117.0	35	66.0%	62.6	20.9
			351.0	117.0	1,000	15.0%	14.2	4.7
		Fruits, pods, seeds, and large insects	39.0	18.2	15	95.0%	10.0	4.7
			39.0	18.2	35	66.0%	7.0	3.2
			39.0	18.2	1,000	15.0%	1.6	0.7

>means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.
Peanuts: The first and second sets of values represent 36-inch, single-row, and 72-inch, double-row bed spacing, respectively.

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Stone Fruits and Apples Maximum Single Application

Table 54: From a Single Application of Nemacur 3EC, the Mammalian (Herbivore/Insectivore) Acute Risk Quotients for Fenamiphos Sulfoxide based on a Rat Acute Oral LD_{50} of 3.7 mg/kg for Fenamiphos Sulfoxide.

Crop/ Formulation	Maximum Single Application	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)	Body Weight (grams)	% Body Wt Consumed	Acute RQ	Mean Acute RQ
Stone Fruits (peaches, cherries and nectarines) Apple Nemacur 3EC	7.5	Short grass	>1800.0	>637.5	15	95.0%	>462.2	>163.7
			>1800.0	>637.5	35	66.0%	>321.1	>113.7
			>1800.0	>637.5	1,000	15.0%	>73.0	>25.8
		Tall grass	>825.0	>270.0	15	95.0%	>211.8	>69.3
			>825.0	>270.0	35	66.0%	>147.2	>48.2
			>825.0	>270.0	1,000	15.0%	>33.4	>10.9
		Broadleaf/ forage plants, and small insects	>1012.5	>337.5	15	95.0%	>260.0	>86.7
			>1012.5	>337.5	35	66.0%	>180.6	>60.2
			>1012.5	>337.5	1,000	15.0%	>41.0	>13.7
		Fruits, pods, seeds, and large insects	112.5	52.5	15	95.0%	28.9	13.5
			112.5	52.5	35	66.0%	20.1	9.4
			112.5	52.5	1,000	15.0%	4.6	2.1

> means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.

For fenamiphos sulfoxide resulting from *single* tree-row banded applications of fenamiphos as the end-use formulation, Nemacur 3, the mammalian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded on stone fruits and apples. LOC exceedances are indicated by shaded areas.

Citrus Maximum Single Application

The results in the following table indicate that fenamiphos sulfoxide resulting from *single* tree-row banded applications of fenamiphos as the end-use formulations, Nemacur 3 and 15G, the mammalian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded on citrus. LOC exceedances are indicated by shaded areas in Table 55.

Table 55: From a Single Applications of Nemacur 15G and 3EC, the Mammalian (Herbivore/Insectivore) Acute Risk Quotients for Fenamiphos Sulfoxide based on a Rat Acute Oral LD_{50} of 3.7 mg/kg for Fenamiphos Sulfoxide.

Crop/ Formulation	Maximum Single Applic (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)	Body Wt (gm)	%Body Wt Consumed	Acute RQ	Mean Acute RQ
Citrus (Certain FL Coun -ties) Nemacur 3EC	5.0	Short grass	616.8	218.5	15	95.0%	158.4	56.1
			616.8	218.5	35	66.0%	110.0	39.0
			616.8	218.5	1,000	15.0%	25.0	8.9
		Tall grass	282.7	92.5	15	95.0%	72.6	23.8
			282.7	92.5	35	66.0%	50.4	16.5
			282.7	92.5	1,000	15.0%	11.5	3.8
		Broadleaf/ forage plants, & small insects	347.0	115.7	15	95.0%	89.1	29.7
			347.0	115.7	35	66.0%	61.9	20.6

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Crop/ Formulation	Maximum Single Appl.Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)	Body Wt (gm)	%Body Wt Consumed	Acute RQ	Mean Acute RQ
			347.0	115.7	1,000	15.0%	14.1	4.7
		Fruits, pods, seeds, & large insects	38.6	18.0	15	95.0%	9.9	4.6
			38.6	18.0	35	66.0%	6.9	3.2
			38.6	18.0	1,000	15.0%	1.6	0.7
Citrus (except FL except Kum-quat, Tangelo, and Citrus Hybrids in CA) Nemcur 3EC	7.5	Short grass	925.2	327.7	15	95.0%	237.6	84.1
			925.2	327.7	35	66.0%	165.0	58.5
			925.2	327.7	1,000	15.0%	37.5	13.3
		Tall grass	424.1	138.8	15	95.0%	108.9	35.6
			424.1	138.8	35	66.0%	75.6	24.8
			424.1	138.8	1,000	15.0%	17.2	5.6
		Broadleaf/ forage plants, & small insects	520.4	173.5	15	95.0%	133.6	44.5
			520.4	173.5	35	66.0%	92.8	30.9
			520.4	173.5	1,000	15.0%	21.1	7.0
		Fruits, pods, seeds, & large insects	57.8	27.0	15	95.0%	14.8	6.9
			57.8	27.0	35	66.0%	10.3	4.8
			57.8	27.0	1,000	15.0%	2.3	1.1

> means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.

Strawberries, Asparagus and Eggplant **Maximum Single Application**

The results in Table 56 indicate that fenamiphos sulfoxide resulting from *single* banded applications of fenamiphos as the end-use formulation, Nemacur 3, the mammalian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded on strawberries, asparagus and eggplant. LOC exceedances are indicated by shaded areas.

Table 56: From a Single Applications of Nemacur 3EC, the Mammalian (Herbivore/Insectivore) Acute Risk Quotients for Fenamiphos Sulfoxide, based on a Rat Acute Oral LD_{50} of 3.7 mg/kg for Fenamiphos Sulfoxide.

Crop/ Formulation	Maximum Single Appl. Rate(lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)	Body Wt (grams)	% Body Wt Consumed	Acute RQ	Mean Acute RQ
Straw-berries Nemacur 3EC	4.5	Short grass	555.1	382.5	15	95.0%	142.5	98.2
			555.1	196.6	35	66.0%	99.0	35.1
			555.1	196.6	1,000	15.0%	22.5	8.0
		Tall grass	254.4	83.3	15	95.0%	65.3	21.4
			254.4	83.3	35	66.0%	45.4	14.9
			254.4	83.3	1,000	15.0%	10.3	3.4
		Broadleaf//forage plants, and small insects	312.3	104.1	15	95.0%	80.2	26.7
			312.3	104.1	35	66.0%	55.7	18.6
			312.3	104.1	1,000	15.0%	12.7	4.2
		Fruits, pods, seeds, and large insects	34.7	16.2	15	95.0%	8.9	4.2
			34.7	16.2	35	66.0%	6.2	2.9
			34.7	16.2	1,000	15.0%	1.4	0.7

Crop/ Formulation	Maximum Single Appl. Rate(lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)	Body Wt (grams)	% Body Wt Consumed	Acute RQ	Mean Acute RQ
Asparagus (CT, DE, ME, MA, NH, NJ, NY, PA, and RI only) Eggplant Nemacur 3EC	4.5	Short grass	555.1	196.6	0.0	95.0%	142.5	50.5
			246.7	87.4	35	66.0%	44.0	15.6
			246.7	87.4	1,000	15.0%	10.0	3.5
		Tall grass	254.4	83.3	15	95.0%	65.3	21.4
			113.1	37.0	35	66.0%	20.2	6.6
			113.1	37.0	1,000	15.0%	4.6	1.5
		Broadleaf/ forage plants, and small insects	312.3	104.1	15	95.0%	80.2	26.7
			138.8	46.3	35	66.0%	24.8	8.3
			138.8	46.3	1,000	15.0%	5.6	1.9
		Fruits, pods, seeds, and large insects	34.7	7.2	15	95.0%	8.9	1.8
			15.4	7.2	35	66.0%	2.7	1.3
			15.4	7.2	1,000	15.0%	0.6	0.3

> means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.

Pineapples, Table Beets and Turf Maximum Single Application

The results in Table 57 indicate that fenamiphos sulfoxide resulting from *single* broadcast applications of fenamiphos as the end-use formulation, Nemacur 3, the mammalian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded on pineapples.

Table 57: From a Single Applications of Nemacur 3EC, the Mammalian (Herbivore/Insectivore) Acute Risk Quotients for Fenamiphos Sulfoxide based on a Rat Acute Oral LD_{50} of 3.7/kg for Fenamiphos Sulfoxide.

Crop/ Formulation	Maximum Single Appl. Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)	Body Weight (grams)	% Body Weight Consumed	Acute RQ	Mean Acute RQ
Pineapple Nemacur 3EC	9.0	Short grass	1110.2	393.2	15	95.0%	285.1	101.0
			1110.2	393.2	35	66.0%	198.0	70.1
			1110.2	393.2	1,000	15.0%	45.0	15.9
		Tall grass	508.9	166.5	15	95.0%	130.7	42.8
			508.9	166.5	35	66.0%	90.8	29.7
			508.9	166.5	1,000	15.0%	20.6	6.8
		Broadleaf/ forage plants, and small insects	624.5	208.2	15	95.0%	160.3	53.4
			624.5	208.2	35	66.0%	111.4	37.1
			624.5	208.2	1,000	15.0%	25.3	8.4
		Fruits, pods, seeds, and large insects	69.4	32.4	15	95.0%	17.8	8.3
			69.4	32.4	35	66.0%	12.4	5.8
			69.4	32.4	1,000	15.0%	2.8	1.3
Table Beets (IL, IN, MI, NY, OH and PA only) Nemacur 3EC	3.1	Short grass	382.4	135.4	15	95.0%	98.2	34.8
			382.4	135.4	35	66.0%	68.2	24.2
			382.4	135.4	1,000	15.0%	15.5	5.5
		Tall grass	175.3	57.4	15	95.0%	45.0	14.7
			175.3	57.4	35	66.0%	31.3	10.2

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Crop/ Formulation	Maximum Single Appl. Rate (lb ai/acre)	Food Items	EEC Predicted Maximum Residue (ppm)	EEC Predicted Mean Residue (ppm)	Body Weight (grams)	% Body Weight Consumed	Acute RQ	Mean Acute RQ
			175.3	57.4	1,000	15.0%	7.1	2.3
		Broadleaf/forage plants, and small insects	215.1	71.7	15	95.0%	55.2	18.4
			215.1	71.7	35	66.0%	38.4	12.8
			215.1	71.7	1,000	15.0%	8.7	2.9
		Fruits, pods, seeds, and large insects	23.9	11.2	15	95.0%	6.1	2.9
			23.9	11.2	35	66.0%	4.3	2.0
			23.9	11.2	1,000	15.0%	1.0	0.5
Turf Nemacur 3EC	9.9	Short grass	1221.3	432.5	15	95.0%	313.6	111.1
			1221.3	432.5	35	66.0%	217.8	77.2
			1221.3	432.5	1,000	15.0%	49.5	17.5
		Tall grass	559.7	432.5	15	95.0%	143.7	111.1
			559.7	432.5	35	66.0%	99.8	77.2
			559.7	432.5	1,000	15.0%	22.7	17.5
		Broadleaf/forage plants, and small insects	687.0	229.0	15	95.0%	176.4	58.8
			215.1	71.7	35	66.0%	38.4	12.8
			215.1	71.7	1,000	15.0%	8.7	2.9
		Fruits, pods, seeds, and large insects	76.3	35.6	15	95.0%	19.6	9.1
			23.9	0.0	35	66.0%	0.7	2.0
			23.9	11.2	1,000	15.0%	1.0	0.5

>means tall grass, short grass, and forage plants exceeded Hoerger-Kenaga values at application rates greater than 2.5, 6.0, and 4.0 lb ai/acre, respectively.

For table beets, the results indicate that fenamiphos sulfoxide resulting from *single* banded applications of fenamiphos as the end-use formulation, Nemacur 3, the mammalian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded on table beets.

For turf, the results indicate that fenamiphos sulfoxide resulting from *single* broadcast applications of fenamiphos as the end-use formulation, Nemacur 3, the mammalian acute high, restricted use, and endangered species levels of concern (0.5, 0.2, and 0.1, respectively) are exceeded.

LOC exceedances are indicated by shaded areas in Table 57.

(3) Beneficial Insects

Risks to Beneficial Insects from Fenamiphos Residues. Fenamiphos is a systemic nematicide; after application it is readily absorbed by plant roots and translocated throughout the target plant. Honey bees and other beneficial insects may have a greater potential for extended exposures via the nectar and pollen of blooming plants growing in and around the treated area. Parent fenamiphos is highly toxic to honey bees (LD_{50}= 1.87 μg). Since 1981, EPA has received reports of honey bee kills from fenamiphos use.

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According to Pollinator Protection, a Bee and Pesticide Handbook, the safest times to soil apply pesticide (and immediate soil incorporate) to avoid exposing honey bees is between dusk to midnight. Cotton, however, is the exception. The cotton bloom attracts foraging bees throughout the day. Hence, fields of pesticide-treated cotton provide greater opportunity for bee poisonings than other crop sites. For most crops, however, bees prefer to forage during set times of the day--typically, between dawn and midmorning.

EFED has requested pollen, nectar and plant residue data on specific crops to help determine more precisely the risks to beneficial insects from the systemic effects of fenamiphos. In the interim, mitigation measures to reduce honey bee exposure to potential residues is recommended. In addition, any measures taken to reduce drift of Nemacur 3 and/or runoff of Nemacur 3, 15G, and 10G from the treated sites to surrounding beneficial insect habitat areas will also reduce the number of wild honey bee poisonings. [30]

b. Exposure and Risks to Nontarget Freshwater Animals

The environmental concentrations listed in the following tables associated with the exposure and risk to nontarget aquatic animals were derived from Tier I GENEEC or Tier II PRZM/EXAMS modelling. Please refer Table 5 for these concentrations.

(1) Freshwater Fish

The LC_{50} of 9.5 ppb of the most sensitive species, Bluegill Sunfish, was used to derive the acute RQ values. The NOEC of 3.8 ppb from a single fish early-life stage toxicity test was used to derive the chronic RQ values.

Cotton, Grapes, Peanuts, Stone Fruits & Tobacco Applications **Tier II PRZM/EXAMS** **Maximum Single**

The environmental concentrations listed in Table 58 below are values derived from Tier II PRZM/EXAMS modelling on the following large acreage crops: cotton, grapes, peanuts, stone fruits, and tobacco. Acute and mean EECs are used in the calculation of acute and chronic risk quotients.

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30 C.A. Johansen and D. A. Mayer, A Bee and Pesticide Handbook, p. 14, Wicwas Press, Cheshire, Connecticut, 1990.

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Table 58: Acute and Chronic Risk Quotients for Freshwater Fish (& Amphibians) for Single Applications of Nemacur 3EC or 15G Based on a Bluegill Sunfish LC_{50} of 9.5 ppb and Rainbow Trout NOEC of 3.8 ppb.

Crop/Formulation	Max Single Application Rate (lb ai/acre)	Max Seasonal Application Rate (lb ai/acre)	Acute Concen-tration (ppb)	Day-60 Con-centration (ppb)	Acute RQ (Acute EEC/LC_{50})		Chronic RQ (Day-60 EEC/NOEC)	
Cotton/Nemacur 3EC	3.0	Not Always Specified But Assumed 3.0	112.0	62.4	11.8		16.4	
Grapes/Nemacur 3EC	6.0	6.0	6.5	3.6	0.7		0.9	
Peanuts/ Nemacur 15G	2.6, 1.2	Not Specified But Assumed 2.6	12.4, 6	6.1, 2.9	1.3	0.6	1.6	0.8
Stone Fruits (peaches, cherries & nectarines) /Nemacur 3EC	7.5	7.5	18.2	10.6	1.9		2.8	
Tobacco/Nemacur 3EC	6.0	Not Specified But Assumed 6.0	60.7	31.4	6.4		8.3	

Peanuts: The first and seconde sets of values represent 36-inch, single-row, and 72-inch, double-row bed spacing, respectively.

The results in the table above indicate that for maximum *single* in-furrow applications on cotton, in-furrow or banded applications on grapes, banded applications on peanuts and stone fruits, and broadcast applications on tobacco of fenamiphos as the end-use formulation, Nemacur 3, the aquatic animal acute high risk, restricted use, and endangered species levels of concern (0.5, 0.1 and 0.05, respectively) are exceeded. The results also reveal that the aquatic animal chronic levels of concern (1.0) are exceeded at the registered maximum single application rates listed in the table above, with the exception of the 6.0 lb ai/acre application rate on grapes and the 1.2 lb ai/acre application rate on peanuts representing 72-inch, double-row bed spacing. LOC exceedances are indicated by shaded areas. Acute and chronic RQ's range from 0.6 to 11.8 and from 0.8 to 29.5, respectively.

The environmental concentrations listed in Tables 59 through 63 were derived from Tier I GENEEC, a screening model designed to estimate surface-water concentrations to use in ecological risk assessments. As such, it provides upper-bound concentrations that might be found in ecologically sensitive environments because of the use of a pesticide. GENEEC is a single runoff event model that can account for spray drift from multiple applications.

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Turf, Citrus, Apple, Kiwi Fruit, Pineapples, Raspberries, & Strawberries **Tier I GENEEC** **Maximum Single/Multiple Applications**

Table 59: Acute and Chronic Risk Quotients for Freshwater Fish (& Amphibians) for Single/Multiple Applications of Nemacur 3EC, 10G, or 15G Based on a Bluegill Sunfish LC_{50} of 9.5 ppb and Rainbow Trout NOEC of 3.8 ppb.

