United States
Department of
Agriculture

Marketing and
Regulatory
Programs

Animal and
Plant Health
Inspection
Service

Golden Nematode Ro2 Eradication in Livingston and Suffolk Counties, New York

Environmental Assessment, September 2008

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I. Introduction

A. Background

Golden nematode, *Globodera rostochiensis*, (GN) is considered to be potentially more dangerous than any of the insects and diseases affecting the potato industry. Once GN is established, potato production is impractical except in long crop rotations or when planting GN-resistant potato varieties. Potatoes and tomatoes are the principal crops of economic importance that are attacked by this pest. The nematode also reproduces on the roots of eggplant and other nonagricultural solanaceous plants.

GN was first discovered in the United States in 1941, when it was found to be responsible for serious crop damage in a potato field on Long Island, New York. Effective State/Federal quarantine, established and maintained for over 50 years, has limited the spread of GN to nine New York counties. Less than 6,000 acres are known to be infested.

The National Potato Council's 1994 Potato Statistical Yearbook shows that in 1992, potatoes were grown commercially in 35 States. The U.S. Department of Agriculture's (USDA) National Agricultural Statistics branch reports a 1994 national farm gate potato value of approximately $2.64 billion, a national combined tomato value of $1.68 billion, and a combined Florida and New Jersey eggplant value of $21 million. This $21 million, combined with the $8.93 million for California, would bring the total three-State eggplant value to $29.93 million. The combined annual farm gate production value of the principal host crops of GN in the United States is almost $4.35 billion.

GN is controlled by growing resistant potato varieties. Nearly 40 new GN-resistant potato varieties have been developed. Unfortunately, a second GN race (Ro2) that can infect these resistant potatoes has developed.

B. Biology of Golden Nematode

GN is a plant parasitic nematode that affects agricultural crops. GN is recognized as a major potato pest in Europe. In England, nearly 75 percent of potato production land is now infested resulting in severe crop restrictions.

Typical of most nematode life cycles, GN has four distinct juvenile stages and an adult stage. The second-stage juvenile hatches from the egg which is contained within a cyst formed from the cuticle of an adult female. Upon hatching, the second-stage juvenile is considered the active phase because it is the life stage that actively seeks host plants. Hatching occurs based on appropriate environmental factors and the presence of substances diffusing from the roots of host plants within the Solanaceae family, which includes the potato, tomato, and eggplant, as well as other nonagricultural hosts (appendix A). Extensive hatching will occur under optimal conditions; however, some juveniles will always remain dormant for several years, regardless of the conditions, to insure population viability (Turner and Evans, 1998). In cases where a host plant is not present, infestations can persist up to 30 years due to delayed hatching and the ability of the second-stage juvenile to become dormant within the cuticle cyst of the female (Turner, 1996; DEFRA, 1996).

Once the second-stage juvenile locates a host it will enter the root near the growing point, or a lateral root, and use its mouth, or stylet, to pierce a cell wall. A feeding tube is then formed as a precursor to the formation of a synctium, or transfer cell, which is formed by the enlargement of root cells and breakdown of the cell walls. The synctium facilitates the passage of nutrients to the nematode. In cases where the nematodes are able to maintain the synctium, the nematode will molt to the sedentary third and fourth stages, and then molt to either male or female adults. In cases where the synctium cannot be maintained and there is a lack of available nutrients, more male nematodes will be produced. Emergent males do not feed, and the fourth-stage male remains within the third-stage cuticle until the final molt to the adult. Likewise, in situations of high-nutrient availability, more females, which require high nutrient levels to facilitate egg production, will be produced.

Third-stage juvenile females develop a sac-like shape that will continue to expand through the fourth stage until the body lies outside the root cortex with only the head remaining in the root area. Once females breach the root zone, they release sex pheromones which attract males for fertilization. After fertilization, embryos will develop in the egg until the second-stage juvenile emerges. Prior to hatching of the second-stage juvenile, the female will die and the cuticle will form a protective cyst which will contain anywhere from 200 to 500 eggs (EPPO, 1990; Turner and Evans, 1998).

Cysts break off from infected plants and remain in the soil until a suitable host plant is present, thus allowing the second-stage juvenile to hatch and repeat the life cycle. The number of generations is dependent on environmental factors and host plant suitability; however, it is typically one generation per year in cooler soils, and can be twice per year under the appropriate environmental conditions (Turner and Evans, 1998).

In cases where GN can establish itself successfully on a host plant, it will reduce the size of the root system and alter total mineral uptake by the plant, resulting in reduced growth and yields due to water stress, altered mineral ratios, and early senescence. The impact on yield is affected by GN abundance where numbers can reach 10,000 individuals per gram of soil (DEFRA, 1996). However, nematode-related impacts to yield are also related to environmental factors and different plant cultivars (Phillips et al., 1998).

