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

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

Reregistration Case: 2460
PC Codes: 056702; 056703; 056704
DP Barcode: D341224

Date: 30 July 2007

MEMORANDUM

SUBJECT: **Nicotine**
(S) -3-(1-Methyl-2-pyrrolidinyl) pyridine
*CAS Reg***.** No. 54-11-5
Ecological Risk Assessment

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There are three active ingredients in the List B, nicotine and derivatives case number 2460: nicotine (PC code 056702), nicotine sulfate (PC code 056703), and tobacco dust (PC code 056704). There are no active products for either nicotine sulfate or tobacco dust; this memorandum transmits the ecological risk assessment for nicotine use as a pesticide active ingredient.

There are two active products for nicotine: Fulex Nicotine Fumigator (EPA Reg. No. 1327-41) and Shotgun® Rabbit and Dog Repellent (EPA Reg.No. 4-465). Fulex Nicotine Fumigator (13.4% nicotine) is a RESTRICTED USE pesticide to control aphids and thrips in greenhouses on ornamental plants. Since this formulation may only be used in greenhouses,

environmental exposures and ecological risk to non-target species are presumed to be negligible. Shotgun® Rabbit and Dog Repellent (Formerly F&B Rabbit and Dog Chaser) is a dust containing 0.35% nicotine[1], 15% naphthalene, and 15% dried blood and is exclusively for residential and/or homeowner use. The product is applied in the perimeter of plants or areas to be protected from dogs and rabbits. The mode of action of nicotine when used as a dog and rabbit chaser is unclear.

Potential Risks to Aquatic Organisms

The EFED performed a qualitative, screening level environmental fate assessment for nicotine using the estimation model EPISuite[2] and up-to-date scientific open literature obtained from peer-reviewed material. An aquatic exposure assessment was performed for the outdoor residential use (Shotgun® Dog and Rabbit Repellent), but not for the greenhouse-use product (Fulex Nicotine Fumigator). The aquatic exposure assessment was conducted using, the Tier I GENEEC (Version 2) simulation model and assuming three application band widths (2, 6, and 12 inches). All of the estimated environmental exposure concentrations (EECs) fall at or below 40 ng/L (40 ppt).

There were no acceptable toxicity data available to quantitatively assess the potential risks to of Shotgun® Rabbit and Dog Repellent to aquatic organisms. Acute and chronic risks to aquatic organisms cannot be precluded; however, given the extremely low predicted aquatic exposures, the likelihood of risk is presumed to be low. Acute toxicity data for freshwater fish (Guideline 72-1) freshwater invertebrates (Guideline 72-2), and aquatic plants (Guideline 123-2) would greatly reduce the uncertainty in this risk assessment.

Potential Risks to Terrestrial Organisms

Terrestrial dietary exposures were estimated using the T-REX model (Version 1.3.1) for Shotgun® Rabbit and Dog Repellent, a granular (dust) formulation for use in residential settings. Assuming a generic residential setting, the estimated exposure for a terrestrial animal is about 67 mg a.i./A. Acute mammalian toxicity data from the open literature suggest that nicotine is very highly toxic to mice, with an acute oral LD_{50} of 3 mg/kg,[3] and based on the modeled exposure, there is a potential for risk. However, this nicotine product is a rabbit and dog repellent, and if small mammals (*e.g.*, field mice) are similarly repelled, terrestrial dietary exposure may be unlikely.

There are no avian toxicity data available for nicotine, and it is unclear whether Shotgun® Rabbit and Dog Repellent is capable of repelling birds as well. Risk to birds cannot be precluded at this time. Acute and chronic avian toxicity data (Guidelines 71-1, 71-2, and 71-4) would greatly reduce this uncertainty regarding the risk of nicotine to birds.

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[1] The source of nicotine in the product is "tobacco dust". The USEPA's "Substance Registry System" defines **tobacco dust** (CAS Reg. No. 8037-19-2) as "extractives and their physically modified derivatives obtained from Nicotiana (*Solanaceae*) of unspecified molecular formula" (http://iaspub.epa.gov/srs/srs_proc_qry.navigate?P_SUB_ID=159855).

[2] EPI (Estimation Programs Interface) EPI Suite™ is a Windows® based suite of physical/chemical property and environmental fate estimation models developed by the EPA's Office of Pollution Prevention Toxics and Syracuse Research Corporation (SRC)

[3] These data have not been reviewed by the Agency.

There are no terrestrial invertebrate data available for consideration in this risk assessment. Nicotine shares a common mode of action with neonicotinoid insecticides, which have been implicated in honey bee incidents. An acute contact toxicity test with honey bees (Guideline 141-1) would greatly reduce the uncertainty in this risk assessment.