Crop/ Formulation	Maximum Single Application Rate (lb ai/acre)	Maximum Seasonal Application Rate (lb ai/acre)	Acute Concentration (ppb)	Day-60 Concentration (ppb)	Acute RQ (Acute EEC/ LC_{50})	Chronic RQ (Day-60 EEC/ NOEC
Turf/ Nemacur 10G & 3EC	10.0	20.0	651.0	329.0	68.5	86.6
Citrus (except Florida, except Kumquat, Tangelo, and Citrus Hybrids)/Nemacur 3EC	7.5	10.0	105.4	53.0	11.1	13.9
Citrus (in California, except Kumquat, Tangelo, and Citrus Hybrids)/Nemacur 15G	10.0	10.0	105.4	53.0	11.1	13.9
Citrus, Certain Counties in Florida/Nemacur 3EC	5.0	10.0	105.4	53.0	11.1	13.9
Apple/Nemacur 3EC	7.5	7.5	105.4	53.0	11.1	13.9
Kiwi Fruit (California only)/ Nemacur 3EC	6.0	6.0	116.5	57.0	12.3	15.0
Pineapple/Nemacur 3EC	9.0	24.0	370.0	188.0	38.9	49.5
Raspberries/Nemacur 3EC	6.0	6.0	86.4	43.6	9.1	11.5
Strawberries/Nemacur 3EC & 15G	4.5	7.0	64.2	33.2	6.8	8.7

The results in Table 59 indicate that for maximum *single/multiple* broadcast applications on turf and kiwi fruit, and banded applications on citrus, apple, pineapple, raspberries and strawberries of fenamiphos as the end-use formulations, Nemacur 3, 10G or 15G, the aquatic animal acute high risk, restricted use, and endangered species levels of concern (0.5, 0.1 and 0.05, respectively) are exceeded. The results also reveal that the aquatic animal chronic levels of concern (1.0) are exceeded at the registered maximum single application rates. LOC exceedances are indicated by shaded areas. Acute and chronic RQ's range from 6.8 to 68.5 and from 8.7 to 86.6, respectively.

The results in Table 60 indicate that the aquatic animal acute high risk, restricted use, and endangered species levels of concern (0.5, 0.1 and 0.05, respectively) are exceeded for maximum *single/multiple* banded applications on asparagus, eggplant, table beets, bok choy, cabbage, brussel sprouts, okra, and non-bell peppers. These LOC's are also exceeded for in-furrow applications on Iris, Lily, and Narcissus Bulbs; garlic; bananas and plantains; and for broadcast applications on Leatherleaf Fern, Protea, Anthurium, and nursery stock. The results also reveal that the aquatic animal chronic levels of concern (1.0) are exceeded at the registered maximum single application rates. LOC exceedances are indicated by shaded areas. Acute and chronic RQ's range from 4.0 to 63.9 and from 4.9 to 80.8, respectively.

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Maximum Single/Multiple Applications **Tier I GENEEC**

Asparagus; Eggplant; Table Beets; Iris, Lily, and Narcissus Bulbs; Leatherleaf Fern; Protea; Anthurium; Nursery Stock; Bok Choy; Cabbage; Brussel Sprouts; Garlic; Okra; Non-bell Peppers; Bananas and Plantains

Table 60: Acute and Chronic Risk Quotients for Freshwater Fish (& Amphibians) for Single/Multiple Applications of Nemacur 3EC, 10G or 15G Based on a Bluegill Sunfish LC_{50} of 9.5 ppb and Rainbow Trout NOEC of 3.8 ppb.

Crop/Formulation	Maximum Single Application Rate (lb ai/acre)	Maximum Seasonal Application Rate (lb ai/acre)	Acute Concentration (ppb)	Day-60 Concentration (ppb)	Acute RQ (Acute EEC/LC_{50})	Chronic RQ (Day-60 EEC/NOEC)
Asparagus (CT, DE, ME, MD, MA, NH, NJ, NY, PA, and RI only)/Nemacur 3EC	2.0	2.0	74.3	37.1	7.8	9.8
Eggplant/3EC &15G	2.0	Not Specified But Assumed 2.0	38.4	18.8	4.0	4.9
Table Beets (IL, IN, MI, NY, OH and PA only)/Nemacur 3EC	3.1	Not Specified But Assumed 3.1	87.3	43.9	9.2	11.6
Iris, Lily & Narcissus bulbs/ Nemacur 10G	10.5	Not Specified But Assumed 10.5	203.6	99.8	21.4	26.3
Leatherleaf Fern/ Nemacur 10G	10.0	Not Specified But Assumed 10.0	607.0	307.0	63.9	80.8
Protea/Nemacur 10G	9.8	19.5	501.0	252.0	52.7	66.3
Anthurium & Nursery Stock/Nemacur 10G	10.0	20.0	529.0	268.0	55.7	70.5
Cabbage, Brussel Sprouts, Boy Choy & Garlic/Nemacur 15G	4.5	Not Specified But Assumed 4.5	85.8	41.9	9.0	11.0
Okra/Nemacur 15G	2.3	Not Specified But Assumed 2.3	44.3	21.7	4.7	5.7
Non-bell Peppers (CA, GA, and PR only)/ Nemacur 15G	2.0	Not Specified But Assumed 2.0	38.1	18.6	4.0	4.9
Bananas & Plantains (SLN for Puerto Rico only)/Nemacur 15G	6.8	13.6	137.4	67.8	14.5	17.8

Risks from environmental degradates, Fenamiphos Sulfone and Sulfoxide. Based on submitted data, fenamiphos sulfone and sulfoxide are moderately toxic to freshwater fish (LC_{50} = 1,173 and 2,653 ppb, respectively).

Cotton, Grapes, Peanuts, Stone Fruits & Tobacco **Tier II PRZM/EXAMS** **Maximum Single Applications**

The results in the following table indicate that for maximum *single* in-furrow applications on cotton, in-furrow or banded applications on grapes, banded applications on peanuts and stone fruits, and broadcast applications on tobacco, the aquatic animal acute high risk level of concern (0.5) is *not* exceeded for fenamiphos sulfone and sulfoxide. The restricted use and endangered species levels of concern (0.1 and 0.05, respectively) are *only* exceeded for fenamiphos sulfone on cotton and tobacco. LOC exceedances are indicated by shaded areas in Table 61.

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Table 61: Fenamiphos Sulfone and Sulfoxide Acute Risk Quotients for Freshwater Fish (& Amphibians) for Single Applications of Nemacur 3EC or 15G Based on respective Bluegill Sunfish LC_{50}'s of 1,173 and 2,653 ppb.

Crop/ Formulation	Maximum Single Application Rate (lb ai/acre)	Maximum Seasonal Application Rate (lb ai/acre)	Acute Concentration (ppb)	Sulfone Acute RQ (Acute EEC/LC_{50})		Sulfoxide Acute RQ (Acute EEC/ LC_{50})	
Cotton/Nemacur 3EC	3.0	Not Always Specified But Assumed 3.0	112.0	0.1		0.0	
Grapes/Nemacur 3EC	6.0	6.0	6.5	0.0		0.0	
Peanuts/ Nemacur 15G	2.6, 1.2	Not Specified But Assumed 2.6	12.4, 6	0.0	0.0	0.0	0.0
Stone Fruits (peaches, cherries & nectarines) /Nemacur 3EC	7.5	7.5	18.2	0.0		0.0	
Tobacco/Nemacur 3EC	6.0	Not Specified But Assumed 6.0	60.7	0.1		0.0	

Peanuts: The first and second sets of values represent 36-inch, single-row, and 72-inch, double-row bed spacing, respectively.

Turf, Citrus, Apple, Kiwi Fruit, Pineapples, Raspberries, & Strawberries **Tier I GENEEC** **Maximum Single/Multiple Applications**

Table 62: Fenamiphos Sulfone and Sulfoxide Acute Risk Quotients for Freshwater Fish (& Amphibians) for Single/Multiple Applications of Nemacur 3EC, 10G, or 15G Based on Bluegill Sunfish LC_{50}'s of 1,173 and 2,653 ppb.

Crop/ Formulation	Maximum Single Application Rate (lb ai/acre)	Maximum Seasonal Application Rate (lb ai/acre)	Acute Concen-tration (ppb)	Day-60 Concen-tration (ppb)	Sulfone Acute RQ (Acute EEC/LC_{50})	Sulfoxide Acute RQ (Acute EEC/LC_{50})
Turf/Nemacur 10G & 3EC	10.0	20.0	651.0	329.0	0.6	0.2
Citrus (except Florida, except Kumquat, Tangelo, and Citrus Hybrids)/Nemacur 3EC	7.5	10.0	105.4	53.0	0.1	0.0
Citrus (in California, except Kumquat, Tangelo, and Citrus Hybrids)/Nemacur 15G	10.0	10.0	105.4	53.0	0.1	0.0
Citrus, Certain Counties in Florida/Nemacur 3EC	5.0	10.0	105.4	53.0	0.1	0.0
Apple/ Nemacur 3EC	7.5	7.5	105.4	53.0	0.1	0.0
Kiwi Fruit (California only)/ Nemacur 3EC	6.0	6.0	116.5	57.0	0.1	0.0
Pineapple/Nemacur 3EC	9.0	24.0	370.0	188.0	0.3	0.1
Raspberries/Nemacur 3EC	6.0	6.0	86.4	43.6	0.1	0.0
Strawberries/Nemacur 3EC & 15G	4.5	7.0	64.2	33.2	0.1	0.0

The results in the following table indicate that for maximum *single/multiple* broadcast applications on turf and kiwi fruit, and banded applications on citrus, apple, pineapple, raspberries and strawberries of fenamiphos as the end-use formulations, Nemacur 3, 10G or 15G, the aquatic animal acute high risk level of concern (0.5) is exceeded for fenamiphos sulfone and sulfoxide on

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turf; the restricted use and endangered species levels of concern (0.1 and 0.05, respectively) are exceeded for fenamiphos sulfone on all of these crops and for fenamiphos sulfoxide on turf and pineapple. LOC exceedances are indicated by shaded areas. Acute RQ's respectively range from 0.1 to 0.6 and from 0.1 to 0.2.

Maximum Single/Multiple Applications **Tier I GENEEC**

Asparagus; Eggplant; Table Beets; Iris, Lily, and Narcissus Bulbs; Leatherleaf Fern; Protea; Anthurium; Nursery Stock; Bok Choy; Cabbage; Brussel Sprouts; Garlic; Okra; Non-bell Peppers; Bananas and Plantains

Table 63: Fenamiphos Sulfone and Sulfoxide Acute Risk Quotients for Freshwater Fish (& Amphibians) for Single/Multiple Applications of Nemacur 3EC, 10G or 15G Based on a Bluegill Sunfish LC_{50} of 1,173 and 2,653 ppb.

Crop/Formulation	Maximum Single Application Rate(lb ai/acre)	Maximum Seasonal Application Rate (lb ai/acre)	Acute Concen-tration (ppb)	Day-60 Concen-tration (ppb)	Sulfone Acute RQ (Acute EEC/LC_{50})	Sulfoxide Acute RQ (Acute EEC/LC_{50})
Asparagus (CT, DE, ME, MD, MA, NH, NJ, NY, PA, and RI only)/Nemacur 3EC	2.0	2.0	74.3	37.1	0.1	0.0
Eggplant/3EC &15G	2.0	Not Specified But Assumed 2.0	38.4	18.8	0.0	0.0
Table Beets (IL, IN, MI, NY, OH and PA only)/Nemacur 3EC	3.1	Not Specified But Assummed 3.1	87.3	43.9	0.1	0.0
Iris, Lily & Narcissus bulbs/ Nemacur 10G	10.5	Not Specified But Assumed 10.5	203.6	99.8	0.2	0.1
Leatherleaf Fern/Nemacur 10G	10.0	Not Specified But Assumed 10.0	607.0	307.0	0.5	0.2
Protea/Nemacur 10G	9.8	19.5	501.0	252.0	0.4	0.2
Anthurium & Nursery Stock/ Nemacur 10G	10.0	20.0	529.0	268.0	0.5	0.2
Cabbage, Brussel Sprouts, & Garlic, Boy Choy/Nemacur 15G	4.5	Not Specified But Assumed 4.5	85.8	41.9	0.1	0.0
Okra/Nemacur 15G	2.3	Not Specified But Assumed 2.3	44.3	21.7	0.0	0.0
Non-bell Peppers (CA, GA, and PR only)/Nemacur 15G	2.0	Not Specified But Assumed 2.0	38.1	18.6	0.0	0.0
Bananas & Plantains (SLN for Puerto Rico only)/Nemacur 15G	6.8	13.6	137.4	67.8	0.1	0.1

The results in Table 63 indicate that for maximum *single/multiple* banded applications on asparagus, eggplant, table beets, bok choy, cabbage and brussel sprouts, okra, and non-bell peppers ; in-furrow applications on Iris, Lily, and Narcissus Bulbs, garlic, bananas and plantains; and broadcast applications on Leatherleaf Fern, Protea, Anthurium, and nursery stock of fenamiphos as the end-use formulations, Nemacur 3, 10G or 15G, the aquatic animal acute high risk, restricted use, and endangered species levels of concern (0.5, 0.1 and 0.05, respectively) for fenamiphos sulfone and sulfoxide are exceeded. LOC exceedances are indicated by shaded areas. Fenamiphos sulfone acute RQ's range from 0.1 to 0.5. Fenamiphos sulfoxide acute RQ's range from 0.1 to 0.2.

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(2) Freshwater Invertebrates

The LC_{50} of 1.9 ppb of the most sensitive species, *Daphnia magna*, was used to derive the acute RQ values. The NOEC of 0.12 ppb from a *Daphnia magna* life-cycle toxicity test was used to derive the chronic RQ values.

Cotton, Grapes, Peanuts, Stone Fruits & Tobacco **Tier II PRZM/EXAMS** **Maximum Single Applications**

The results in the following table indicate that for maximum *single* in-furrow applications on cotton, in-furrow or banded applications on grapes, banded applications on peanuts and stone fruits, and broadcast applications on tobacco, the aquatic animal acute high risk, restricted use, and endangered species levels of concern (0.5, 0.1 and 0.05, respectively) are exceeded. The results also reveal that the aquatic animal chronic levels of concern (1.0) are exceeded at the registered maximum single application rates listed, with the exception of the chronic value for the 6.0 lb ai/acre application rate on grapes and the 1.2 lb ai/ace application rate on peanuts representing 72-inch, double-row bed spacing. LOC exceedances are indicated by shaded areas. Acute and chronic RQ's range from 3.4 to 58.9 and from 41.7 to 767.5, respectively.

Table 64: Acute and Chronic Risk Quotients for Freshwater Invertebrates for Single Applications of Nemacur 3EC or 15G Based on a *Daphnia magna* LC_{50} and NOEC of 1.9 and 0.12 ppb, respectively.

Crop/Formulation	Maximum Single Application Rate (lb ai/acre)	Maximum Seasonal Application Rate (lb ai/acre)	Acute Concen-tration (ppb)	Day-21 Concen-tration (ppb)	Acute RQ (Acute EEC/LC_{50})	Chronic RQ (Day-21 EEC/NOEC
Cotton/Nemacur 3EC	3.0	Not Always Specified But Assumed 3.0	112.0	92.1	58.9	767.5
Grapes/Nemacur 3EC	6.0	6.0	6.5	5.0	3.4	41.7
Peanuts/ Nemacur 15G	2.6, 1.2	Not Specified But Assumed 2.6	12.4, 6	11.3	6.5	94.2
Stone Fruits (peaches, cherries & nectarines) /Nemacur 3EC	7.5	7.5	18.2	14.8	9.6	123.3
Tobacco/Nemacur 3EC	6.0	Not Specified But Assumed 6.0	60.7	47.8	31.9	398.3

Peanuts: The first and second sets of values represent 36-inch, single-row, and 72-inch, double-row bed spacing, respectively.

Turf, Citrus, Apple, Kiwi Fruit, Pineapple, Raspberries, & Strawberries **Tier I GENEEC** **Maximum Single/Multiple Applications**

The results in the following table indicate that for maximum *single/multiple* broadcast applications on turf and kiwi fruit, and banded applications on citrus, apple, pineapple, raspberries and strawberries of fenamiphos as the end-use formulations, Nemacur 3, 10G or 15G, the aquatic animal acute high risk, restricted use, and endangered species levels of concern (0.5, 0.1 and 0.05, respectively) are exceeded. The results also reveal that the aquatic animal chronic levels of concern (1.0) are exceeded at the registered maximum single application rates. LOC exceedances are indicated by shaded areas. Acute and chronic RQ's range from 33.8 to 342.6 and from 406.7 to 4125.0, respectively.

Table 65: Acute and Chronic Risk Quotients for Freshwater Invertebrates for Single/Multiple Applications of Nemacur 3EC, 10G, or 15G Based on a Daphnia magna LC_{50} and NOEC of 1.9 and 0.12 ppb, respectively.