II. Purpose and Need

USDA, Animal and Plant Health Inspection Service (APHIS), is proposing a treatment program to eradicate a new race of golden nematode from Livingston and Suffolk Counties in New York, known as GN Ro2 race. The Ro2 race was first detected simultaneously in 1994 in a field on Long Island and in a research plot in South Lima, in western New York. The population in the Long Island field continued to increase even after several crops of the Ro2 resistant “Sunrise” potato cultivar were grown. Eventually, the Ro2 race was detected in 10 fields (4 fields in close proximity to each other in South Lima, New York, and 6 fields—2 of which have been converted to residential areas and, therefore, are not of concern—in close proximity to each other in Suffolk County, New York). The last new field in which Ro2 was detected was found in 2004. The Ro2 race has developed in areas where the Ro1 race previously had been found. Unfortunately, the Ro2 race is able to infest the GN-resistant potato varieties.

APHIS has the responsibility for taking actions to exclude, eradicate, and/or control plant pests under the Plant Protection Act (7 United States Code (U.S.C.) 7701 et seq.). It is important that APHIS take steps necessary to eradicate the Ro2 race of GN from areas in New York to prevent damage to potato crops in the United States. This is particularly important because the GN-resistant varieties of potatoes that have been developed are not resistant to the new GN Ro2 race. APHIS, in cooperation with the New York Department of Agriculture and Markets, is proposing an eradication program of the GN Ro2 race from the infested areas in New York. The program proposes to eradicate the GN Ro2 race from infested fields using a compound of methyl bromide and chloropicrin (MBC) fumigation to prevent infestation of other potato-growing areas, to protect potatoes, tomatoes, and other solanceous plants, and prevent excessive pesticide use as others treat for GN Ro2. The eradication program will continue for a period of 5 to 7 years to ensure elimination of the nematode.

This environmental assessment (EA) has been prepared consistent with the National Environmental Policy Act of 1969 (NEPA) and APHIS’ NEPA implementing procedures (7 Code of Federal Regulations (CFR) part 372) for the purpose of evaluating how the proposed action, if implemented, may affect the quality of the human environment.

III. Affected Environment

The treatment site contains eight infested fields, as well as adjacent fields, to ensure the eradication of GN Ro2. Four of the infested sites are located in a rural area near South Lima, New York, and an additional four infested sites are located in Long Island, New York. Depending on the number of adjacent fields that are treated, the treatment area could contain a maximum of 812 acres.

A. South Lima, New York

South Lima is in the northwest section of Livingston County in New York State. The infested sites in South Lima are artificially drained. The area has a high water table and contains clay soil. The Little Conesus Creek runs between two of the infested fields, and an unnamed tributary to Spring Brook is adjacent to one of the other GN Ro2-infested fields. There are no drinking water wells within this treatment area. In addition, there are no schools or commercial establishments within the immediate vicinity.

B. Suffolk County, New York

Suffolk County occupies two thirds of Long Island, New York. The weather is temperate and the area has excellent farming conditions, including abundant water and good quality soil. Suffolk is the leading agricultural county in the State of New York. The four infested fields are at the eastern end of Suffolk County, near the town Sagaponack, New York. Some parts of the infested fields, as well as adjacent lots, are being or have been sold for development of residential lots. There are no drinking water wells within the treatment area. No schools or commercial establishments are within the immediate vicinity of the proposed treatment area.

IV. Alternatives

This EA analyzes the potential environmental consequences of the proposed action to eradicate GN Ro2 race from fields in New York where it has been detected. Two alternatives are being considered: (1) no action by APHIS to eliminate GN Ro2 race, and (2) the preferred alternative, which includes the application of MBC to eradicate the GN Ro2 race from infested fields in Livingston and Suffolk Counties, New York, over a period of 5 to 7 years.

A. No Action Alternative

Under the no action alternative, APHIS would not eradicate the GN Ro2 race from New York. The Federal and State domestic quarantine orders would remain in effect. Under the Federal Order, the infested fields may not grow potatoes, tomatoes, eggplants, or other host crops of GN. In addition, regulated articles (including potatoes, nursery stock, and soil) may not be moved outside the quarantine zone unless the articles are from sites that have been tested and found free of GN. Farm equipment may not be removed from an infested field unless it has been pressure washed to ensure that all soil has been removed, or it has been steam treated in accordance with schedule T406–d of the USDA, Plant Protection and Quarantine (PPQ) Treatment Manual (available: www.aphis.usda.gov/import_export/plants/manuals/ports/treatment.html).

B. The Preferred Alternative

Prompted by finds of potato cyst nematode (PCN) in Idaho in 2006 and golden nematode in Canada in 2006 and 2007, PPQ determined the need to review the GN program. The review was conducted by PPQ, National Plant Board personnel and nematologists, in conjunction with a PCN Technical Working Group meeting in late March, 2008. A number of recommendations were made during the GN review, including "attempt eradication in a manner similar to the program in Idaho, of any field where race Ro2 is known to exist" (USDA, APHIS, 2008). As a result, the preferred alternative is derived from the PCN program in Idaho and consists of maintaining the current State and Federal quarantine orders, as well as spring and fall treatment with MBC fumigation of currently infested fields, some associated fields, and a buffer area. This twice-per-year treatment could continue for 5 to 7 years to ensure that the GN Ro2 race is eradicated, depending upon the results of regular monitoring of the GN Ro2 population. The fall treatment would occur in September 2008 in the Livingston County site, and both sites will begin receiving spring and fall applications of MBC in 2009. A nonharvested cover crop will be planted prior to the fall treatment. A cover crop may be planted after the fall treatment; however, the planting will be dependent on weather conditions and pesticide label directions. When appropriate, cover crops may consist of biofumigants which are plants that naturally produce secondary products which are toxic to some soil micro-organisms, including nematodes. Management of fields during the eradication program, including use of a cover crop, will be established through cooperative grower agreements. In addition, phytosanitary requirements are in place for application equipment to ensure the GN Ro2 race is not artificially spread from treated fields. The planned chemical treatment available for spring and fall is discussed below.