There are no terrestrial plant toxicity data available for consideration in this risk assessment. At this time, risks to terrestrial plants cannot be precluded. Tier I seedling emergence and vegetative vigor studies (Guideline 123-1(a,b)) would help reduce the uncertainty in this assessment.

Uncertainties and Data Gaps

The environmental fate and exposure assessments carry a high degree of uncertainty. The major sources of uncertainty are:

1. The assumptions made to estimate the application rate in terms of lbs nicotine/A for a product that is only applied within a localized area of the residential site (i.e., only a percent of the residential site is treated).
2. The environmental fate input parameters used to run GENEEC and FIRST come from estimates (EPISuite). However, when the EPISuite data is integrated and supplemented by the open scientific literature, a fairly complete qualitative environmental fate assessment could be made. The EFED concludes that the assessment is sufficient and that no guideline studies are necessary.
3. The 0.35% nicotine stated in the label was taken as the actual concentration of nicotine in the product and assumed that all of the nicotine is available for runoff.
4. The modeled EECs were adjusted to account for the uneven distribution of nicotine in the treated area based on an assumed generic residential setting and may be underestimated or overestimated depending on the actual use site conditions and application scheme of Shotgun® Rabbit and Dog Repellent.

There are no acceptable ecotoxicity data available to quantitatively estimate the potential ecological risks associated with the use of nicotine as a pesticide. **Table 1** summarizes the ecotoxicity data gaps for nicotine.

Table I.2 Ecological Effects Data Requirements for Nicotine			
Guideline	**Data Requirement**	**MRID**	**Are More Data Needed?**
71-1	Avian Oral LD_{50}	No data	**Yes**. The data waiver request for this study was denied in 1994, and the data are still needed. There are no data to quantitatively assess the potential acute risk to birds. Nicotine exposure to birds is possible. The assessed nicotine product is a mammalian repellent, but it is unclear if it also repels avian species. Acute mammalian toxicity data suggest possible high toxicity of nicotine to terrestrial animals.
71-2	Avian Dietary LC_{50}	No data	
71-4	Avian Reproduction	No data	**Yes**. There are no data to quantitatively assess the potential chronic risk to birds. Chronic nicotine exposure to birds is possible given that the product may be applied multiple times (as needed). The assessed nicotine product is a mammalian repellent, but it is unclear if it also repels avian species. Mammalian toxicity data suggest potential chronic toxicity effects of nicotine to terrestrial animals.
72-1	Freshwater Fish LC_{50}	00107188	**Yes**. The data waiver request for this study was denied in 1994, and the data are still needed. Data from the open literature suggest that nicotine is at least moderately toxic to freshwater fish.
72-2	Freshwater Invertebrate Acute LC_{50}	No data	**Yes**. Data from the open literature suggest that nicotine is at least highly toxic to freshwater invertebrates.
72-3(a)	Estuarine/Marine Fish LC_{50}	No data	Not at this time.
72-3(b)	Estuarine/Marine Mollusk EC_{50}	No data	Not at this time.
72-3(c)	Estuarine/Marine Shrimp EC_{50}	No data	Not at this time.
72-4(a)	Freshwater Fish Early Life-Stage	No data	Pending results of Guideline 72-1
72-4(b)	Aquatic Invertebrate Life-Cycle	No data	Pending results of Guideline 72-2
123-1(a)	Seedling Emergence (Tier I)	No data	**Yes**. There are no data to assess the potential phytotoxic effects of nicotine. There is a label statement that suggests potential phytotoxicity.[1]
123-1(b)	Vegetative Vigor (Tier I)	No data	**Yes**. There are no data to assess the potential phytotoxic effects of nicotine. There is a label statement that suggests potential phytotoxicity.[1]
123-2	Aquatic Plant Growth (Tier I)	No data	**Yes**. There are no data to assess the potential phytotoxic effects of nicotine. There is a label statement that suggests potential phytotoxicity.[1]
141-1	Honey Bee Acute Contact LD_{50}	No data	**Yes**. There are no data to assess the potential effects of nicotine to beneficial insects. Nicotine shares a common mode of action with a class of pesticides (neonicotinoids) that has been implicated in honey bee incidents.

[1] The label states, "Do not apply the product directly to foliage or stems." It is unknown if this refers to nicotine or one of the two other active ingredients in the formulation.

Label Recommendations

In order to reduce the amount of uncertainty associated with the estimated environmental exposures for nicotine, the EFED recommends that the label for Shotgun® Rabbit and Dog Repellent be amended to specify the following:

- Maximum band width (inches)
- Minimum application interval (days)
- Maximum single application rate (lbs a.i./A)
- Maximum annual application rate (lbs a.i./A)