Crop/ Formulation	Maximum Single Application Rate (lb ai/acre)	Maximum Seasonal Application Rate (lb ai/acre)	Acute Concentration (ppb)	Day-21 Concentration (ppb)	Acute RQ (Acute EEC/LC_{50})	Chronic RQ (Day-21 EEC/ NOEC)
Turf/Nemacur 10G & 3EC	10.0	20.0	651.0	495.0	342.6	4125.0
Citrus (except Florida, except Kumquat, Tangelo, and Citrus Hybrids)/emacur 3EC	7.5	10.0	105.4	80.0	55.5	666.7
Citrus (in California, except Kumquat, Tangelo, and Citrus Hybrids)/Nemacur 15G	10.0	10.0	105.4	80.0	55.5	666.7
Citrus, Certain Counties in Florida/Nemacur 3EC	5.0	10.0	105.4	80.0	55.5	666.7
Apple/ Nemacur 3EC	7.5	7.5	105.4	80.0	55.5	666.7
Kiwi Fruit(California only)/Nemacur 3EC	6.0	6.0	116.5	88.5	61.3	737.5
Pineapple/Nemacur 3EC	9.0	24.0	370.0	282.0	194.7	2350.0
Raspberries/Nemacur 3EC	6.0	6.0	86.4	65.7	45.5	547.5
Strawberries/Nemacur 3EC & 15G	4.5	7.0	64.2	48.8	33.8	406.7

Maximum Single/Multiple Applications **Tier I GENEEC**

Asparagus; Eggplant; Table Beets; Iris, Lily, and Narcissus Bulbs; Leatherleaf Fern; Protea; Anthurium; Nursery Stock; Bok Choy; Cabbage; Brussel Sprouts; Garlic; Okra; Non-bell Peppers; Bananas and Plantains

Table 66: Acute and Chronic Risk Quotients for Freshwater Invertebrate for Single/Multiple Applications of Nemacur 3EC, 10G or 15G Based on a *Daphnia magna* LC_{50} and NOEC of 1.9 and 0.12 ppb, respectively.

Crop/Formulation	Maximum Single Application Rate (lb ai/acre)	Maximum Seasonal Application Rate (lb ai/acre)	Acute Concentration (ppb)	Day-21 Concentration (ppb)	Acute RQ (Acute EEC/LC_{50})	Chronic RQ (Day-21 EEC/ NOEC)
Asparagus (CT, DE, ME, MD, MA, NH, NJ, NY, PA, and RI only)/Nemacur 3EC	2.0	2.0	74.3	56.2	39.1	468.3
Eggplant/3EC &15G	2.0	Not Specified But Assumed 2.0	38.4	28.8	20.2	240.0
Table Beets (IL, IN, MI, NY, OH and PA only)/Nemacur 3EC	3.1	Not Specified But Assumed 3.1	87.3	66.3	45.9	552.5
Iris, Lily & Narcissus bulbs/ Nemacur 10G	10.5	Not Specified But Assumed 2.0	203.6	152.8	107.2	1273.3
Leatherleaf Fern/Nemacur 10G	10.0	Not Specified But Assumed 10.0	607.0	462.0	319.5	3850.0
Protea/Nemacur 10G	9.8	19.5	501.0	380.0	263.7	3166.7
Anthurium & Nursery Stock/ Nemacur 10G	10.0	20.0	529.0	403.0	278.4	3358.3
Cabbage, Brussel Sprouts, Boy Choy & Garlic/Nemacur 15G	4.5	Not Specified But Assumed 4.5	85.8	65.0	45.2	541.7
Okra/Nemacur 15G	2.3	Not Specified But Assumed 2.3	44.3	33.2	23.3	276.7
Non-bell Peppers (CA, GA, and PR only)/ Nemacur 15G	2.0	Not Specified But Assumed 2.0	38.1	28.6	20.1	238.3
Bananas & Plantains (SLN for Puerto Rico only)/Nemacur 15G	6.8	13.6	137.4	103.4	72.3	861.7

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The aquatic animal acute high risks, restricted use, and endangered species levels of concern (0.5, 0.1 and 0.05, respectively) for maximum *single/multiple* banded applications on asparagus, eggplant, table beets, bok choy, cabbage and brussel sprouts, okra, and non-bell peppers; in-furrow applications on Iris, Lily, and Narcissus Bulbs, garlic, bananas and plantains; and broadcast applications on Leatherleaf Fern, Protea, Anthurium, and nursery stockt are exceeded. The results also reveal that the aquatic animal chronic levels of concern (1.0) are exceeded at the registered maximum single application rates. LOC exceedances are indicated by shaded areas in Table 66. Acute and chronic RQ's range from 20.2 to 319.5 and from 240.0 to 3850.0, respectively.

Risks from the environmental degradate, Fenamiphos Sulfoxide. Based on submitted data, fenamiphos sulfoxide is very highly toxic to freshwater invertebrates (LC_{50}= 7.5 ppb).

Cotton, Grapes, Peanuts, Stone Fruits & Tobacco Applications **Tier II PRZM/EXAMS** **Maximum Single**

Table 67: Fenamiphos Sulfoxide Acute Risk Quotients for Freshwater Invertebrates for Single Applications of Nemacur 3EC or 15G Based on a *Daphnia magna* LC_{50} of 7.5 ppb.

Crop/Formulation	Maximum Single Application Rate (lb ai/acre)	Maximum Seasonal Application Rate (lb ai/acre)	Acute Concentration (ppb)	Sulfoxide Acute RQ (Acute EEC/LC_{50})	
Cotton/Nemacur 3EC	3.0	Not Always Specified But Assumed 3.0	112.0	14.9	
Grapes/Nemacur 3EC	6.0	6.0	6.5	0.9	
Peanuts/ Nemacur 15G	2.6, 1.2	Not Specified But Assumed 2.6	12.4, 6	1.7	0.8
Stone Fruits (peaches, cherries & nectarines)/Nemacur 3EC	7.5	7.5	18.2	2.4	
Tobacco/Nemacur 3EC	6.0	Not Specified But Assumed 6.0	60.7	8.1	

Peanuts: The first and second sets of values represent 36-inch, single-row, and 72-inch, double-row bed spacing, respectively.

The results in the above table indicate that for maximum *single* in-furrow applications on cotton, in-furrow or banded applications on grapes, banded applications on peanuts and stone fruits, and broadcast applications on tobacco, the aquatic animal acute high risk, restricted use and endangered species levels of concern (0.1 and 0.05, respectively) are exceeded for fenamiphos sulfone on cotton and tobacco. LOC exceedances are indicated by shaded areas in Table 67. Fenamiphos sulfoxide acute RQ's range from 0.8 to 14.9.

Turf, Citrus, Apple, Kiwi Fruit, Pineapple, Raspberries, & Strawberries **Tier I GENEEC** **Maximum Single/Multiple Applications**

The results in Table 68 indicate that for maximum *single/multiple* broadcast applications on turf and kiwi fruit, and banded applications on citrus, apple, pineapple, raspberries and strawberries, the aquatic animal acute high risk, restricted use, and endangered species levels of concern (0.5, 0.1 and 0.05, respectively) are exceeded. LOC exceedances are indicated by shaded areas. Fenamiphos sulfoxide acute RQ's range from 8.6 to 86.8.

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Table 68: Fenamiphos Sulfoxide Acute Risk Quotients for Freshwater Invertebrates for Single/Multiple Applications of Nemacur 3EC, 10G, or 15G Based on a *Daphnia magna* LC_{50} of 7.5 ppb.

Crop/ Formulation	Maximum Single Application Rate (lb ai/acre)	Maximum Seasonal Application Rate (lb ai/acre)	Acute Concentration (ppb)	Sulfoxide Acute RQ (Acute EEC/LC_{50})
Turf/Nemacur 10G	10.0	20.0	651.0	86.8
Citrus (except Florida, except Kumquat, Tangelo, and Citrus Hybrids)/Nemacur 3EC	7.5	10.0	105.4	14.1
Citrus (in California, except Kumquat, Tangelo, and Citrus Hybrids)/Nemacur 15G	10.0	10.0	105.4	14.1
Citrus, Certain Counties in Florida/Nemacur 3EC	5.0	10.0	105.4	14.1
Apple/ Nemacur 3EC	7.5	7.5	105.4	14.1
Kiwi Fruit(California only)/Nemacur 3EC	6.0	6.0	116.5	15.5
Pineapple/Nemacur 3EC	9.0	24.0	370.0	49.3
Raspberries/Nemacur 3EC	6.0	6.0	86.4	11.5
Strawberries/Nemacur 3EC & 15G	4.5	7.0	64.2	8.6

Maximum Single/Multiple Applications **Tier I GENEEC**

Asparagus; Eggplant; Table Beets; Iris, Lily, and Narcissus Bulbs; Leatherleaf Fern; Protea; Anthurium; Nursery Stock; Bok Choy; Cabbage; Brussel Sprouts; Garlic; Okra; Non-bell Peppers; Bananas and Plantains

Table 69: Fenamiphos Sulfoxide Acute Risk Quotients for Freshwater Invertebrates for Single/Multiple Applications of Nemacur 3EC, 10G or 15G Based on a *Daphnia magna* LC_{50} of 6.2 ppb.

Crop/Formulation	Maximum Single Application Rate (lb ai/acre)/	Maximum Seasonal Application Rate (lb ai/acre)	Acute Concentration (ppb)	Acute RQ (Acute EEC/LC_{50})
Asparagus (CT, DE, ME, MD, MA, NH, NJ, NY, PA, and RI only)/Nemacur 3EC	2.0	2.0	74.3	12.0
Eggplant/3EC &15G	2.0	Not Specified But Assumed 2.0	38.4	6.2
Table Beets (IL, IN, MI, NY, OH and PA only)/Nemacur 3EC	3.1	Not Specified But Assumed 3.1	87.3	14.1
Iris, Lily & Narcissus bulbs/ Nemacur 10G	10.5	Not Specified But Assumed 10.5	203.6	32.8
Leatherleaf Fern/Nemacur 10G	10.0	Not Specified But Assumed 10.0	607.0	97.9
Protea/Nemacur 10G	9.8	19.5	501.0	80.8
Anthurium & Nursery Stock/ Nemacur 10G	10.0	20.0	529.0	85.3
Cabbage, Brussel Sprouts, Bok Choy & Garlic/Nemacur 15G	4.5	Not Specified But Assumed 4.5	85.8	13.8
Okra/Nemacur 15G	2.3	Not Specified But Assumed 2.3	44.3	7.1
Non-bell Peppers (CA, GA, and PR only)/Nemacur 15G	2.0	Not Specified But Assumed 2.0	38.1	6.1
Bananas & Plantains (SLN for Puerto Rico only)/Nemacur 15G	6.8	13.6	137.4	22.2

The aquatic animal acute high risk, restricted use, and endangered species levels of concern (0.5, 0.1 and 0.05, respectively) are exceeded for maximum *single/multiple* banded applications on asparagus,

eggplant, table beets, bok choy, cabbage and brussel sprouts, okra, and non-bell peppers; in-furrow applications on Iris, Lily, and Narcissus Bulbs, garlic, bananas and plantains; and broadcast applications on Leatherleaf Fern, Protea, Anthurium, and nursery stock. LOC exceedances are indicated by shaded areas. Fenamiphos sulfoxide acute RQ's respectively range from 6.1 to 97.9. See Table 69.

c. Exposure and Risks to Nontarget Estuarine and Marine Animals

The LC_{50} of 6.2 ppb of the most sensitive species, Mysid Shrimp, was used to derive the acute RQ values. Chronic data have not been submitted and are required; hence chronic RQ values cannot be determined at this time.

Cotton, Grapes, Peanuts, Stone Fruits & Tobacco **Tier II PRZM/EXAMS** **Maximum Single/MultipleApplications**

The aquatic animal acute high risk, restricted use, and endangered species levels of concern (0.5, 0.1 and 0.05, respectively) are exceeded for maximum *single/multiple* in-furrow applications on cotton, in-furrow or banded applications on grapes, banded applications on peanuts and stone fruits, and broadcast applications on tobacco. LOC exceedances are indicated by shaded areas in Table 70 below. Acute RQ's respectively range from 1.0 to 18.1.

Table 70: Acute Risk Quotients for Estuarine/Marine Animals for Single/Multiple Applications of Nemacur 3EC or 15G Based on a Mysid Shrimp LC_{50} of 6.2 ppb.

Crop/Formulation	Maximum Single Application Rate (lb ai/acre)	Maximum Seasonal Application Rate (lb ai/acre)	Acute Concentration (ppb)	Acute RQ (Acute EEC/LC_{50})	
Cotton/Nemacur 3EC	3.0	Not Always Specified But Assumed 3.0	112.0	18.1	
Grapes/Nemacur 3EC	6.0	6.0	6.5	1.0	
Peanuts/ Nemacur 15G	2.6, 1.2	Not Specified But Assumed 2.6	12.4, 6	2.0	1.0
Stone Fruits (peaches, cherries & nectarines) /Nemacur 3EC	7.5	7.5	18.2	2.9	
Tobacco/Nemacur 3EC	6.0	Not Specified But Assumed 6.0	60.7	9.8	

Peanuts: The first and second sets of values represent 36-inch, single-row, and 72-inch, double-row bed spacing, respectively.

Turf, Citrus, Apple, Kiwi Fruit, Pineapples, Raspberries, & Strawberries **Tier I GENEEC** **Maximum Single/Multiple Applications**

The aquatic animal acute high risk, restricted use, and endangered species levels of concern (0.5, 0.1 and 0.05, respectively) are exceeded for maximum *single/multiple* broadcast applications on turf

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and kiwi fruit, and banded applications on citrus, apple, pineapple, raspberries and strawberries LOC exceedances are indicated by shaded areas. Acute RQ's range from 10.4 to 105.0.

Table 71: Acute Risk Quotients for Estuarine/Marine Animals from Single/Multiple Applications of Nemacur 3EC, 10G, or 15G Based on a Mysid Shrimp LC_{50} of 6.2 ppb.

Crop/ Formulation	Maximum Single Application Rate (lb ai/acre)	Maximum Seasonal Application Rate (lb ai/acre)	Acute Concentration (ppb)	Acute RQ (Acute EEC/LC_{50})
Turf/Nemacur 10G & 3EC	10.0	20.0	651.0	105.0
Citrus (except Florida, except Kumquat, Tangelo, and Citrus Hybrids)/Nemacur 3EC	7.5	10.0	105.4	17.0
Citrus (in California, except Kumquat, Tangelo, and Citrus Hybrids)/Nemacur 15G	10.0	10.0	105.4	17.0
Citrus, Certain Counties in Florida/Nemacur 3EC	5.0	10.0	105.4	17.0
Apple/ Nemacur 3EC	7.5	7.5	105.4	17.0
Kiwi Fruit (California only)/Nemacur 3EC	6.0	6.0	116.5	18.8
Pineapple/Nemacur 3EC	9.0	24.0	370.0	59.7
Raspberries/Nemacur 3EC	6.0	6.0	86.4	13.9
Strawberries/Nemacur 3EC & 15G	4.5	7.0	64.2	10.4

Maximum Single/Multiple Applications **Tier I GENEEC**

Asparagus; Eggplant; Table Beets; Iris, Lily, and Narcissus Bulbs; Leatherleaf Fern; Protea; Anthurium; Nursery Stock; Bok Choy; Cabbage; Brussel Sprouts; Garlic; Okra; Non-bell Peppers; Bananas and Plantains

Table 72: Acute Risk Quotients for Estuarine/Marine Animals from Single/Multiple Applications of Nemacur 3EC, 10G or 15G Based on a Mysid Shrimp LC_{50} of 6.2 ppb.

Crop/Formulation	Maximum Single Application Rate (lb ai/acre)	Maximum Seasonal Application Rate (lb ai/acre)	Acute Concentration (ppb)	Acute RQ (Acute EEC/LC_{50})
Asparagus (CT, DE, ME, MD, MA, NH, NJ, NY, PA, and RI only)/Nemacur 3EC	2.0	2.0	74.3	12.0
Eggplant/3EC &15G	2.0	Not Specified But Assumed 2.0	38.4	6.2
Table Beets (IL, IN, MI, NY, OH and PA only) /Nemacur 3EC	3.1	Not Specified But Assumed 3.1	87.3	14.1
Iris, Lily & Narcissus bulbs/ Nemacur 10G	10.5	Not Specified But Assumed 10.5	203.6	32.8
Leatherleaf Fern/Nemacur 10G	10.0	Not Specified But Assumed 10.0	607.0	97.9
Protea/Nemacur 10G	9.8	19.5	501.0	80.8
Anthurium & Nursery Stock/ Nemacur 10G	10.0	20.0	529.0	85.3
Cabbage, Brussel Sprouts, Boy Choy & Garlic/ Nemacur 15G	4.5	Not Specified But Assumed 4.5	85.8	13.8
Okra/Nemacur 15G	2.3	Not Specified But Assumed 2.3	44.3	7.1
Non-bell Peppers (CA, GA, and PR only)/ Nemacur 15G	2.0	Not Specified But Assumed 2.0	38.1	6.1
Bananas & Plantains (SLN for Puerto Rico only)/Nemacur 15G	6.8	13.6	137.4	22.2

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The aquatic animal acute high risk, restricted use, and endangered species levels of concern (0.5, 0.1 and 0.05, respectively) are exceeded for maximum *single/multiple* banded applications on asparagus, eggplant, table beets, bok choy, cabbage and brussel sprouts, okra, and non-bell peppers; in-furrow applications on Iris, Lily, and Narcissus Bulbs, garlic, bananas and plantains; and broadcast applications on Leatherleaf Fern, Protea, Anthurium, and nursery stock. LOC exceedances are indicated by shaded areas. Acute RQ's range from 6.1 to 97.9.

d. Exposure and Risks to Nontarget Plants

Nemacur labels bear phytoxicity warnings which suggest that fenamiphos is toxic to plants. The potential for acute risks to nonendangered, endangered or threatened terrestrial, semi-aquatic and aquatic plants exposed to fenamiphos at use sites is unknown. EFED is presently requesting plant data to determine its toxicity in order to assess the risks to terrestrial, semi-aquatic and aquatic plants. Currently, EFED does not perform chronic risk assessments for terrestrial and semi-aquatic plants.

e. Exposure and Risks to Endangered Species

At current registered rates and uses, endangered species LOCs are exceeded for all species. The Agency has concerns about the risks posed to endangered aquatic and terrestrial animal species exposed to fenamiphos under current use practices and application methods.