A standard application of MBC will be injected approximately 12 inches below the soil surface at a rate of 600 lbs of 98 percent methyl bromide plus 2 percent chloropicrin per acre, in the Livingston County sites, and 435 lbs per acre in the Suffolk County sites. The heavier, mucky soil in Livingston County requires a higher application rate than the sandy soil in Suffolk in order to be efficacious. Methyl bromide is odorless and the chloropicrin serves as a warning agent. A plastic tarpaulin will cover the treated fields for approximately 4 days to reduce off-site transport and promote degradation.

V. Environmental Impacts

A. No Action Alternative

The no action alternative in the GN Ro2 program would be the continuation of the domestic quarantine order which is currently in place in New York. In addition to preventing farmers from growing potatoes and other host crops, the current order restricts interstate movement of regulated articles including—

- potatoes,
- nursery stock,
- soil, compost, humus, muck, peat, and decomposed manure,
- grass sod,
- small grains and soybeans,
- hay, straw, fodder, and plant litter,
- ear corn, except shucked,
- used farm equipment, and
- any other products, articles, or means of conveyance of any character, whatsoever, when it is determined by an inspector that they present a hazard of the spread of GN.

The no action alternative would provide a means of slowing the spread of the GN Ro2 race from infested fields and outside of the State; however, due to the difficulty of inspecting all the regulated articles listed above, it would not be easy to contain the infested acreage to the small area where it currently exists. In addition, GN can be spread by wind dispersal, water runoff from infested fields, and livestock movement from infested areas (Turner and Evans, 1998). The GN Ro2 race would be expected to expand its range beyond the currently infested fields and possibly infect other potato-growing areas within the State of New York, as well as other potato-growing regions in the United States (figure 1).

Movement of GN Ro2 race to other potato-growing areas of the United States would eventually result in nematode levels reaching economic threshold levels which would justify additional pesticide applications. Applications to newly infested areas could result in pesticide applications occurring in proximity to sensitive areas which could be a human health and/or environmental concern. The current area of infestation does not occur in an environmentally sensitive area; therefore, risks to human health and the environment are considered minimal.

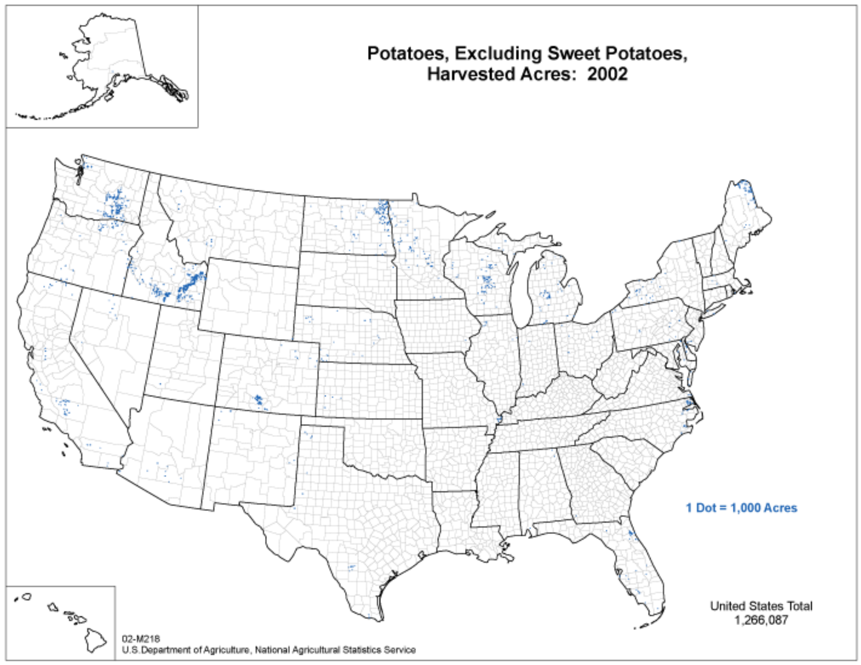

Figure 1. Harvested potato acreage for 2002 in the United States. (USDA, National Agricultural Statistics Service)

While the GN Ro2 infestation is localized and affects only potatoes, GN is known to have additional host plants within the plant family Solanaceae (appendix A). These include other agricultural crops, such as tomatoes and eggplant, and also a wide variety of nonagricultural species. While the impacts of GN Ro2 race to Solanaceae other than potatoes are unknown, it could be expected to impact those species in cases where nematode levels increase to damaging levels. In addition, these areas could serve as sources for the GN Ro2 race to be spread to other areas where the planting of GN-resistant strains has reduced or eliminated GN infestations.