The Agency has developed a program (the "Endangered Species Protection Program") to identify pesticides whose use may cause adverse impacts on endangered and threatened species, and to implement mitigation measures that will eliminate the adverse impacts. At present, the program is being implemented on an interim basis as described in a Federal Register notice (54 FR 27984-28008, July 3, 1989), and is providing information to pesticide users to help them protect these species on a voluntary basis. As currently planned, the final program will call for label modifications referring to required limitations on pesticide uses, typically as depicted in county-specific bulletins or by other site-specific mechanisms as specified by state partners. A final program, which may be altered from the interim program, will be described in a future Federal Register notice. The Agency is not imposing label modifications at this time through the RED. Rather, any requirements for product use modifications will occur in the future under the Endangered Species Protection Program. Currently available county specific information, maps and a downloadable version of the Endangered Species data base can be found on the Internet at the Agency's web site, http://www.epa.gov/ESPP.

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APPENDIX A:

CHEMICAL PROFILE FOR FENAMIPHOS

Common name	fenamiphos, Nemacur
CAS Number	22224-92-6
Chemical name	ethyl 3-methyl-4-(methylthio)phenyl (1-methylethyl)phosphoramidate
Structure	

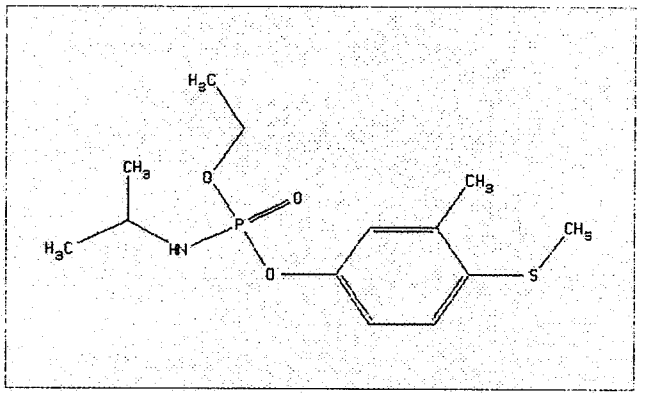

Figure 1. Molecular structure of fenamiphos.

Molecular formula	$C_{13}H_{22}PSNO_3$
Molecular weight	303.36
Henry's Law Constant	1.0×10^{-9} atm.*m3/mol
Vapor pressure	1.3×10^{-6} Torr
Solubility at 20 C	400 mg/L in water soluble in most organic solvents

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APPENDIX B:

SURFACE WATER MODELING INPUT PARAMETERS:

Table 1. Fenamiphos chemistry input parameters for GENEEC.

Parameter	Value
Aerobic Soil Metabolism	4.43 d
Solubility	400 mg L^{-1}
Aqueous Photolysis	0.218 d
Hydrolysis	706 d*
Aerobic Aquatic Metabolism	none available

* This value is in error; the correct value is 300 d. However, this change would not effect the results so the GENEEC EEC's have not been recalculated.

Table 2. Tier 1 EECs for fenamiphos calculated with GENEEC.

Crop	Incorporation Depth	K_{oc}	Peak	4 Day	21 Day	56 Day
	(cm)	L kg^{-1}	ug L^{-1}	ug L^{-1}	ug L^{-1}	ug L^{-1}
Cotton	2	129	84.3	80.8	64.0	42.3
Peanuts	2	129	84.3	80.8	64.0	42.3
Tobacco	5	132	85.2	81.7	64.7	42.8
Apple[b]	2	129	105.4	100.9	80.0	53.0
Cherry[b]	2	129	105.4	100.9	80.0	53.0
Nectarine[b]	2	129	105.4	100.9	80.0	53.0
Peach[b]	2	129	105.4	100.9	80.0	53.0
Grapes[b]	2	129	86.4	82.8	65.7	43.6
Kiwi Fruit	2	129	116.6	111.7	88.5	58.6
Citrus[b]	2	129	105.4	100.9	80.0	53.0
Pineapple[a]	0	106	370	355	282	188
Raspberries[b]	2	119	86.4	82.8	65.7	43.6
Strawberries	2	123	64.2	61.5	48.8	32.3
Asparagus[b]	in furrow	148	74.3	71.1	56.2	37.1
Eggplant	2	134	105.4	100.9	80.0	53.0

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Table 2. Tier 1 EECs for fenamiphos calculated with GENEEC.						
Crop	Incorporation Depth	K_{oc}	Peak	4 Day	21 Day	56 Day
	(cm)	L kg^{-1}	ug L^{-1}	ug L^{-1}	ug L^{-1}	ug L^{-1}
Table beets	2	128	87.3	83.6	66.3	43.9
Iris, Lily & Narcissus bulbs	2	122	139.0	133	105.5	70.0
Leatherleaf Fern	2	113	607	581	462	307
Protea	5	125	501	480	380	252
Anthurium	2	113	529	507	403	268
Nursery Stock	2	113	529	507	403	268
Bok Choy	2	125	107.0	102.4	81.2	53.8
Cabbage[b]	2	129	41.8	40.0	31.7	21.0
Brussels Sprouts[b]	2	129	41.8	40.0	31.7	21.0
Garlic	in furrow	138	51.8	49.6	39.2	25.9
Okra	2	125	107.0	102.4	81.2	53.6
Non-bell Peppers	2	129	105.4	100.9	80.0	53.0
Turf	2	112	651	623	495	329

a watering in with rainfall allowed
b applied to 50% of acreage over each row

Table3. Environmental fate parameters for fenamiphos.		
Fate Parameter	Value	Source
Molecular Mass	303.36 g ·mol^{-1}	EFGWB One-Liner
Aerobic Soil Metabolism Rate Constant	1.56x10^{-1} d^{-1}	Spiteller, 1989b
Anaerobic Soil Metabolism Rate Constant	1.04x10^{-2} d^{-1}	Spiteller, 1989b
K_f, n (adsorption)	2.86, 1.255 (sand) 0.958, 1.034 (sandy loam) 3.457, 1.140 (silt loam) 1.980, 1.110 (clay loam)	Daly, 1988
K_f, n (desorption)	2.612, 1.041 (sand) 0.682, 0.897 (sandy loam) 4.294, 1.111 (silt loam) 1.471, 0.927 (clay loam)	Daly, 1988.
Solubility	400 mg ·L^{-1}	EFGWB One-Liner
Vapor Pressure	9.97 x 10^{-10} torr	EFGWB One-Liner
Hydrolysis Rate Constant at pH 5	2.803 x 10^{-3} L ·(mol-H^{+})$^{-1}$ ·d^{-1}	Mulford, 1987
Hydrolysis Rate Constant at pH 7	2.307 x 10^{-3} d^{-1}	Mulford, 1987
Hydrolysis Rate Constant at pH 9	2.969 x 10^{-3} L ·(mol-OH^{-})$^{-1}$ ·d^{-1}	Mulford, 1987
Aqueous Photolysis Constant	3.173 x10^{-1} d^{-1}	Press *et al.* 1984
Soil Photolysis Constant	5.15 d^{-1}	Hanlon, 1988

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Table 4. PRZM 2.0 input parameters for fenamiphos.	
Input Parameter	Value
Foliar Volatilization (PLVKRT)	0 d^{-1}
Foliar Decay Rate (PLDKRT)	0 d^{-1}
Foliar Washoff Extraction Coefficient (FEXTRC)	0 cm^{-1}
Plant Uptake Fraction (UPTKF)	0
Soil-Water Partition Coefficient (KD)	3.83 L ·kg-soil^{-1} (cotton) 1.486 L ·kg-soil^{-1} (peaches) 3.55 L ·kg-soil^{-1} (grapes) 0.897 L ·kg-soil^{-1}(peanuts) 0.876 L ·kg-soil^{-1} (tobacco)
Dissolved Phase Decay Rate: Photolysis Horizon (DWRATE)	1.769 d^{-1}
Adsorbed Phase Decay Rate: Photolysis Horizon (DSRATE)	1.769 d^{-1}
Dissolved Phase Decay Rate: A Horizon (DWRATE)	5.20×10^{-2} d^{-1}
Adsorbed Phase Decay Rate: A Horizon (DSRATE)	5.20×10^{-2} d^{-1}
Dissolved Phase Decay Rate: Lower Horizons (DWRATE)	2.50×10^{-3} d^{-1}
Adsorbed Phase Decay Rate: Lower Horizons (DSRATE)	2.50×10^{-3} d^{-1}
Vapor Phase Decay Rate (DGRATE) (all horizons)	0 d^{-1}

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APPENDIX C:

ECOLOGICAL INCIDENTS SUMMARY

Ecological Incidents. The number of documented kills in the Ecological Incident Information System is believed to be but a very small fraction of total mortality caused by pesticides. Mortality incidents must be seen, reported, investigated, and have investigation reports submitted to EPA to have the potential to get entered into a data base. Incidents often are not seen, due to scavenger removal of carcasses, decay in a field, or simply because carcasses may be hard to see on many sites and/or few people are systematically looking. Poisoned birds may also move off-site to less conspicuous areas before dying. Incidents seen may not get reported to appropriate authorities capable of investigating the incident because the finder may not know of the importance of reporting incidents, may not know who to call, may not feel they have the time or desire to call, may hesitate to call because of their own involvement in the kill, or the call may be long-distance and discourage callers. Incidents reported may not get investigated if resources are limited or may not get investigated thoroughly, with residue and ChE analyses, for example. Also, if kills are not reported and investigated promptly, there will be little chance of documenting the cause, since tissues and residues may deteriorate quickly. Reports of investigated incidents often do not get submitted to EPA, since reporting by states is voluntary and some investigators may believe that they don't have the resources to submit incident reports to EPA.

Incidents reports submitted to EPA since approximately 1994 have been tracked by assignment of I-#s in an Incident Data System (IDS), microfiched, and then entered to a second database, the Ecological Incident Information System (EIIS). This second data base has some 85 fields for potential data entry. An effort has also been made to enter information to EIIS on incident reports received prior to establishment of current data bases. Although many of these have been added, the system is not yet a complete listing of all incident reports received by EPA. Incident reports are not received in a consistent format (e.g., states and various labs usually have their own formats), may involve multiple incidents involving multiple chemicals in one report, and may report on only part of a given incident investigation (e.g., residues). While some progress has been made in recent years, both in getting incident reports submitted and entered, there has never been the level of resources assigned to incidents that there has been to the tracking and review of laboratory toxicity studies, for example. This adds to the reasons cited above for why EPA believes the documented kills are but a fraction of total mortality caused by fenamiphos and other highly toxic pesticides.

Incidents have continued to occur on remaining use sites, especially lawn and other turf sites. Waterfowl are especially attracted to sites that have water bodies nearby. Non-waterfowl can be attracted to nearly any vegetated site (and many nonvegetated sites), although those with food, shelter, and/or water can be the most attractive.

Incidents have occurred with both liquid and granular formulations of fenamiphos. Incidents have occurred despite watering in (irrigation) on turf, possibly due to residues still on the turf blades or in the thatch, or due to puddling (water can attract birds). Birds can receive a lethal dose quite quickly, as was shown in a golf course where wigeon were killed on treated turf in just 30-40 minutes of feeding.

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Fenamiphos is toxic enough to birds that most reductions of application rates are not likely to prevent mortality. Incidents entered into EIIS are categorized into one of several certainty levels: highly probable, probable, possible, unlikely, or unrelated. In brief, "highly probable" incidents usually require carcass residues, substantial ChE inhibition (for chemicals such as fenamiphos and other organophosphates that depress brain and blood cholinesterase), and/or clear circumstances regarding the exposure. "Probable" incidents include those where residues were not available and/or circumstances were less clear than for "highly probable." "Possible" incidents include those where multiple chemicals may have been involved and it is not clear what the contribution was of a given chemical. The "unlikely" category is used, for example, where a given chemical is practically nontoxic to the category of organism killed and/or the chemical was tested for but not detected in samples. "Unrelated" incidents are those that have been confirmed to be not pesticide-related.

Table C1: Ecological Incident Information System Summary Report as of 8/13/1999.

Date	State	County	Common Name/ Organism Class	Total	Tissue Analyses (Y/N)	Formulation Type/ Method Application	Use/Misuse	Certainty Index
02/02/98	CA	Fresno	Fish	1,000	No	Fenamiphos/NR	Kiwifruit Orchard/ Accidental Misuse	Highly Probable
			Birds	28				
11/04/96	FL	Bay	Birds	28	No	Fenamiphos/NR	Golf Course/ Registered Use	Highly Probable
02/02/96	NR	NR	Fish	200	No	Fenamiphos/NR	Building/ Accidental Misuse	Highly Probable
06/12/96	FL	Orange	Tilapia Fish	NR	No	Fenamiphos/NR	Golf Course Greens/NR	Unlikely
06/09/95	FL	Palm Beach	Birds	NR	No	Fenamiphos/NR	Golf Course/ Accidental Misuse	Probable
05/27/95	FL	Broward	Fish	NR	No	Nemacur 3EC	Golf Course/ Registered Use	Probable
07/13/93	FL	Dade	Fish	>200	Yes	NR	Golf Course /Registered Use	Highly Probable
07/08/93	FL	Dade	Fish	200-1,000	Yes	Nemacur 10G /Broadcast w/ Soil Incorporation	Golf Course/ Registered Use	Highly Probable
07/07/93	FL	Dade	Fish	200-1,000	Yes	Nemacur 10G /Broadcast No Incorporation	Golf Course/ Registered Use	Highly Probable
07/06/93	FL	Dade	Fish	200-1,000	Yes	Nemacur 10G/Broadcast w/ Soil Incorporation	Golf Course/ Registered Use	Highly Probable
06/11/92	LA	Orleans	Fish	NR	No	Fenamiphos/NR	Golf Course/ Registered Use	Probable
07/09/91	MO	St. Louis	Fish	NR	No	Fenamiphos/NR	Golf Course/NR	Probable
02/09/90	FL	Martin	Birds	NR	Yes	Nemacur 3EC/ Ground Spray	Turf/Undetermined	Highly Probable
10/01/81	OH	NR	Birds	NR	No	Fenamiphos/NR	Agricultural Area/NR	Probable
05/18/81	MO	Cape Giardeau	Fish	>1,000	No	Fenamiphos/NR	Golf Course/ Registered Use	Highly Probable
09/01/77	TX	NR	Bird	1	No	Fenamiphos	Pyracanthus Bush/NR	Probable

*NR means Not Reported

Incidents entered into EIIS are also categorized as to use/misuse. Unless specifically confirmed by a state or federal agency to be misuse, or there was very clear misuse such as intentional baiting to kill wildlife, incidents would not typically be considered misuse. Data entry personnel often do not have

a copy of the specific label used in a given application, and would not usually be able to detect a variety of label-specific violations.

APPENDIX D:

Fenamiphos Use Profile with Label Conversions

Fenamiphos is an organophosphate, systemic nematicide and insecticide, which is translocated throughout the plant crop to primarily control plant-parasitic nematodes and to secondarily control certain insect pests. Fenamiphos is sold under the trade name, Nemacur. Three end-use Nemacur nematicides are registered: Nemacur 10% (granular) Turf and Ornamental Nematicide, Nemacur 3 (emulsifiable concentrate) Turf Nemacticide and Nemacur 3 Emulsifiable Systemic Insecticide-Nematicide, and Nemacur 15% Granular Systemic Insecticide-Nematicide. In the subsections 1, 2 and 3 below the labeled rates have been converted to a standard pound active ingredient per acre (lb ai/acre) in order to complete the environmental risk assessment. In addition, where label text needs to be amended to implement specific crop rate mitigation measures, and/or to clarify product use, EFED has provided recommendations for revision, which are highlighted in bold and redline.

1. Nemacur[R] 10% Turf and Ornamental Nematicide (Nemacur 10G)

According to the February 13, 1997, notification label, Nemacur 10G is to be used to control nematodes in turfgrasses located in golf courses, cemeteries, sod farms, and industrial grounds; in ornamentals such as iris, lily, narcissus, leather leaf fern, protea, and anthurium; and in nursery stock. In California only, it is registered for control of nematodes in turfgrasses on golf courses and sod farms. Formulation percentages are represented below:

Nemacur 10G End-Use Formulation
Active Ingredients: 10.0 % Inert Ingredients: 90.0 %

Rates for Nemacur 10G on Turfgrasses:
Maximum Single Application = 0.23 lb ai/1,000 sq ft or 10 lb ai/acre
Maximum Seasonal Application = 20 lb ai/acre/year

These application rates are based on applying a maximum of 2.3 lb product /1,000 square feet. The number of square feet in one acre is 43,560. To equate the 1,000 square-feet application rate to acres:

2.3 lb product/1,000 sq ft X 43,560 sq ft/1 acre = 100.188 lbs product/acre

The label rounds the value and recommends 100 lbs of product per acre. In addition, according to the label, Nemacur 10G can also be as more than one application for a total maximum seasonal application of 200 lbs of product per acre per year. **EFED previously recommended (September, 1996) that the maximum seasonal rate be reduced from 20 to 10 lb ai/acre; however, as indicated above, mitigation measures have not been implemented for this use.**

Rates for Nemacur 10G on Iris, Lily and Narcissus Bulb, except in California:
Maximum Single Application = 0.48 to 0.8 lb ai/1,000 feet of row, 10.5 lb ai/acre
Maximum Seasonal Application = Not specified

60 lb product/acre X .10 ai in formulation = 6 lb ai/acre
100 lb product/acre X .10 ai in formulation = 10 lb ai/acre

For a 42-inch row : 4.8 lb of product/1,000 ft of row X .10 ai in formulation X [43,560 sq ft/acre/(42 in of row width X 1 ft/12 in)] = 5.97, rounded = 6.0 lb ai/acre
8.0 lb of product/1,000 ft of row X .10 ai in formulation X [43,560 sq ft/acre/(42 in of row width X 1 ft/12 in)] = 9.95, rounded = 10.0 lb ai/acre

**For a 40-inch row : 4.8 lb of product/1,000 ft of row X .10 ai in formulation X [43,560 sq ft/acre/(40 in of row width X 1 ft/12 in)] = 6.27, rounded = 6.3 lb ai/acre
8.0 lb of product/1,000 ft of row X .10 ai in formulation X [43,560 sq ft/acre/(40 in of row width X 1 ft/12 in)] =10.45, rounded = 10.5 lb ai/acre

These application rates are based on applying a maximum of 4.8 to 8 lbs of product /1,000 feet of row which approximately equates to 60 to 100 lbs of product per acre based on 42-inch rows and 12,445 linear feet of row per acre. **Although row spacing is variable, for the majority of commercial production, bulbs are planted in 8-inch row bands, spaced 40 inches apart.[31] This is an in-the-furrow application before planting; however, if the plants are already established, it is banded (10-to-12 inch band) on the top of the row. Then it is to be watered in with at least 0.5 inches of water. **The maximum seasonal application rate should be specified on the label as 10 lb ai/acre or 100 lb of product/acre.**

Rates for Nemacur 10G on Leather Leaf Fern:
Maximum Single Application = 10 lb ai/acre
Maximum Seasonal Application = Not specified

These application rates are based on applying a maximum of 100 lbs of product /acre. Then it is to be watered in with at least 0.5 inches of water. **The maximum seasonal application is not and should be specified as 10 lb ai/acre or 100 lb of product/acre.**

Rates for Nemacur 10G on Protea:
Maximum Single Application = 0.1 to 0.225 lb ai/1,000 sq ft, 4.5 to 9.8 lb ai/acre
Maximum Seasonal Application = 0.2 to 0.450 lb ai/1,000 sq ft, 9.0 to 19.5 lb ai/acre

2.25 lb product/1,000 sq ft X 43,560 sq ft/1 acre = 98.01 lb product/acre
98.01 X 0.10 ai in formulation = 9.8 lb ai/acre

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31 William M. Roozen, Washington Bulb Company Inc., 1599 Beaver Marsh Road, Mount Vernon, Washington 98273.

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These application rates are based on applying a maximum of 1 to 2.25 lbs product/1,000 square feet which approximately equates to 45 to 97.5 lbs of product /acre. The label specifies soil incorporation (2-to-3 inches), and then it is to be watered in with at least 0.5 inches of water. The number of applications per year is limited to two for a maximum seasonal application of 90 to 195 lbs of product/acre.

Rates for Nemacur 10G on Anthurium:
Maximum Single Application = 0.1 to 0.2 lb ai/1,000 sq ft , 5 to 10 lb ai/acre
Maximum Seasonal Application = 0.2 to 0.4 lb ai/1,000 sq ft , 20 lb ai/acre

18.3 oz product/1,000 sq ft X .10 ai in formulation X 1 lb/16 oz = 0.11, rounded = 0.1 lb ai/1,000 sq ft
18.3 oz product/1,000 sq ft X 1 lb/16 oz X 43,560 sq ft/1 acre = 797,148/16,000 = 49.8 lb product/acre
49.82 lb product/acre X .10 percent of ai in formulation = 4.98, rounded = 5.0 lb ai/acre
36.7 oz product/1,000 sq ft X .10 ai in formulation X 1 lb/16 oz = 0.23, rounded = 0.2 lb ai/1,000 sq ft
36.7 oz product/1,000 sq ft X 1 lb/16 oz X 43,560 sq ft/1 acre = 1,598,652/16,000 = 99.9 lb product/acre
99.92 lb product/acre X .10 percent of ai in formulation = 9.99, rounded= 10.0 lb ai/acre
100 lb product/acre X .10 percent of ai in formulation = 10 lb ai/acre
200 lb product/acre X .10 percent of ai in formulation = 20 lb ai/acre

These application rates are based on applying a maximum of 18.3 to 36.7 oz product per 1,000 square feet which approximately equates to 50 to 100 lbs of product /acre. Then Nemacur 10G is to be watered in with at least 0.5 inches of water. The number of applications per year is limited to two for a maximum seasonal application of 100 to 200 lbs of product/acre. **EFED previously recommended (September, 1996) that the maximum seasonal rate be reduced from 20 to 10 lb ai/acre; however, as indicated above, mitigation measures have not been implemented for this use.**

Rates for Nemacur 10G on Nursery Stock:
Maximum Single Application = 10 lb ai/acre
Maximum Seasonal Application = 20 lb ai/acre planting site/year

These application rates are based on applying a maximum of 100 lbs of product /acre. Then Nemacur 10G is to be watered in with at least 0.5 inches of water. The number of applications per year is limited to two for a maximum seasonal application of 200 lbs of product/acre/year. **EFED previously recommended (September, 1996) that the maximum seasonal rate be reduced from 20 to 10 lb ai/acre; however, as indicated above, mitigation measures have not been implemented for this use.**

2. Nemacur[R] 3 Emulsifiable Systemic Insecticide-Nematicide (Nemacur 3)

According to the December 6, 1996 notification label, Nemacur 3 is to be used to control nematodes in certain field, fruit and vegetable crops. Formulation percentages are represented below:

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Nemacur 3 End-Use Formulation

Active Ingredients: 35.0 % Inert Ingredients: 65.0 %

Rates for Nemacur 3 on Cotton for Early Season Reduction of Thrips:

Maximum Single Application = 0.1 lb ai/1,000 ft of row, 0.8 to 1.1 lb ai/acre and 4.2* to 5.8* lb ai/acre

Maximum Seasonal Application = Not specified , but assumed as once=1.1 lb ai/acre

These application rates are based on applying a maximum of 2.4 to 3.3 fluid ounces /1,000 feet of plant row for any row spacing. Assuming 40-inch row spacing, the application rate per acre approximately equates to 1 to 1.33 quarts/acre or 0.8 to 1.0 lb ai/acre. The label indicates the amount of fenamiphos per gallon is 3 pounds.

2.4 fl oz product/1,000 ft row length X 1 gal/128 fl oz X 3 lb ai/gal = 0.05625, rounded = 0.1 lb ai/1,000 ft row

Assuming 40-inch row spacing: 2.4 fl oz product/1,000 ft of row length X 1 gal/128 fl oz X 3 lb ai/gal X [43,560 sq ft/acre /(40 in row width X 1 ft/12 in)] =0.735 lb ai/acre or 1 qt product/acre X 1 gal/4 qts X 3 lb/gal = 0.75, rounded = 0.8 lb ai/acre

Assuming 36-inch row spacing: 2.4 fl oz product/1,000 ft row length X 1 gal/128 fl oz X 3 lb ai/ gal X [43,560 sq ft/acre/(36 in row width X 1 ft/12 in)]=0.81, rounded=0.8 lb ai/acre

Assuming 7-inch row spacing*: 2.4 fl oz product/1,000 ft row length X 1 gal/128 fl oz X 3 lb ai/gal X [43,560 sq ft/acre /(7 in row width X 1 ft/12 in)]= 4.20, rounded=4.2 lb ai/acre

3.3 fl oz product/1,000 ft of row X 1 gal/128 fl oz X 3 lb ai/gal= 0.0773, rounded = 0.1 lb ai/1,000 ft of row

Assuming 40-inch row spacing: 1.33 qt product/acre X 1 gal/4 qts X 3 lb/gal =0.9975, rounded =1.0 lb ai/acre
3.3 fl oz product/1,000 ft of row length X 1 gal/128 fl oz X 3 lb ai/ gal X [43,560 sq ft/acre/(40 in row width X 1 ft/12 in)]= 1.01, rounded=1.0 lb ai/acre

Assuming 36-inch row spacing: 3.3 fl oz product/1,000 ft of row length X 1 gal/128 fl oz X 3 lb ai/ gal X [43,560 sq ft/acre /(36 in row width X 1 ft/12 in)]= 1.12, rounded=1.1 lb ai/acre

Assuming 7-inch row spacing*: 3.3 fl oz product/1,000 ft row length X 1 gal/128 fl oz X 3 lb ai/ gal X [43,560 sq ft/acre /(7 in of row width X 1 ft/12 in)]= 5.77, rounded = 5.8 lb ai/acre

Traditional cotton single row spacing varies from a minimum of 36 inches to a maximum of 40 inches. Spacing width is predominantly dependent on available soil moisture, soil type, planter equipment requirements, and yield benefits. In the eastern United States, rows tend to be closer together with single rows spaced 36 inches apart. As one travels west, row spacing width increases to 38 inches in the central United States and to 40 inches in the arid southwest. Approximately 70 percent of the cotton grown in the United States is planted in single rows,

spaced 40-inches apart. Approximately 28 percent is grown in single rows, spaced 36-to-38 inches apart. Currently, about 2 percent is genetically-engineered and planted in ultra-narrow rows, spaced 7-to-10 inches apart.[32] In the United States, pima and upland cotton are grown in the southern states as indicated on the USDA/National Agricultural Statistics Service's 1996 Harvested Acres by County Maps (See Appendix B of this document.).

The Nemacur 3 application is at planting in the furrow or banded followed by a layer of soil to cover the cotton seed and sprayed Nemacur 3. **Previously submitted and accepted mitigation reduced the maximum single/seasonal use rate to 1.46 lb ai/acre; however, as indicated above, the rate has not been reduced. EFED recommends implementation of the previous mitigation reducing the rate to 1.46 lb ai/acre (1.9 quarts of Nemacur 3 per acre) regardless of row spacing or formulation used. This maximum single and seasonal rate should be specified on the label.**

Rates for Nemacur 3 on Cotton for Control of Nematodes and Thrips by an in the Furrow or Band Method of Application:

Maximum Single Application = 0.1 to 0.2 lb ai/1,000 ft of row, 1.1 to 2.4 lb ai/acre, 5.8* to 12.4* lb ai/acre
Maximum Seasonal Application = Not Specified, but assumed once at seeding

3.3 fl oz product/1,000 ft of row X 1 gal/128 fl oz X 3 lb ai/gal=0.07, rounded= 0.1 lb ai/1,000 ft of row
7.1 fl oz product/1,000 ft of row X 1 gal/128 fl oz X 3 lb ai/gal= 0.1664, rounded = 0.2 lb ai/1,000 ft of row

Assuming 40-inch row spacing:
1.33 qt product/acre X 1 gal/4 qts X 3 lb/gal=0.99, rounded = 1.0 lb ai/acre
2.9 qt product/acre X 1 gal/4 qts X 3 lb/gal = 2.175, rounded = 2.2 lb ai/acre
3.3 fl oz product/1,000 ft of row length X 1 gal/128 fl oz X 3 lb ai/ gal X [43,560 sq ft/acre /(40 in of row width X 1 ft/12 in)]= 1.01, rounded=1.0 lb ai/acre
7.1 fl oz product/1,000 ft of row length X 1 gal/128 fl oz X 3 lb ai/gal X [43,560 sq ft/acre /(40 in of row width X 1 ft/12 in)]= 2.17, rounded=2.2 lb ai/acre

Assuming 36-inch row spacing:
3.3 fl oz product/1,000 ft of row length X 1 gal/128 fl oz X 3 lb ai/ gal X [43,560 sq ft/acre /(36 in row width X 1 ft/12 in)] = 1.123, rounded = 1.1 lb ai/acre
7.1 fl oz product/1,000 ft row length X 1 gal/128 fl oz X 3 lb ai/ gal X [43,560 sq ft/acre /(36 in row width X 1 ft/12 in)] = 2.41, rounded = 2.4 lb ai/acre

Assuming 7-inch row spacing*:
3.3 fl oz product/1,000 ft row length X 1 gal/128 fl oz X 3 lb ai/ gal X [43,560 sq ft/acre /(7 in row width X 1 ft/12 in)]= 5.77, rounded = 5.8 lb ai/acre
7.1 fl oz product/1,000 ft of row length X 1 gal/128 fl oz X 3 lb ai/ gal X [43,560 sq ft/acre /(7 in row width X 1 ft/12 in)] = 12.426, rounded = 12.4 lb ai/acre

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32 Dr. Gus Lorenz, University of Arkansas, Cooperative Extension, Fayatteville, Arkansas, and the 1996 National Agricultural Statistics Service Commodity Cropand Maps and Report (See Appendix B).

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These application rates are based on applying a maximum of 3.3 to 7.1 fluid ounces /1,000 feet of plant row for any row spacing. Assuming 40-inch row spacing, the application rate per acre approximately equates to 1.33 to 2.9 quarts/acre or 1.0 to 2.2 lb ai/acre For 36-inch row spacing, the rate is 1.1 to 2.4 lb ai/acre. The application is at planting in the furrow or banded (6- to 12-inch band) followed by a layer of soil to cover the cotton seed and the spray-applied Nemacur 3. A maximum seasonal application rate is not specified. **Previously submitted and accepted mitigation reduced the maximum single/seasonal use rate to 1.46 lb ai/acre; however, as indicated above, the rate has not been reduced. EFED recommends implementation of the previous mitigation reducing the rate to 1.46 lb ai/acre (1.9 quarts of Nemacur 3 per acre) regardless of row spacing or formulation used. This maximum single and seasonal rate should be specified on the label.**

Rates for Nemacur 3 on Cotton for Control of Nematodes and Thrips by Soil Injection Application:

Maximum Single Application = 0.2 lb ai/1,000 ft of row, 3.0 lb ai/acre
Maximum Seasonal Application = Not Specified, but implies one application then crop is planted

9.8 fl oz product/1,000 ft of row X 1 gal/128 fl oz X 3 lb ai/gal= 0.229, rounded = 0.2 lb ai/1,000 ft of row

Assuming 40-inch row spacing: 4 qt product/acre X 1 gal/4 quarts X 3 lb ai/gal = 3.0 lb ai/acre
9.8 fl oz product/1,000 ft of row length X 1 gal/128 fl oz X 3 lb ai/gal X [43,560 sq ft/acre /(40 in of row width X 1 ft/12 in)] =3.0 lb ai/acre

These application rates are based on applying a maximum of 9.8 fluid ounces/1,000 feet of plant row for any row spacing. Assuming 40-inch row spacing, the application rate per acre approximately equates to 4 quarts/acre or 3 lb ai/acre. ***However, the label specifies for this application a maximum single rate of 4 quarts/acre regardless of row spacing.*** For soil-injection application of Nemacur 3 in California, the label requires that the application be applied in a water emulsion or with liquid fertilizer through 2 or more injection shanks centered on the seed row covering an 18-inch band. **Previously submitted and accepted mitigation reduced the maximum single/seasonal use rate to 1.46 lb ai/acre; however, as indicated above, the rate has not been reduced. EFED recommends implementation of the previous mitigation reducing the rate to 1.46 lb ai/acre (1.9 quarts of Nemacur 3/acre) regardless of row spacing or formulation used. This maximum single and seasonal rate should be specified on the label.**

Rates for Nemacur 3 on Cotton for Control of Nematodes and Early Season Reduction of Thrips with Treflan 4EC and/or a Liquid Fertilizer in a 12- to 18-inch band pre-plant application:

Maximum Single Application= 0.1 to 0.2 lb ai/1,000 ft of row, 2.7; 3.0 and 15.6* lb ai/acre
Maximum Seasonal Application = Not Specified, but assumed once due to pre-plant application

8.9 oz product/1,000 ft of row X 1 gal/128 fl oz X 3 lb ai/ gal =0.2086, rounded =0.2 lb ai/1,000 ft of row

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Assuming 40-inch row spacing: 8.9 fl oz product/1,000 ft of row length X 1 gal/128 fl oz X 3 lb ai/gal X [43,560 sq ft/acre /(40 in row width X 1 ft/12 in)] =
2.72, rounded =2.7 lb ai/acre

Assuming 36-inch row spacing: 8.9 fl oz product/1,000 ft of row length X 1 gallon/128 fl oz X 3 lb ai/ gallon X [43,560 sq ft/acre /(36 in of row width X 1 ft/12 in)] =
3.02, rounded =3.0 lb ai/acre

Assuming 7-inch row spacing*: 8.9 fl oz product/1,000 ft of row length X 1 gal/128 fl oz X 3 lb ai/gal X [43,560 sq ft/acre /(7 in of row width X 1 ft/12 in)] =
15.576, rounded =15.6 lb ai/acre
3.9 oz product/1,000 ft of row X 1 gal/128 fl oz X 3 lb ai/ gal =0.09 , rounded =0.1 lb ai/1,000 ft of row

Assuming 40-inch row spacing: 3.9 fl oz product/1,000 ft of row length X 1 gal/128 fl oz X 3 lb ai/gal X [43,560 sq ft/acre /(40 in of row width X 1 ft/12 in)] =
1.194, rounded =1.2 lb ai/acre

Assuming 36-inch row spacing: 3.9 fl oz product/1,000 ft of row length X 1 gal/128 fl oz X 3 lb ai/gal X [43,560 sq ft/acre /(36 in of row width X 1 ft/12 in)] =
1.327, rounded =1.3 lb ai/acre

Assuming 7-inch row spacing: 3.9 fl oz product/1,000 ft of row length X 1 gal/128 fl oz X 3 lb ai/gal X [43,560 sq ft/acre /(7 in of row width X 1 ft/12 in)] =
6.82, rounded = 6.8 lb ai/acre