Controlling the GN Ro2 race in agricultural and nonagricultural areas would require increased pesticide use which would result in an increase in pesticide loading to the environment with fumigants, such as MBC, as well as other nematicides. High use rates are common with fumigants, therefore, any additional pesticide applications to control the GN Ro2 race could dramatically increase environmental loading while also increasing potential risk. Environmental concerns could result from the increased use of pesticides while also increasing production costs for any crops which would require additional pesticide applications. Eradication of the GN Ro2 race from the relatively small area which has been identified for the current program would reduce the potential need for additional pesticide applications over larger geographic areas at a later time because GN infestations are being controlled by planting resistant strains.

B. The Preferred Alternative

The preferred alternative consists of maintaining the Federal Order to prevent any futher movement of the GN Ro2 race, and to eradicate it from currently infested fields using two pesticide treatments per year. The Federal Order and associated monitoring for the GN Ro2 race are not expected to have any environmental effects; therefore, the discussion on potential environmental impacts from the preferred alternative will focus on pesticide use. The pesticide being considered for use in the GN Ro2 race eradication program is MBC.

The chemical treatments, as applied in this preferred alternative, will result in minimal human health and nontarget effects. This is based on the notices to the public and the adherence to warning signs on the treatment areas, as well as to the adherance to the pesticide labels. There is always concern of effects to global warming with the use of methyl bromide because it is a volatile compound and is a known ozone-depleting chemical. However, under this alternative, the quantity and use of methyl bromide will not produce significant effects, as described below.

1. Methyl Bromide/ Chloropicrin

The U.S. Environmental Protection Agency (EPA) approved the pesticide label for the proposed application of MBC for the GN Ro2 race eradication program. The compound contains two active ingredients—methyl bromide, which is the primary active ingredient comprising 98 percent of the formulated product, and chloropicrin, which makes up the remaining 2 percent of the product. The purpose of adding chloropicrin to the formulation is to act as a warning agent because methyl bromide is odorless, while chloropicrin has a strong odor. Risk profiles for both chemicals are discussed in the following sections.

2. Methyl Bromide

a. Toxicity

Methyl bromide is an odorless gas which has low to moderate toxicity via oral or inhalation exposure. Methyl bromide does have high toxicity through dermal and ocular routes of exposure (EPA, 2006a). The median lethal oral dose (LD_{50}) in the rat was 104 milligrams/kilograms (mg/kg), while the median lethal inhalation concentration (LC_{50}) was 780 parts per million (ppm) (EPA, 2005). Neurotoxicity is the major hazard concern in acute and chronic toxicity exposure studies. Decreased activity, ataxia, and tremors are common signs of exposure in inhalation studies using methyl bromide. In developmental inhalation studies using the rabbit, the maternal no observed adverse effects level (NOAEL) was 40 parts per million (ppm), while the developmental toxicity NOAEL was also 40 ppm. In longer term studies (5 to 7 weeks) using the dog, a systemic NOAEL of 26 ppm was established based on daily doses of methyl bromide. Chronic studies using the rat, over a 127-week period, resulted in a lowest observed adverse effects level of 3 ppm, based on respiratory irritation and a systemic toxicity NOAEL of 30 ppm. Methyl bromide has not been shown to be carcinogenic (EPA, 2006a).

In nontarget organisms, such as birds, the clinical signs of toxicity are comparable to mammals. Decreased activity, ataxia, and tremors were noted clinical signs of toxicity for the bobwhite quail. The LD_{50} value was 73 mg/kg with a no observable effect concentration (NOEC) of 33 mg/kg. Impacts to nontarget plants, ground dwelling invertebrates, fungi, and other nematodes are expected; however, these impacts will be limited to areas of treatment.

Methyl bromide is moderately to highly toxic to aquatic organisms. The range of acute LC_{50} values in five different fish species ranges from 0.7 to 17 ppm. Chronic fish toxicity is lower with a reported NOEC of 0.1 ppm. Toxicity to the freshwater aquatic invertebrate, *Daphnia magna*, appears to be similar to fish, with a reported 48-hour LC_{50} value of 2.6 ppm and a NOEC of 1.2 ppm. The breakdown product of methyl bromide, the bromide ion, has also been evaluated for aquatic toxicity and found to be much less toxic to aquatic fauna. For acute exposures to fish and invertebrates, the bromide ion was approximately four to five orders of magnitude less toxic for invertebrates and fish. Chronic fish toxicity values for the bromide ion were also less toxic than methyl bromide with a NOEC value which is an order of magnitude less than the parent.

b. Exposure and Risk

The primary mechanism of methyl bromide dissipation is through volatilization into the atmosphere. Methyl bromide that does not volatilize is susceptible to hydrolysis (half-life 8 to 30 days), as well as microbial activity, with reported aerobic soil half-lives ranging from 6 to 57 days, depending on soil type. Degradation of methyl bromide is dependent on soil organic matter, with increased rates of degradation in soils with increasing levels of organic matter. Methyl bromide degradation in water is somewhat pH-dependent with hydrolysis half-life values ranging from 29 days at a pH of 3.0, to 9 days at a pH of 8.0 (EPA, 2005).