These application rates are based on applying a maximum of 8.9 fluid ounces /1,000 feet of plant row for any row spacing. The minimum recommended was 3.9 oz product/1,000 ft of row. **Previously submitted and accepted mitigation reduced the maximum single/seasonal use rate to 1.46 lb ai/acre; however, as indicated above, the rate has not been reduced. EFED recommends implementation of the previous mitigation reducing the maximum single and seasonal rate to 1.46 lb ai/acre regardless of row spacing or formulation used.**

Rates for Nemacur 3 on Peanut for Control of Nematodes and Early Season Reduction of Thrips Applied as a 12- inch band over the row at planting:
Maximum Single Application = 0.1 to 0.2 lb ai/1,000 ft of row , 2.5 lb ai/acre
Maximum Seasonal Application= Not Specified

7.3 oz product/1,000 ft of row X 1 gal/128 fl oz X 3 lb ai/gal = 0.1710, rounded = 0.2 lb ai/1,000 ft of row
4.5 oz product/1,000 ft of row X 1 gal/128 fl oz X 3 lb ai/gal = 0.105, rounded = 0.1 lb ai/1,000 ft of row

Assuming 38-inch single-row spacing: 7.3 fl oz product/1,000 ft of row length X 1 gal/128 fl oz X 3 lb ai/ gal X [43,560 sq ft/acre /(38 in row width X 1 ft/12 in)] =
2.353, rounded= 2.4 lb ai/acre
4.5 fl oz product/1,000 ft of row length X 1 gal/128 fl oz X 3 lb ai/gal X

[43,560 sq ft/acre /(38 in row width X 1 ft/12 in)] =
1.450, rounded=1.5 lb ai/acre

Assuming 36-inch single-row spacing: 3.3 qts/acre X 1 gal/4 qts X 3 lb ai/gal = 2.475, rounded
= 2.5 lb ai/acre
7.3 fl oz product/1,000 ft of row length X 1 gal/128 fl oz X 3 lb ai/ gal X [43,560 sq ft/acre /(36 in row width X 1 ft/12 in)]
=2.484, rounded =2.5 lb ai/acre
2 qts/acre x 1 gallon/4 qts X 3 lb ai/gallon = 1.5 lb ai/acre

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4.5 fl oz product/1,000 ft of row length X 1 gal/128 fl oz X 3 lb ai/ gal X [43,560 sq ft/acre /(36 in row width X 1 ft/12 in)] =1.531, rounded=1.5 lb ai/acre

Assuming 72-inch (6 ft) bed spacing: 7.3 fl oz product/1,000 ft of row length X 1 gal/128 fl oz X 3 lb ai/ gal X [43,560 sq ft/acre /(72 in width X 1 ft/12 in)] = 1.242, rounded =1.2 lb ai/acre

4.5 fl oz product/1,000 ft of row length X 1 gal/128 fl oz X 3 lb ai/gal X [43,560 sq ft/acre /(72 in width X 1 ft/12 in)] =0.765, rounded =0.8 lb ai/acre

Peanuts are typically grown as a supplemental cash crop in the same counties where upland cotton is grown. The planter purchased to grow cotton at a 36- or 38-inch row spacing would also be used and would then dictate the row spacing for peanuts. Hence, peanuts in the southeast are planted in single rows, 36 inches apart. In the south-central United States, peanuts are typically planted in single rows, spaced 38 inches apart.[33] Less than 10 percent of the peanuts grown are planted as double-row beds, each row 28 inches apart and 6 feet between bed centers. In the south-central and western states, varieties of Spanish peanut are also grown. Many varieties of Spanish peanut require 20-inch row spacing. These varieties typically are grown in double-row beds with 6 feet between bed centers. When double-rowed peanuts are planted, only one application is applied over the bed, rather than to each row. Therefore, the application bands would be 6 feet apart.

These application rates are based on applying a maximum of 7.3 fluid ounces /1,000 feet of plant row for any row spacing. The minimum recommended was 4.5 oz product/1,000 ft of row. **This maximum single and seasonal rate should be specified on the label regardless of row spacing or formulation used.**

Rates for Nemacur 3 on Tobacco (Not Shade Grown Varieties) for Control of Nematodes (Except Tobacco Cyst) and Suppression of Aphids Applied Broadcast, then Incorporated 2 to 4 inches:

Maximum Single Application = 4.0 to 6.0 lb ai/acre
Maximum Seasonal Application = Not Specified

2 gallons of product X 3 lb ai/gallon (on label) = 6.0 lb ai/acre
1.33 gallons of product X 3 lb ai/gallon (on label) = 3.99, rounded = 4.0 lb ai/acre

These application rates are based on applying a maximum of 2 gallons of product /20 gallons of water/acre. The minimum recommended was 1.33 gallons of product/20 gallons of water/acre. **The maximum seasonal application rate needs to be specified.**

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33 Ibid, and Dr. Benjamin Whitty, University of Florida, Agricultural Extension, Gainsville, Florida.

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Rates for Nemacur 3 Tank Mixed with Lorsban 4 EC (2 qt/acre) on Tobacco (Not Shade Grown Varieties) for Control of Cutworms, Flea Beetles, and Wireworms Applied Broadcast, then Incorporated 2 to 4 inches:

Maximum Single Application = 3.0 to 6.0 lb ai/acre
Maximum Seasonal Application = Not Specified

2 gallons of product X 3 lb ai/gallon (on label) = 6.0 lb ai/acre
1 gallon of product X 3 lb ai/gallon (on label) = 3.0 lb ai/acre

These application rates are based on applying a maximum of 2 gallons of product /20 gallons of water/acre. The minimum recommended was 1 gallon of product/20 gallons of water/acre. **The maximum seasonal application rate needs to be specified.**

Rates for Nemacur 3 Tank Mixed with Mocap EC (2 to 4 qt/acre) on Tobacco (Not Shade Grown Varieties) for Control of Cutworms, Flea Beetle Larvae, Mole Crickets and Wireworms Applied Broadcast, then Incorporated 2 to 4 inches:

Maximum Single Application = 3.0 to 6.0 lb ai/acre
Maximum Seasonal Application = Not Specified

2 gallons of product X 3 lb ai/gallon (on label) = 6.0 lb ai/acre
1 gallon of product X 3 lb ai/gallon (on label) = 3.0 lb ai/acre

These application rates are based on applying a maximum of 2 gallons of product /20 gallons of water/acre. The minimum recommended was 1 gallon of product/20 gallons of water/acre. **The maximum seasonal application rate needs to be specified.**

Rates for Nemacur 3 on Apple, Cherry, Nectarine and Peach trees for control of Nematodes Applied by Banding 50 Percent of the Tree Row, then soil incorporating:

Maximum Single Application = 5.0 to 7.5 lb ai/acre
Maximum Seasonal Application = 7.5 lb ai/acre/year

2.5 gallons of product X 3 lb ai/gallon (on label) = 7.5 lb ai/acre
1.66 gallons of product X 3 lb ai/gallon (on label) = 4.98, rounded= 5.0 lb ai/acre

These application rates are based on applying a maximum of 2.5 gallons of product with at least 10 gallons of water/acre. The minimum recommended was 1.66 gallons of product with at least 10 gallons of water/acre.

Rates for Nemacur 3 on Apple, Cherry, Nectarine and Peach trees for control of Nematodes Applied by Low-Pressure Irrigation:

Minimum and Maximum Single Application = 1.5 to 6.0 lb ai/acre
Maximum Seasonal Application = 6.0 lb ai/acre/year

2 gallons of product X 3 lb ai/gallon = 6.0 lb ai/acre/year

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1 gallon of product X 3 lb ai/gallon = 3.0 lb ai/acre
0.5 gallon (2 quarts) of product X 3 lb ai/gallon = 1.5 lb ai/acre

The dosage per acre to the soil is applied in 1 to 4 applications with at least 30 days between applications using a minimum of 1 gallon to a maximum of 2 gallons of NEMACUR 3 per acre per season.

Rates for Nemacur 3 on Grapes for control of Nematodes and Phylloxera Suppression Applied by Banding 50 Percent of the Vine Row, then soil incorporating:

Maximum Single Application = 3.0 to 6.0 lb ai/acre
Maximum Seasonal Application = 6.0 lb ai/acre/year

2 gallons of product X 3 lb ai/acre = 6.0 lb ai/acre/year
1 gallon of product X 3 lb ai/acre = 3.0 lb ai/acre

These application rates are based on applying a maximum of 2 gallons of product with at least 10 gallons of water/acre. The minimum recommended was 1 gallon of product with at least 10 gallons of water/acre.

Rates for Nemacur 3 on Grapes for control of Nematodes and Phylloxera Suppression Applied by Low-Pressure Irrigation:

Minimum and Maximum Single Application = 1.5 to 6.0 lb ai/acre
Maximum Seasonal Application = 6.0 lb ai/acre/year

2 gallons of product X 3 lb ai/gallon = 6.0 lb ai/acre/year
1 gallon of product X 3 lb ai/gallon = 3.0 lb ai/acre
0.5 gallons of product X 3 lb ai/gallon = 1.5 lb ai/acre

The dosage is applied in 1 to 4 applications with at least 30 days between applications using a minimum of 1 gallon to a maximum of 2 gallons of NEMACUR 3 per acre per season.

In California only, Rates for Nemacur 3 on Kiwifruit for control of Nematodes Applied by Low-Pressure Irrigation:

Minimum and Maximum Single Application = 1.5 to 6.0 lb ai/acre
Maximum Seasonal Application = 6.0 lb ai/acre/year

2 gallons of product X 3 lb ai/gallon = 6.0 lb ai/acre/year
1 gallon of product X 3 lb ai/gallon = 3.0 lb ai/acre
0.5 gallons of product X 3 lb ai/gallon = 1.5 lb ai/acre

The dosage per acre is applied in 1 to 4 applications with at least 30 days between applications using a minimum of 1 gallon to a maximum of 2 gallons of NEMACUR 3 per acre per season.

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Rates for Nemacur 3 on Citrus, Except in Florida, and Except on Kumquat, Tangelo, or Citrus Hybrids in California for Control of Nematodes and Citrus Root Weevil Complex including Fuller Rose Beetle Suppression, Applied by Banding 50 Percent of the Tree Row, then Soil Incorporating:

Maximum Single Application = 5.0 to 7.5 lb ai/acre
Maximum Seasonal Application (2 applications) = 7.5 lb ai/acre/year

2.5 gallons of product X 3 lb ai/gallon = 7.5 lb ai/acre/year
1.66 gallons of product X 3 lb ai/gallon = 4.98, rounded = 5.0 lb ai/acre

These application rates are based on applying a maximum of 2.5 gallons of product with at least 10 gallons of water/acre. The minimum recommended was 1.66 gallon of product with at least 10 gallons of water/acre. The label limits the number of applications per year to two, at a maximum of 2.5 gallons of product/acre.

Rates for Nemacur 3 on Citrus, Except in Florida, and Except on Kumquat, Tangelo, or Citrus Hybrids in California for Control of Nematodes and Citrus Root Weevil Complex including Fuller Rose Beetle Suppression, Applied by Low-Pressure Irrigation:

Minimum and Maximum Single Application = 1.5 to 6.0 lb ai/acre
Maximum Seasonal Application = 6.0 lb ai/acre/year

2 gallons of product X 3 lb ai/gallon = 6.0 lb ai/acre/year
1 gallon of product X 3 lb ai/gallon = 3.0 lb ai/acre
0.5 gallons of product X 3 lb ai/gallon = 1.5 lb ai/acre

The dosage is applied in 1 to 4 applications with at least 30 days between applications using a minimum of 1 gallon to a maximum of 2 gallons of NEMACUR 3 per acre per season.

Rates for Nemacur 3 on Citrus for Control of Nematodes and Citrus Root Weevil Complex including Fuller Rose Beetle Suppression Using Band Application in Florida for the following counties: Brevard, Broward, Charlotte, Citrus, Collier, DeSoto, Glades, Hardee, Hendry, Hernando, Hillsborough, Indian River, Lee, Manatee, Marion, Martin, Okeechobee, Palm Beach, Pasco, Pinellas, Putnam, St. Lucie, Sarasota, Seminole, and Volusia.

Maximum Single Application = 2.5 to 5.0 lb ai/acre
Maximum Seasonal Application (2 applications) = 10.0 lb ai/acre/year

3.33 qts of product X 1 gal/4 qts X 3 lb ai/gal = 2.4975, rounded = 2.5 lb ai/acre
1.66 gallons of product X 3 lb ai/gal = 4.98, rounded = 5.0 lb ai/acre

These application rates are based on applying a maximum of 1.66 gallons of product with at least 10 gallons of water/acre. The minimum recommended was 3.33 quarts of product with at least 10 gallons of water/acre. The label limits the number of applications per year to two, at a maximum of 1.66 gallons of product/acre.

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Rates for Nemacur 3 on Citrus for Control of Nematodes and Citrus Root Weevil Complex including Fuller Rose Beetle Suppression Using Low-Pressure Application in Florida for the following counties: Brevard, Broward, Charlotte, Citrus, Collier, DeSoto, Glades, Hardee, Hendry, Hernando, Hillsborough, Indian River, Lee, Manatee, Marion, Martin, Okeechobee, Palm Beach, Pasco, Pinellas, Putnam, St. Lucie, Sarasota, Seminole, and Volusia.

Minimum and Maximum Single Application = 1.5 to 4.5 lb ai/acre
Maximum Seasonal Application = 4.5 lb ai/acre/year

2 quarts of product X 1 gallon/4 quarts X 3 lb ai/gallon = 1.5 lb ai/acre
1 gallon of product X 3 lb ai/gallon = 3 lb ai/acre
1.5 gallons of product X 3 lb ai/gallon = 4.5 lb ai/acre/year

The dosage is applied in 1 to 4 applications with at least 30 days between applications using a minimum of 1 gallon to a maximum of 1.5 gallons of NEMACUR 3 per acre per season.

Additional label instructions are the following:

* Incorporate mechanically, and irrigate after application not to exceed the depth of the root zone under dry conditions.
* Do not apply within 300 feet of a drinking water well.
* If soils have a permeability rate greater than 20 inches per hour, do not apply with 1,000 feet of a drinking water well unless it is known or reasonably believed based on authoritative sources that such wells are either cased to 100 feet below ground level or a minimum of 30 feet below the water table.
* Apply between October 15 and April 30.
* Do not apply within thirty days of harvest.
* Do not exceed 1.66 gallons of Nemacur 3 (5 pounds active ingredient) per acre in a 50 percent band or 1.5 gallons of Nemacur 3 (4.5 pounds active ingredient) per acre by low pressure irrigation per season.

In Hawaii, Rates for Nemacur 3 on Pineapple for Control of Nematodes (*Rotylenchulus* and *Meloidogyne* species) via a Preplant Soil Application as a Band on the Crop Row:

Maximum Single Application = 9 lb ai/acre
Maximum Seasonal Application (4 to 12 applications, each at 1 to 3 month intervals) = 24 lb ai/acre/year

3 gallons of product X 3 lb ai/gallon = 9 lb ai/acre
8 gallons of product X 3 lb ai/gallon = 24 lb ai/acre/year

3.33* gallons X 3 lb ai/gallon = 9.99, rounded = 10.0 lb ai/acre (SLN for Puerto Rico)
6.66* gallon X 3 lb ai/gallon = 19.98, rounded = 20.0 lb ai/acre (SLN for Puerto Rico)

These application rates are based on applying a maximum of 3 gallons product as a water emulsion. The minimum recommended was 3 gallons of product, with additional applications at 1 to 3 month intervals. The label limits the maximum seasonal rate to 8 gallons of

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product/acre/year including a preplant application. **The rate and number of applications per year needs to be limited to reflect the lowest level necessary for efficacy based on actual data.**

*A submitted March 17, 1997 Special Local Need Registration label for distribution and use in Puerto Rico has a maximum single application rate of 20 lbs ai/acre as a preplant, broadcast then soil incorporate application. **The rate and number of applications per year needs to be limited to reflect the lowest level necessary for efficacy based on actual data.**

In Hawaii, Rates for Nemacur 3 on Pineapple for Control of Nematodes (*Rotylenchulus* and *Meloidogyne* species) via a Postplant Foliar Spray or Drip Irrigation Application on the Plant Crop:

Minimum and Maximum Single Application = 0.5 to 3.0 lb ai/acre
Maximum Seasonal Application (4 to 12 applications) = 24 lb ai/acre/year

1.33 pts of product X 1 qt/2 pts X 1 gal/4 qts X 3 lb ai/gal= 0.49, rounded = 0.5 lb ai/acre
8 pts of product X 1 qt/2 pts X 1 gal/4 qts X 3 lb ai/gal = 3.0 lb ai/acre
8 gal of product X 3 lb ai/gal = 24 lb ai/acre/year

These application rates are based on applying a maximum of 8 pints of product with 50 to 250 gallons of water/acre as a foliar spray or through drip irrigation. The minimum recommended was 1.33 pints of product with 50 to 250 gallons of water/acre. The label limits the maximum seasonal rate to 8 gallons of product/acre/year including a preplant application. **The rate and number of applications per year needs to be limited to reflect the lowest level necessary for efficacy based on actual data.**

In Hawaii, Rates for Nemacur 3 on Pineapple for Control of Nematodes (*Rotylenchulus* and *Meloidogyne* species) via a Postplant Foliar Spray or Drip Irrigation Application on the Ratoon Crop:

Maximum Single Application = 0.5 to 3.0 lb ai/acre
Maximum Seasonal Application (4 to 12 applications) = 9.0 lb ai/acre/year

1.33 pts of product X 1 qt/2 pts X 1 gal/4 qts X 3 lb ai/gal= 0.49, rounded= 0.5 lb ai/acre
8 pints of product X 1 qt/2 pts X 1 gal/4 qts X 3 lb ai/gal = 3.0 lb ai/acre
3 gal of product X 3 lb ai/gal = 9.0 lb ai/acre/year

These application rates are based on applying a maximum of 8 pints of product with 50 to 250 gallons of water/acre as a foliar spray or through drip irrigation. The minimum recommended was 1.33 pints of product with 50 to 250 gallons of water/acre. The label limits the maximum seasonal rate to 3 gallons of product/acre/year on the ratoon crop.

In Puerto Rico, Rates for Nemacur 3 on Pineapple for Control of Nematodes Through a Postplant Foliar Spray Application:

Maximum Single Application = 5.0 to 9.0 lb ai/acre
Maximum Seasonal Application (2 to 4 applications) = 18.0 lb ai/acre/year

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1.66 gallons of product X 3 lb ai/gallon = 4.98, rounded = 5.0 lb ai/acre
3 gallons of product X 3 lb ai/gallon = 9 lb ai/acre
3.33* gallons of product X 3 lb ai/gallon = 9.99, rounded = 10.0 lb ai/acre

These application rates are based on applying a maximum of 3 gallons of product with 50 to 250 gallons of water/acre as a foliar spray or through drip irrigation. The minimum recommended was 1.66 gallons of product with 50 to 250 gallons of water/acre. The label limits the maximum seasonal rate to 18 lb ai/acre/year on the plant crop and ratoon crop regardless of application method or formulation used. **The rate and number of applications per year needs to be limited to reflect the lowest level necessary for efficacy based on actual data.**

*A submitted March 17, 1997 Special Local Need Registration label for distribution and use in Puerto Rico increased the maximum single postplant applications to the plant and first ratoon crops from 3 to 3.33 gallons/acre.

Rates for Nemacur 3 on Raspberry, except in California, for Control of Nematodes By Banding 50 Percent of the Crop Row followed by Soil Incorporation:

Maximum Single Application = 3 to 6.0 lb ai/acre
Maximum Seasonal Application (1 application) = 6.0 lb ai/acre/year

2 gallons of product X 3 lb ai/gallon = 6 lb ai/acre
1 gallon of product X 3 lb ai/gallon = 3 lb ai/acre

These application rates are based on applying a maximum of 2 gallons of product with at least 10 gallons of water/acre. The minimum recommended was 1 gallon with at least 10 gallons of water/acre. Application is limited to once per year. Other label instructions follow:

* Apply during the period of October 1 to December 31 when adequate rainfall can be expected. Do not apply within six months of harvest.

Rates for Nemacur 3 on Strawberries for Control of Nematodes Using a 12- to 18-Band on the Crop Row followed by Soil Incorporation by Cultivation or Irrigation:

Maximum Single Application = 0.1 to 0.2 lb ai/1,000 feet of row, 4.5 lb ai/acre
Maximum Seasonal Application (one application) = 4.5 lb ai/acre/year

8.8 fl oz of product/1,000 feet of row X 1 gal/128 fl oz X 3 lb ai/gal = 0.20, rounded
= 0.2 lb ai/1,000 ft of row
5.9 fl oz of product/1,000 feet of row X 1 gal/128 fl oz X 3 lb ai/gal = 0.13, rounded
= 0.1 lb ai/1,000 ft of row
2.4 quarts of product/acre X 1 gallon/4 quarts X 3 lb ai/gallon = 1.8 lb ai/acre
3.6 quarts of product/acre X 1 gallon/4 quarts x 3 lb ai/gallon = 2.7 lb ai/acre

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Assuming two rows/bed and 48 inches between bed centers: 2 rows X 8.8 fl oz of product/1,000 feet of row length X 1 gal/128 fl oz X 3 lb ai/gal X [43,560 sq ft/acre/(48 in bed width X 1 ft/12 in)] = 4.49, rounded = 4.5 lb ai/acre
2 rows X 5.9 fl oz of product/1,000 feet of row length X 1 gal/128 fl oz X 3 lb ai/gal X [43,560 sq ft/acre/(48 in bed width X 1 ft/12 in)] = 3.01, rounded = 3.0 lb ai/acre

Strawberries for commercial production are planted in beds with two rows per bed that are spaced 11 inches apart with 4 feet of spacing from bed center to bed center. [34]

These application rates are based on applying a 5.9 to 8.8 ounces of product/1,000 feet of row. A 40-inch row is specified on the label as equating to a rate of 2.4 to 3.6 quarts of product/acre. For two-rows with 4 feet between bed centers, the rate is 3.0 to 4.5 lb ai/acre or 1 to 1.5 gallons of

Nemacur 3/acre. Application is limited to one per year. **The maximum seasonal rate is specified; however, a statement indicating the rate regardless of row spacing or formulation used should be added.**

Other label instructions follow:
*Ground application only. Do not apply within 110 days of harvest.

Rates for Nemacur 3 on Asparagus in Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, and Rhode Island Only, for Control of Nematodes Applied Banded on 50 Percent of the Crop Row, then Soil Incorporated on Nursery stock, Newly Planted Crowns in the Field, and Post Harvest.
Maximum Single Application = 2.0 lb ai/acre
Maximum Seasonal Application, One Application = 2.0 lb ai/acre/year

5.33 pts of product X 1 qt/2 pts X 1 gal/4 qts x 3 lb ai/gal = 1.99, rounded= 2.0 lb ai/acre
Application is limited to one per year; however this application limitation is not clear on the label because it appears within the post harvest instructions.

Rates for Nemacur 3 on Eggplant for Control of Nematodes Applied in a 12-Inch Band Over the Crop Row at Transplanting:
Maximum Single Application = 0.1 lb ai/1,000 feet of row, 2.0 lb ai/acre for 36-inch rows
Maximum Seasonal Application= Not Specified

5.9 fl oz of product/1,000 ft of row X 1 gal/128 fl oz X 3 lb ai/gal = 0.13, rounded

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34 Dr. Stephen Kostewicc, Horticultural Research, University of Florida at Gainesville, and Dr. Vince Rubatzky, Research and Information Center, University of California at Davis.

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= 0.1 lb ai/1,000 feet of row

For a 36-inch row, the label indicates: 2.66 qts/acre X 1 gal/4 qts X 3 lb ai/gal = 1.995, rounded
= 2.0 lb ai/acre

For single rows, 72-inch row spacing: 5.9 fl oz of product/1,000 ft of row X
1 gal/128 fl oz X 3 lb ai/gal X
[43,560 sq ft/acre/(72 in row width X
1 ft/12 in)] =1.0 lb ai/acre

In Florida, where a large percentage of eggplant is grown commercially, plants are staked in single rows with rows spaced 6 feet apart.[35] **Although the maximum seasonal application is assumed to be once because the application occurs at transplanting, the label should clearly indicate what the maximum seasonal rate is regardless of row spacing or formulation used.**

Rates for Nemacur 3 on Table Beets for Control of Cyst Nematodes Applied in a 8- to 12-Inch Band Over the Crop Row Before or at Seeding in Illinois, Indiana, Michigan, New York, Ohio and Pennsylvania only:

Maximum Single Application = 0.1 lb ai/1,000 feet of row for any row spacing, 3.1 lb ai/acre for 2 ft spacing
Maximum Seasonal Application = 0.1 lb ai/1,000 feet of row for any row spacing, 3.1 lb ai/acre for 2 ft spacing,

Single application

4 oz of product/1,000 ft of row X 1 gal/128 fl oz X 3 lb ai/gal = 0.09, rounded = 0.1 lb ai/1,000 feet of row
6 oz of product/1,000 ft of row X 1 gal/128 fl oz X 3 lb ai/gal = 0.140, rounded = 0.1 lb ai/1,000 feet of row

For 24-inch row spacing: 4 fl oz of product/1,000 ft of row X 1 gal/128 fl oz X 3 lb ai/gal X
[43,560 sq ft/acre/(24 in row width X 1 ft/12 in)] =2.04, rounded= 2.0 lb ai/acre
6 fl oz of product/1,000 ft of row X 1 gal/128 fl oz X 3 lb ai/gal X
[43,560 sq ft/acre/(24 in row width X 1 ft/12 in)] =3.06, rounded =3.1 lb ai/acre

Grown in northern states, such as Michigan and New York, table beets are seeded in clusters, which are spread over bands 4-inches wide, with each band of rows spaced 2 feet apart.[36] **Although the maximum seasonal rate is only once because the label's use directions state apply before or at seeding, a statement indicating the rate regardless of row spacing or formulation used should be added.**

Note--The following use was added to this Label Conversion Appendix D and EFED's Environmental Risk Assessment on 08/25/99 based on receipt of the 11/08/95 EPA Stamped Accepted label which was provided to EFED by SRRD and RD on 08/24/99:

Rates for Nemacur 3 on Turf for Control of Nematodes with Uniform Distribution Over the Treatment Area Using Ground Spray Equipment with a Coarse-Spray Nozzle Directed at the Turf Surface:

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35 Dr. Stephen Kostewicc, Horticultural Research, University of Florida at Gainesville.

36 Dr. Vince Rubatzky, Horticultural Research, University of California at Davis.

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Maximum Single Application = 0.1 to 0.2 lb ai/1,000 sq ft , 5 to 10 lb ai/acre
Maximum Seasonal Application = 0.2 to 0.4 lb ai/1,000 sq ft , 20 lb ai/acre

9.7 fl. oz product/1,000 sq ft X .35 ai in formulation X 1 lb/16 oz = 0.21, rounded = 0.2 lb ai/1,000 sq ft
9.7 fl oz product/1,000 sq ft X 1 lb/16 oz X 43,560 sq ft/1 acre = 26.4 lb product/acre
26.4 lb product/acre X .35 percent of ai in formulation = 9.24, rounded = 9.2 lb ai/acre

3.3 gallons of product /acre X 3 lb ai/gal = 9.9 lb ai/acre

The label indicates to irrigate the treated area immediately following application. Apply a minimum of ½ inch of water to move the product into the soil with the total irrigation complete with 6 hours of application. The label indicates that irrigation should be applied in a manner not to result in puddling or runoff.

Additional instructions are the following:

2. On golf course fairways apply across fairways with irrigation zones. Irrigation should be applied by zone immediately following application with that zone. Do not apply to more fairway irrigation zones than can be irrigated upon completion of application and finished with 6 hours after treatment.
3. Do not treate more than 10 acres of turf on any golf course in a single 24-hour period.
4. Any application, regardless of acreage, must be followed by a three-day interval before an additional 10 acres or less may be treated. Do not apply with 10-feet of any surface body of water or fairway surface drains. Do not apply NEMACUR between noon and sunset during the heavy thunderstorm season {June through September}.
5. Do not apply product after soil has become saturated with water (reached field capacity).
6. Do not treat newly seeded areas until the plants have developed secondary root systems. Do not apply more than twice per year. Do not use on residential lawns or public recreational areas other than golf courses. Not recommended for use on tees and greens.
7. On sod farms, treated turf should not be cut for sod or sod handled for 30 days after treatment.

3. Nemacur[R] 15% Granular Systemic Insecticide-Nematicide (Nemacur 15G)

According to the September 12, 1996 EPA stamped acceptable with comments label, Nemacur 15G is to be used for the control of nematodes on certain field, fruit, and vegetable crops. SRRD and RD, please note that the terms, "for effective control," are on the label. Formulation percentages are represented below:

Nemacur 15G End-Use Formulation
Active Ingredients: 15.0 % Inert Ingredients: 85.0 %

Rates for Nemacur 15G on Cotton for Early Season Reduction of Thrips:
Maximum Single Application = 0.1 lb ai/1,000 feet of row, 1.1 lb ai/acre and 4.2* to 5.6* lb ai/acre
Maximum Seasonal Application = Not specified, but assumed as a single early season application

6 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz =0.056, rounded =0.1 lb ai/1,000 ft of row

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8 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz =0.075, rounded =0.1 lb ai/1,000 ft of row

Assuming 40-inch row spacing: 5 lb of product/acre X .15 ai in formulation = 0.75, rounded = 0.8 lb ai/acre

6.5 lb of product/acre X .15 ai in formulation = 0.97, rounded = 1.0 lb ai/acre

6 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(40 in of row width X 1 ft/12 in)] = 0.735, rounded = 0.7 lb ai/acre

8 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(40 in of row width X 1 ft/12 in)] = 0.980, rounded = 1.0 lb ai/acre

Assuming 36-inch row spacing: 6 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(36 in of row width X 1 ft/12 in)] = 0.816, rounded = 0.8 lb ai/acre

8 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(36 in of row width X 1 ft/12 in)] = 1.089, rounded = 1.1 lb ai/acre

Assuming 7-inch row spacing*: 6 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(7 in of row width X 1 ft/12 in)] = 4.20, rounded = 4.2 lb ai/acre

8 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(7 in of row width X 1 ft/12 in)] = 5.600, rounded = 5.6 lb ai/acre

As previously stated, traditional cotton single row spacing varies from a minimum of 36 inches to a maximum of 40 inches. Approximately 70 percent of the cotton grown in the United States is planted in single rows, spaced 40-inches apart. Approximately 28 percent is grown in single rows, spaced 36-to-38 inches apart. Currently, about 2 percent is genetically-engineered and planted in ultra-narrow rows, spaced 7-to-10 inches apart.[37] On the label, application rates are based on applying a maximum of 6 to 8 ounces of product /1,000 feet of plant row in the furrow for any row spacing. **Previously submitted and accepted mitigation reduced the maximum single/seasonal use rate to 1.46 lb ai/acre; however, as indicated above, the rate has not been reduced. EFED recommends implementation of the previous mitigation reducing the maximum single and seasonal rate to 1.46 lb ai/acre or 9.7 pounds of Nemacur 15 G per acre regardless of row spacing or formulation used (Nemacur 3 has cotton uses) should be specified on the label.**

Rates for Nemacur 15G on Cotton for Nematode and Thrip Control Applied as an 8- to 12-Inch Band at Planting:

Maximum Single Application = 0.1 lb ai/1,000 feet of row, 1.6 lb ai/acre and 5.6* to 8.4* lb ai/acre

Maximum Seasonal Application = Not specified, but assumed one early season application =1.5 lb ai/acre

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37 Dr. Gus Lorenz, University of Arkansas, Cooperative Extension, Fayatteville, Arkansas, and the 1996 National Agricultural Statistics Service Commodity Crop and Maps and Report (See Appendix B).

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8 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz = 0.075, rounded
= 0.1 lb ai/1,000 ft of row
12 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz = 0.113, rounded
= 0.1 lb ai/1,000 ft of row

Assuming 40-inch row spacing: 6.5 lb of product/acre X .15 ai in formulation = 0.97, rounded
= 1.0 lb ai/acre
9.8 lb of product/acre X .15 ai in formulation = 1.47, rounded
= 1.5 lb ai/acre
8 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X
[43,560 sq ft/acre/(40 in of row width X 1 ft/12 in)] =
0.980, rounded = 1.0 lb ai/acre
12 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X
[43,560 sq ft/acre/(40 in of row width X 1 ft/12 in)] =
1.47, rounded = 1.5 lb ai/acre

Assuming 36-inch row spacing: 8 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X
[43,560 sq ft/acre/(36 in of row width X 1 ft/12 in)] =
1.089, rounded = 1.1 lb ai/acre
12 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X
[43,560 sq ft/acre/(36 in of row width X 1 ft/12 in)] =
1.633, rounded = 1.6 lb ai/acre

Assuming 7-inch row spacing*: 8 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X
[43,560 sq ft/acre/(7 in row width X 1 ft/12 in)]= 5.60, rounded
= 5.6 lb ai/acre

12 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X
[43,560 sq ft/acre/(7 in row width X 1 ft/12 in)]=
8.40, rounded = 8.4 lb ai/acre

These application rates are based on applying a maximum of 8 to 12 fluid ounces /1,000 feet of plant row in the furrow for any row spacing. Assuming 40-inch row spacing, the application rate per acre approximately equates to 6.5 to 9.8 lb of product /acre or 1.0 to 1.5 lb ai/acre. For 36- and 7-inch row spacing, the maximum rate of active ingredient per acre is 1.6 and 8.4 lb ai/acre. **Previously submitted and accepted mitigation reduced the maximum single/seasonal use rate to 1.46 lb ai/acre; however, as indicated above, the rate has not been reduced. EFED recommends implementation of the previous mitigation reducing the maximum single and seasonal rate to 1.46 lb ai/acre or 9.7 pounds of Nemacur 15 G per acre regardless of row spacing or formulation used (Nemacur 3 has cotton uses) should be specified on the label.**

Rates for Nemacur 15G on Peanuts for Nematode Control and Early Season Trip Reduction Applied as a 12-Inch Band at Planting:
Maximum Single Application = 0.1 to 0.2 lb ai/1,000 feet of row, 1.5 to 2.6 lb ai/acre
Maximum Seasonal Application = Not specified

11 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz =0.103, rounded =0.1 lb ai/1,000 ft of row
18.7 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz =0.175, rounded =0.2 lb ai/1,000 ft of row

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Assuming 38-inch row spacing:	18.7 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(38 in of row width X 1 ft/12 in)] = 2.41, rounded = 2.4 lb ai/acre 11 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(38 in of row width X 1 ft/12 in)] = 1.41, rounded = 1.4 lb ai/acre
Assuming 36-inch row spacing:	10 lb of product/acre X .15 ai in formulation =1.5 lb ai/acre 17 lb of product/acre X .15 ai in formulation = 2.55, rounded = 2.6 lb ai/acre 18.7 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(36 in of row width X 1 ft/12 in)] = 2.54, rounded = 2.5 lb ai/acre 11 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(36 in of row width X 1 ft/12 in)] = 1.49, rounded = 1.5 lb ai/acre
Assuming 72-inch bed spacing:	18.7 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(72 in width X 1 ft/12 in)] = 1.27, rounded = 1.3 lb ai/acre 11 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(72 in width X 1 ft/12 in)] = 0.74, rounded = 0.7 lb ai/acre

As previously stated, peanuts are typically grown as a supplemental cash crop in the same counties where upland cotton is grown. The planter purchased to grow cotton at a 36- or 38-inch row spacing would also be used and would then dictate the row spacing for peanuts. Hence, peanuts in the southeast are planted in single rows, 36 inches apart. In the south-central United States, peanuts are typically planted in single rows, spaced 38 inches apart.[38] Less than 10 percent of the peanuts grown are planted as double-row beds, each row 28 inches apart and 6 feet between bed centers. In the south-central and western states, varieties of Spanish peanut are also grown. Many varieties of Spanish peanut require 20-inch row spacing. These varieties typically are grown in double-row beds with 6 feet between bed centers. When double-rowed peanuts are planted, only one application is applied over the bed, rather than to each row. Therefore, the application bands would be 6 feet apart.