Management techniques in the field can also have a large influence on methyl bromide volatilization and degradation. The use of plastic tarpaulins after methyl bromide application has been shown to be an effective means of reducing volatilization and increasing degradation of methyl bromide (EPA, 2005). Soil injection has also been shown to be an effective means of limiting methyl bromide volatilization (Yagi et al., 1995). Both management actions will be implemented in the GN Ro2 eradication program as a means to limit off-site movement of MBC. Language on the label regarding placards for the site, as well as the use of chloropicrin as a warning agent, will further reduce potential human-related exposure. Additional mitigation measures to protect human health have been proposed by EPA during the reregistration eligibility decision which was recently published. Any additional mitigation measures which become part of the label will also be implemented in this program (EPA, 2008a). Cover crops, which will not be harvested, will be planted in treated fields during the program; therefore, the risk of dietary exposure for humans is deemed negligible.

There is the potential for small, nontarget, terrestrial organisms to be exposed through inhalation or ingestion of contaminated soil. The proposed treatment areas are agricultural fields which are highly disturbed areas. The likelihood of small terrestrial organisms being exposed is expected to be minimal. The use of plastic tarpaulins and the warning agent, chloropicrin, will act as a deterrent for small mammals that may try to forage in or near treated fields. Residues in forage from any cover crops planted in treated fields would not contain MBC due to the time period between the fumigation and cover-crop planting. Any exposure to nontarget terrestrial organisms related to the ingestion of treated soil or inhalation should not be at levels sufficient to cause adverse effects. Small terrestrial nontarget organisms that could serve as prey would not be expected to accumulate sufficient residues to impact predators. Methyl bromide has been shown to be rapidly excreted primarily through urine or exhaled as carbon dioxide (EPA, 2006a). The environmental fate and limited exposure pathway, as well as the rapid metabolism of methyl bromide, would suggest that methyl bromide does not accumulate in the tissue of exposed animals.

Because volatilization is the primary means of dissipation, exposure to aquatic organisms is expected to be minimal. For methyl bromide remaining in soil, there is the potential for off-site transport due to high solubility and mobility under various conditions (EPA, 2005; Gan et al., 1994). Off-site transport in surface water will be minimized by the use of tarpaulins which will cover the treatment area and reduce off-site transport from rainfall events. The use of tarpaulins will also facilitate degradation to the bromide ion, which has a lower toxicity to aquatic organisms when compared to the parent material. In addition, all applications will be made as injections 12 inches below the soil surface, thus minimizing the potential for MBC to impact groundwater resources. The use of tarpaulins will minimize the potential for vertical and lateral transport of MBC during rain events to groundwater resources.

Methyl bromide has been identified by EPA and the United Nations as a product which may cause ozone-layer depletion; however, manmade sources of methyl bromide contribute a minor amount of ozone-depleting compounds to the atmosphere when compared to other chlorine and bromine gas sources (figure 2). Total chlorine gas sources are more than 100-fold above bromine sources.

Atmospheric methyl bromide levels peaked in the 1990’s, and have been decreasing at a rate of 4 to 6 percent per year in the northern hemisphere since 1996 (UNEP, 2007; Yokouchi et al., 2002). While many of the ozone-depleting substances have long half-lives in the atmosphere, the half-life for methyl bromide is comparatively shorter (0.7 years) and, therefore, any decline in methyl bromide use is reflected more quickly in atmospheric levels.

Based on the proposed application rate for the GN Ro2 race eradication program (600 lb product/acre twice a year in Livingston County, and 435 lb product/acre twice a year in Suffolk County), the estimated treatment area, including adjacent fields and buffer areas (a maximum of 812 acres), and the total global human use of methyl bromide in 2006 (143,000,000 lb), the percent contribution to global human methyl bromide use from the GN Ro2 race eradication program per year would be 0.68 percent (EPA, 2006b). This is a minor contribution to the total manmade methyl bromide released, and an even smaller contribution to all ozone-depleting substances. The additional methyl bromide loading is planned to last for up to 7 years. If the proposed GN Ro2 race eradication program is not implemented, GN Ro2 race distribution would be expected to expand into other potato-growing areas in the United States, potentially resulting in a substantial increase in the use of methyl bromide over a much larger area for a longer period of time.

c. Summary

The proposed method of application, the limited area of treatment, and adherence to all label recommendations will minimize potential exposure and risk of MBC to human health and the environment. Risk to terrestrial organisms is also minimal due to the method of application and the environmental fate of MBC. Risk to human health and the environment is further reduced by other management practices, such as soil injection of MBC, posting warning signs at the application site, and the use of plastic tarpaulins to reduce volatilization of MBC and enhance degradation.

Potential impact to the ozone layer is also minimal because methyl bromide is not a large source of manmade ozone-depleting gases, and its use in this program relative to global methyl bromide use is negligible.

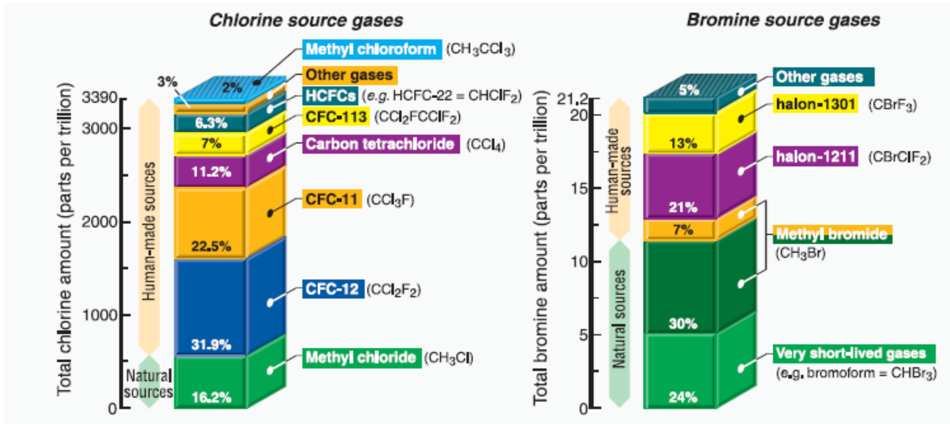

Figure 2. Primary source of chlorine and bromine gases for the stratosphere in 2004. (Source: UNEP, 2006. Twenty Questions and Answers about the Ozone Layer: 2006 Update.)

3. Chloropicrin

a. Toxicity

Chloropicrin is a fumigant with insecticidal, fungicidal, herbicidal, and nematicidal properties which is used in several agricultural and greenhouse applications (EPA, 2008b). Maximum use rates can vary from 175 to 500 lbs active ingredient (ai)/acre in formulations containing up to 100 percent chloropicrin; however, when it is applied as 2 percent of the formulation, or less, as in this case, it is considered a warning agent preventing accidental fumigant exposure because methyl bromide is nearly odorless. Chloropicrin, when inhaled, causes eye and nasal irritability. It has chemical properties similar to other fumigants, such as high volatility (vapor pressure of 20 mm Hg at 20 ^{o}C), and a low affinity for binding to soil (Koc 36.05 ml/g).

Mammalian toxicity data for chloropicrin demonstrates high acute and chronic toxicity based on acute oral (LD_{50} = 37.5 mg/kg), acute inhalation (LC_{50} = 17 ppm), and chronic inhalation (NOEL = 0.4 ppm) studies. Chronic feeding studies using the rat and dog resulted in a NOAEL value of 0.1 mg/kg/day for both test species based on periportal hepatocyte vacuolation and thyroid C-cell hyperplasia in the rat, and gastrointestinal irritation and blood chemistry alterations in the dog (EPA, 2006c).

No acute or chronic data are available which describes effects to avian species. Chloropicrin is toxic to soil borne invertebrates, plants, and fungi; however, impacts would be restricted to areas of treatment.

Chloropicrin is considered very highly toxic to aquatic organisms, with fish LC_{50} values ranging from 16.5 part per billion (ppb) for the rainbow trout, to 105 ppb for the bluegill sunfish. Toxicity to aquatic invertebrates is similar to fish, with a 48-hour median effective concentration (EC_{50}) value of 63 ppb for *Daphnia pulex*. No chronic aquatic toxicity values appear to be available for chloropicrin; this may be due to its extremely short half-life in water (EPA, 2006d).

b. Exposure and Risk

Based on the chemical properties of chloropicrin, the primary route of dissipation is through volatilization. Once the material volatilizes, it will photolyze rapidly with half-lives ranging from 3.4 to 8 hours in direct sunlight. Material left in the soil will break down with half-lives ranging from 4.5 to 10 days (EPA, 2006d). No exposure from drift is expected based on the method of application (soil injection approximately 12 inches below the soil surface). The use of plastic tarpaulins on the fields after application will further reduce exposure to any nontarget terrestrial organisms.

The low affinity for adsorption to soil and high water solubility (1.62 g/L) suggests that chloropicrin is mobile in soil and could impact aquatic resources. Proposed areas of application in this program may be sensitive to off-site transport of mobile pesticides, such as chloropicrin. Significant surface water exposure is not expected based on the method of application, small area of treatment, and the short environmental half-life for chloropicrin. The use of tarpaulins over the treatment area will also reduce the potential for runoff and allow for degradation of chloropicrin. The method of application (soil injection to 12 inches followed by tarping) will also reduce the potential for groundwater contamination by reducing the possibility of vertical movement of water through soil which could contain chloropicrin. In addition, the use rate of chloropicrin in this program is very low relative to its normal use as a fumigant. The low application rate further reduces exposure in aquatic environments. No food crops will be harvested from the treated fields for the duration of the program.

Direct and indirect exposure to nontarget terrestrial organisms is unlikely due to the method of application and the use of plastic tarpaulins during treatment. There is a slight possibility that terrestrial prey could be contaminated if they ingest soil from the treated area; however, prey would have to occupy the treated fields immediately after removal of the plastic tarpaulins to be exposed. Because its use for this application is as a warning agent, any terrestrial prey would most likely not forage in treated areas due to the eye and nasal irritability of chloropicrin. In the event of chloropicrin exposure, and based on the low octanol water partition coefficient (2.58) and rapid metabolism in mammals, residues would not accumulate in tissue. Risks to human health and the environment are expected to be minimal.

c. Summary

The use of chloropicrin poses minimal risk to human health based on the method of application, environmental fate, and the use of chloropicrin as a warning agent on a small number of acres. These factors also contribute to reducing exposure to nontarget organisms, and minimizing risk to nontarget terrestrial and aquatic resources. Risk to human health and the environment is further reduced by other management practices, such as soil injection during application, posting warning signs at the application site, and the use of a tarpaulin to reduce volatilization and enhance degradation. Based on the low exposure potential and available toxicity data, the use of chloropicrin and methyl bromide as a formulated mixture will not significantly increase environmental risk as compared to the associated risks when used individually.