These application rates are based on applying a maximum of 11 to 18.7 ounces product/1,000 feet of plant row. Assuming 36-inch row spacing, the application rate per acre approximately equates to 10 to 17 lb of product /acre. **This maximum single and seasonal rate should be specified on the label regardless of row spacing or formulation used.**

Rates for Nemacur 15G on Bok Choy for Nematode Control Applied as a 12- to 15-Inch Band Before or At Direct Seeding Only for California Only:

Maximum Single Application =0.1 to 0.2 lb ai/1,000 feet of row, 4.5 lb ai/acre

Maximum Seasonal Application = Not specified, but assumed as a single early season application = 4.5 lb ai/acre

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38 Ibid, and Dr. Benjamin Whitty, University of Florida, Agricultural Extension, Gainsville, Florida.

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14.7 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz = 0.138, rounded =0.1 lb ai/1,000 ft of row
18.4 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz = 0.1725, rounded
= 0.2 lb ai/1,000 ft of row

For 40-inch bed spacing: 2 rows X 14.7 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(40 in width X 1 ft/12 in)] = 3.60 , rounded = 3.6 lb ai/acre
2 rows X 18.4 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(40 in width X 1 ft/12 in)] = 4.50 , rounded = 4.5 lb ai/acre

In the western United States, bok choy is grown in beds with 2 rows per bed, each row spaced 20 inches apart, and each bed center 40 inches apart. (In the eastern United States, bok choy is grown in single rows, spaced 24-to-30 inches apart.)[39] These application rates are based on applying a maximum of 14.7 to 18.4 fluid ounces /1,000 feet of plant row. **The maximum seasonal rate should be specified on the label and indicate that it is applicable regardless of row spacing.**

Rates for Nemacur 15G on Cabbage and Transplanted Brussel Sprouts (Except Cabbage and Brussel Sprouts Grown for Seed) for Nematode Control Applied as a 6- to 15-Inch Band Over the Row Anytime Prior to Emergence When Seeded and Directly After Transplanting:

Maximum Single Application = 0.1 to 0.2 lb ai/1,000 feet of row, 4.5 lb ai/acre
Maximum Seasonal Application = a single early season application, 4.5 lb ai/acre

7.3 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz = 0.068, rounded
= 0.1 lb ai/1,000 ft of row
18.4 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz = 0.17, rounded
= 0.2 lb ai/1,000 ft of row

For 40-inch bed spacing: 2 rows X 7.3 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(40 in width X 1 ft/12 in)] = 1.78, rounded =1.8 lb ai/acre
2 rows X 18.4 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(40 in width X 1 ft/12 in)] = 4.50, rounded =4.5 lb ai/acre

For 24-inch row spacing: 1 row X 7.3 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(24 in width X 1 ft/12 in)] =1.49 , rounded =1.5 lb ai/acre
1 row X 18.4 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(24 in width X 1 ft/12 in)] =3.75, rounded =3.8 lb ai/acre

In the western United States, like bok choy, cabbage is grown in beds with 2 rows per bed, each row spaced 20 inches apart, and each bed center 40 inches apart. In the eastern United States, like bok choy, cabbage is grown in single rows, spaced 24-to-30 inches apart.[40] **The maximum**

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39 Dr. Vince Rubatzky, Horticultural Research and Information Center, University of California at Davis.

40 Dr. Vince Rubatzky, Horticultural Research and Information Center, University of California at Davis.

seasonal rate should be specified on the label to indicate that it is applicable regardless of row spacing.

Rates for Nemacur 15G on Eggplant for Nematode Control Applied as a 12-Inch Band Over the Row at Transplanting then Soil Incorporating:

Maximum Single Application = 0.1 lb ai/1,000 feet of row, 2.0 lb ai/acre, probably 1.0 lb ai/acre
Maximum Seasonal Application = Not specified, but assumed as a single early season application

14.7 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz = 0.1378, rounded
= 0.1 lb ai/1,000 ft of row

For single rows, 36-inch row spacing: 13.4 lb of product/acre X .15 ai in formulation = 2.01, rounded
= 2.0 lb ai/acre

For single rows, 72-inch row spacing: 14.7 oz of product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(72 in row width X 1 ft/12 in)]
=1.0 lb ai/acre

For commercial eggplant production in Florida, plants are staked in single rows with each row spaced 6 feet apart.[41] These application rates are based on applying a maximum of 14.7 ounces /1,000 feet of plant row. **Although the maximum seasonal application is assumed to be once because the application occurs at transplanting, the label should clearly indicate what the maximum seasonal rate is and that it is applicable regardless of row spacing or formulation used.**

Rates for Nemacur 15G on Garlic for Bulb and Stem Nematode Control Applied in the Furrow at Planting:

Maximum Single Application = 0.1 to 0.2 lb ai/1,000 feet of row, 4.5 lb ai/acre
Maximum Seasonal Application = Not specified, but assumed as a single early season application = 4.5 lb ai/acre

9.2 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz = 0.08, rounded
= 0.1 lb ai/1,000 ft of row
18.4 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz = 0.17, rounded
= 0.2 lb ai/1,000 ft of row

15 lb of product/acre X .15 ai in formulation =2.25, rounded = 2.3 lb ai/acre
30 lb of product/acre X .15 ai in formulation = 4.5 lb ai/acre
For 40-inch bed rows: 2 rows X 18.4 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X[43,560 sq ft/acre/(40 in row width X 1 ft/12 in)] =4.5 lb ai/acre

For commercial production, garlic is grown as two seedlines per bed (scattered cloves in two linear rows), each seedline is spaced 20-to-22 inches apart, and each bed center is 40 inches

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41 Dr. Stephen Kostewicc, Horticultural Research, University of Florida at Gainesville.

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apart.[42] These application rates are based on applying a maximum of 9.2 to 18.4 fluid ounces /1,000 feet of plant row or 15 to 30 lb product/acre with two seed rows per bed row and with 40-inch spaced bed rows. **Although the maximum seasonal application is assumed to be once because the application occurs at seeding, the label should clearly indicate what the maximum seasonal rate is.**

Rates for Nemacur 15G on Okra, Except in California, for Nematode Control Applied as a 12- to 15-Inch Band Before or At Planting:

Maximum Single Application =0.1 to 0.2 lb ai/1,000 feet of row, 2.3 lb ai/acre
Maximum Seasonal Application = Not specified, but assumed as a single early season application = 2.3 lb ai/acre

14.7 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz = 0.13, rounded = 0.1 lb ai/1,000 ft of row
18.4 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz = 0.17, rounded = 0.2 lb ai/1,000 ft of row

For 40-inch single-row spacing: 14.7 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(40 in row width X 1 ft/12 in)] = 1.8 lb ai/acre
18.4 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(40 in row width X 1 ft/12 in)] = 2.25, rounded = 2.3 lb ai/acre

For 40-inch double-row spacing: 2 rows X 14.7 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(40 in row width X 1 ft/12 in)] = 3.6 lb ai/acre
2 rows X 18.4 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(40 in row width X 1 ft/12 in)] = 4.50, rounded = 4.5 lb ai/acre

For 48-inch row spacing: [43,560 14.7 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X sq ft/acre/(48 in row width X 1 ft/12 in)] = 1.5 lb ai/acre

18.4 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(48 in row width X 1 ft/12 in)] = 1.87, rounded = 1.9 lb ai/acre

For 54-inch row spacing: [43,560 14.7 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X sq ft/acre/(54 in row width X 1 ft/12 in)] = 1.33, rounded = 1.3 lb ai/acre
18.4 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(54 in row width X 1 ft/12 in)] = 1.66, rounded = 1.7 lb ai/acre

In the United States, 90 percent of the okra grown commercially is planted in single rows spaced 40 inches apart for dwarf ; 48 inches apart for medium-tall; and 54 inches apart for tall varieties. Wide-row spacing is necessary because okra is harvested entirely by hand labor. The remaining 10 percent is planted with a two-row planter. Okra is commercially grown for fresh market in the southern part of the United States from northern Florida and

42 Dr. Edward Kurst, California Garlic and Onion Association, and Dr. Vince Rubatzky, Horticultural Research and Information Center, University of California at Davis.

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southern Georgia stretching west to California.[43] The label indicates a dosage of 14.7 to 18.4 oz/1,000 feet of row and provides the dosage for 36-inch row spacing. **Instead, the label should be amended to provide the dosage for 40-inch row spacing as the example dosage. Although the maximum seasonal application is assumed to be once because the application occurs at or before planting, the label should clearly indicate what the maximum seasonal rate is.**

Rates for Nemacur 15G on Non-Bell Peppers in California, Georgia and Puerto Rico Only for Nematode Control Applied as a 12-Inch Band Before or At Planting:
Maximum Single Application = 0.1 lb ai/1,000 feet of row, 2.0 lb ai/acre
Maximum Seasonal Application = Not specified, but assumed a single early season application =2.0 lb ai/acre

10 oz product/1,000 ft of row X .15 ai in product X 1 lb/16 oz =0.09, rounded = 0.1 lb ai/1,000 ft of row
14.7 oz product/1,000 ft of row X .15 ai in product X 1 lb/16 oz =0.13, rounded =0.1 lb ai/1,000 ft of row

For 72-inch bed spacing: 2 rows X 10 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(72 in row width X 1 ft/12 in)] =1.36, rounded = 1.4 lb ai/acre
2 rows X 14.7 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(72 in row width X 1 ft/12 in)] =2.00, rounded = 2.0 lb ai/acre

1.36 lb ai/acre/.15 = 9.07 rounded = 9.1 lbs of Nemacur 15G/acre
2.0 lb ai/acre/.15 = 13.33, rounded = 13.3 lbs of Nemacur 15G/acre

For 96-inch bed spacing: 2 rows X 10 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(96 in row width X 1 ft/12 in)] =1.02, rounded =1.0 lb ai/acre
2 rows X 14.7 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(96 in row width X 1 ft/12 in)] =1.50, rounded =1.5 lb ai/acre

Non-bell peppers are planted for commercial production in beds each containing two rows. Each bed row is spaced 20 inches apart, and each bed center 6 to 8 feet apart.[44] The label indicates a dosage of 10 to 14.7 oz/1,000 feet of row and 9.0 to 13.3 lb of Nemacur 15G/acre for 36-inch row spacing. **Instead, the label should be amended to provide the dosage for double-row beds, spaced 6 feet apart as the example dosage. Although the maximum seasonal application is assumed to be once because the application occurs at or before planting, the label should clearly indicate what is the maximum seasonal rate.**

Rates for Nemacur 15G on Strawberries for Nematode Control Applied as a 12- to 18-Inch Band Over the Row, then Incorporated by Cultivation or Irrigation Prior to Transplanting:
Maximum Single Application = 0.1 to 0.2 lb ai/1,000 ft of row, 4.5 lb ai/acre
Maximum Seasonal Application (one application) = 4.5 lb ai/acre

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43 DR. C.R. Andersen, Department of Horticulture, University of Arkansas at Fayetteville.

44 Dr. Vince Rubatzky, Horticultural Research and Information Center, University of California at Davis.

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14.7 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz =0.13, rounded
= 0.1 lb ai/1,000 ft of row
22 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz =0.20, rounded
= 0.2 lb ai/1,000 ft of row
Assuming two rows/bed and 48 inches between bed centers: 2 rows X 14.7 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(48 in bed width X 1 ft/12 in)] = 3.00, rounded = 3.0 lb ai/acre
2 rows X 22 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(48 in bed width X 1 ft/12 in)] = 4.49, rounded =4.5 lb ai/acre

These application rates are based on applying a maximum of 14.7 to 22 fluid ounces /1,000 feet of plant row. Strawberries for commercial production are planted in beds with two rows per bed that are spaced 11 inches apart with 4 feet of spacing from bed center to bed center.[45] Therefore, the product application rate equates to 20 to 30 lbs of product/acre. **The maximum seasonal rate is specified; however, a statement indicating the rate regardless of row spacing or formulation used should be added.**

Rates for Nemacur 15G on Non-bearing Strawberry Nursery Stock for Nematode Control Applied as a 12-Inch Band Over the Row, then incorporated by cultivation or irrigation:
Maximum Single Application = 0.1 to 0.2 lb ai/1,000 ft of row, 3.5 lb ai/acre
Maximum Seasonal Application = 7.0 lb ai/acre

17 oz product/1,000 ft of row X .15 ai in product X 1 lb/16 oz =0.15, rounded =0.2 lb ai/1,000 ft of row
Assuming two rows/bed and 48 inches between bed centers: 2 rows X 17 oz product/1,000 ft of row X .15 ai in formulation X 1 lb/16 oz X [43,560 sq ft/acre/(48 in bed width X 1 ft/12 in)] = 3.47, rounded = 3.5 lb ai/acre

The label specifies two applications, one pre-transplant and the other 8-weeks post-transplant. The maximum seasonal application would be 7 lb ai/acre or 46.7 lb of Nemacur 15G/acre. **The maximum number of applications is specified; however, the maximum seasonal rate needs to be indicated which is applicable regardless of row spacing or formulation used should be added. In addition, the label provides an example product dosage for 40-inch single row spacing of 13.8 lb of product/acre. Instead, the label could be amended to provide a double-row bed as the example product dosage.**

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45 Dr. Stephen Kostewicc, Horticultural Research, University of Florida at Gainesville, and Dr. Vince Rubatzky, Research and Information Center, University of California at Davis.

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Rates for Nemacur 15G on Pineapple, for Puerto Rico only, for Nematode Control Applied Broadcast then Soil Incorporated Mechanically, or by Rainfall or Irrigation Before Planting:
Maximum Single Application = 9.0 lb ai/acre
Maximum Seasonal Application = 18 lb ai/acre regardless of formulation

60 lb of product/acre X .15 ai in formulation = 9.0 lb ai/acre

These application rates are based on applying a maximum single application of 60 lb of product/acre which equates to 9.0 lb ai/acre. The label limits the maximum seasonal application of fenamiphos to 18 lb ai/acre regardless of formulation. **EFED recommends that the number of applications be reduced to reflect the lowest number necessary for efficacy based on actual data.**

Special Local Need Registration Label, dated March 17, 1997 with Rates for Nemacur 15G on Bananas and Plantains for Nematode and Banana Root Borer Control Applied as Grams/Production Unit:
Maximum Single Application = 4.5 to 6.8 lb ai/acre/8 ft spacing, 2.9 to 4.3 lb ai/acre/10 ft spacing
Maximum Seasonal Application (2 applications) = 13.6 lb ai/acre/8 ft spacing, 8.6 lb ai/acre/10 ft spacing

For 8-foot spacing:
20 grams/64 ft^2 X 43,560/ acre X 1 kg/1,000 grams X 1 lb/0.454 kg =29.983, rounded = 30.0 lb product/acre
30 grams/64 ft^2 X 43,560/acre X 1 kg/1,000 grams X 1 lb/0.454 kg = 44.975, rounded = 45.0 lb product/acre
30.0 lb of product/acre X .15 ai in formulation = 4.5 lb ai/acre
45.0 lb of product/acre X .15 ai in formulation = 6.75, rounded = 6.8 lb ai/acre

For 10-foot spacing:
20 g/100 sq ft X 43, 560 sq ft/1 acre X 1 kg/1,000 g X 1 lb/.454 kg = 19.18, rounded = 19.2 lb product/acre
30 g/100 sq ft X 43,560 sq ft/1 acre X 1 kg/1,000 g X 1 lb/.454 kg = 28.78, rounded = 28.8 lb product/acre
19.2 lb of product/acre X .15 ai in formulation = 2.88, rounded = 2.9 lb ai/acre
28.8 lb of product/acre X .15 ai in formulation = 4.32, rounded = 4.3 lb ai/acre

These rates are based on a maximum single application of 20 to 30 grams/corm and assuming a row spacing of 8 to 10 feet.[46] The number of square feet in one acre is 43,560. **EFED recommends that the number of applications be reduced to reflect the lowest number necessary for efficacy based on actual data.**

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46 Dr. C.L. Chia, Banana Production Extension Specialist, Hawaii Cooperative Extension Service, Hawaii Institute of Tropical Agriculture and Human Resources, University of Hawaii at Manoa.

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