C. Cumulative Effects

Cumulative effects from the preferred alternative relate to the management actions in the proposed treatment area. The fields are currently fallow and will remain out of production for the duration of the eradication program. A cover crop will be planted after the first application to reduce the potential for soil erosion; therefore, no cumulative impacts related to soil erosion are expected. A cover crop may be used in the winter; however, it will be dependent on whether environmental conditions allow a cover crop to be established prior to the end of the growing season. Soil erosion related to the preferred alternative is not expected to be any greater than would occur under typical agricultural practices in the area.

Cumulative effects to nontarget aquatic and terrestrial resources are expected to be minimal. Within the areas of treatment there will be mortality to the target pest, as well as mortality to most plant, fungal, microbial, and terrestrial invertebrate fauna. These impacts are not expected to be cumulative because the fields scheduled for treatment are intensively managed agricultural fields and are similarly affected by standard agricultural practices. Cumulative impacts to nontarget terrestrial and aquatic resources are expected to be minimal based on the small area of application, the method of application, and environmental fate for methyl bromide and chloropicrin which will reduce exposure. The highly volatile nature of MBC and the relatively rapid degradation of any MBC that does not volatilize will prohibit any accumulation of fumigant during (and after) the eradication project, thus no cumulative effects are anticipated. The treated fields will be removed from traditional agriculture and will be planted with a cover crop for the duration of the eradication program. At the conclusion of the project, the fields can revert to agricultural use, assuming the successful eradication of GN.

The proposed maximum 812-acre treatment area is composed of potato fields, adjacent fields, and a buffer area which will not be planted with crops that could provide residues for human health exposure; therefore, no cumulative effects are anticipated from additional dietary MBC crop residues. The method of application and following the precautionary label language further reduces other pathways of exposure and minimizes cumulative impacts to human health.

As previously discussed, MBC is a highly volatile fumigant which can impact air quality and has been identified as an ozone-depleting compound. The impact of program MBC treatments on air quality, as it relates to other methyl bromide use on a local level, is expected to be minimal. The proposed application methodology, including the use of tarpaulins and deep soil injections, as well as the small area proposed for treatment, will minimize potential cumulative impacts to air quality.

Chloropicrin is not known to be an ozone-depleting compound; however, on a global scale, the use of methyl bromide in the GN Ro2 eradication program will contribute to the overall release of manmade ozone-depleting substances. Relative to the global use of methyl bromide, two applications of MBC in the GN Ro2 eradication project equates to approximately 0.68 percent of the total annual manmade methyl bromide use. When compared to all sources of chlorinated and brominated ozone-depleting substances, the proposed use represents an even smaller fraction of the total amount of ozone-depleting compounds (figure 2).

D. Threatened, Endangered, and Protected Species

Section 7 of the Endangered Species Act (ESA) and its implementing regulations require Federal agencies to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of critical habitat. No federally listed species occur in Livingston County, NewYork. Therefore, the proposed eradication program for GN Ro2 race will have no effect on listed species in that county. In Suffolk County, several federally listed species occur, including sea turtles, piping plover, roseate tern, sandplain gerardia, seabeach amaranth, shortnosed sturgeon, and small whorled pogonia. The treated fields would not be expected to be habitat for those species. In addition, APHIS received a report from the New York Natural Heritage Program, dated July 31, 2008, indicating that no federally listed species have been reported in or near the proposed treatment area. Therefore, the eradication program will have no effect on federally listed species.

In 2007, the bald eagle was removed from protection under ESA; however, it remains federally protected under the Bald and Golden Eagle Protection Act. As a result, protection measures for the eagle must still be implemented. In accordance with APHIS policies, the program will implement the protection measures specified by the Act if eagles are found in the vicinity of the eradication project. Bald eagles are not known to occur in Suffolk County. There may be bald eagles in Livingston County. If their presence in the project area is confirmed, APHIS will implement appropriate protection measures as outlined in the National Bald Eagle Management Guidelines (U.S. FWS, 2007).

VI. Other Considerations

Executive Order (EO) 13175, "Consultation and Coordination with Indian Tribal Governments," was issued to ensure that there would be "meaningful consultation and collaboration with tribal officials in the development of Federal policies that have tribal implications…." There are no tribal lands in the vicinity of the proposed eradication project, thus, the initiation of this project will have no direct impact to Native Americans. However, if the GN Ro2 race were to spread from the currently infested fields, there is a potential to impact all potato growers, including those who are Native Americans. State and Federal agriculture officials have consulted and collaborated with Indian tribal officials to ensure that they are well-informed and represented in policy and program decisions which may impact their agricultural interests. Collaboration with the Native American officials will continue, as appropriate, until the proposed eradication of GN Ro2 race is achieved.

EO 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations," focuses Federal attention on the human health and environmental conditions of minority and low-income communities, and promotes community access to public information and public participation in matters relating to human health or the environment. This EO requires Federal agencies to conduct their programs, policies, and activities that substantially affect human health or the environment in a manner so as not to exclude persons and populations from participation in or benefiting from such programs. It also enforces existing statutes to prevent minority and low-income communities from being subjected to disproportionately high or adverse human health or environmental effects. APHIS has determined that the environmental and human health effects from the proposed applications for eradication of the GN Ro2 race in New York are minimal and are not expected to have disproportionate adverse effects to any minority or low-income populations.

EO 13045, “Protection of Children from Environmental Health Risks and Safety Risks,” acknowledges that children, as compared to adults, may suffer disproportionately from environmental health and safety risks because of developmental stage, greater metabolic activity levels, and behavior patterns. This EO (to the extent permitted by law and consistent with the agency’s mission) requires each Federal agency to identify, assess, and address environmental health risks and safety risks that may disproportionately affect children. Applications will not occur in proximity to schools, parks, or daycare facilities where children may be present. In addition, the method of application and management of the fields will minimize residues from drift, volatilization, and dietary exposure. Based on the distance of the application area from surface and groundwater resources, no residues from any of the proposed fumigants are anticipated to occur in drinking water. A cover crop will be planted between applications of MBC and possibly after the fall application; however, none of the cover crop will be harvested for human or livestock consumption. None of the alternatives being considered are expected to have disproportionately high or adverse human health or environmental effects to children.

VII. Agencies and Individuals Consulted

This EA was prepared and reviewed by APHIS. The addresses of participating APHIS units, cooperators, and consultants (as applicable) follow.

U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Policy and Program Development
Environmental Services
4700 River Road, Unit 149
Riverdale, MD 20737–1238

U.S. Department of Agriculture
Animal Plant Health Inspection Service
Plant Protection and Quarantine
Emergency and Domestic Programs
4700 River Road, Unit 134
Riverdale, MD 20737

U.S. Department of Agriculture
Animal Plant Health Inspection Service
Plant Protection and Quarantine
8327 Kanona Road
Avoca, NY 14809

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Appendix A: Potential Host Plants for *Globodera rostochiensis*

Primary Hosts:
Lycopersicon esculentum (tomato)
Solanum melongena (eggplant, aubergine)
Solanum tuberosum (potato)

Minor Hosts:
Datura stramonium (Devil's trumpet, Jamestown-weed)
Lycopersicon pimpinellifolium (currant tomato) (syn. Lycopersicon racemigerum)
Oxalis tuberosa (oca)
Solanum aviculare (kangaroo apple)
Solanum gilo (syn. Solanum integrifolium) (scarlet or tomato eggplant)
Solanum indicum (Indian nightshade)
Solanum marginatum (white-edged (margined) nightshade)
Solanum mauritianum (tree tobacco, earleaf nightshade)
Solanum nigrum (black nightshade)
Solanum quitoense (Naranjillo)
Solanum sarrachoides (hairy nightshade)

Other Hosts:
Avena sativa (oat)
Datura tatula (jimsonweed)
Hyoscyamus niger (black henbane)
Lycopersicon glandulosum (Peruvian nightshade)
Lycopersicon hirsutum (hairy tomato)
Lycopersicon pyriforme (garden tomato)
Physalis philadephica (Mexican groundcherry)
Physochlainia orientalis (purple trumpet flowers)
Pistacia vera (pistachio)
Salpiglossis spp. (painted tongue)

Other *Solanum* spp.
Solanum acaule (Wild Andean potato)
Solanum aethiopicum (Ethiopian nightshade, African eggplant)
Solanum alandiae
Solanum alatum (red fruited nightshade)
Solanum anomalocalyx
Solanum antipoviczii (now S. stoloniferum)
Solanum armatum (forest nightshade)
Solanum ascasabii
Solanum asperum
Solanum berthaultii (wild potato)

Solanum blodgettii (mullein nightshade)
Solanum boergeri
Solanum brevimucronatum
Solanum bulbocastanum – (ornamental nightshade) - also listed as *S. bulbocastana*
Solanum calcense
Solanum caldasii
Solanum canasense
Solanum capsicibaccatum
Solanum capsicoides (cockroach berry)
Solanum carolinense (Carolina horsenettle)
Solanum chacoense – (Chaco potato) also reported as *S. chacoense* v. *subtilis*
Solanum citrullifolium (watermelon nightshade) – also listed as *S. citrillifolium*
Solanum coeruleifolium (chaucha)
Solanum commersonii (Commerson's nightshade)
Solanum curtilobum (rucki)
Solanum curtipes
Solanum demissum (nightshade)
Solanum demissum x Solanum tuberosum
Solanum dulcamara (bittersweet)
Solanum elaeagnifolium (silverleaf nightshade)
Solanum famatinae
Solanum garciae
Solanum gibberulosum
Solanum giganteum (African holly)
Solanum gigantophyllum
Solanum glaucophyllum (waxyleaf nightshade)
Solanum goniocalyx (yellow potato)
Solanum gracile (whitetip nightshade)
Solanum heterodoxum (melonleaf nightshade)
Solanum heterophyllum (unarmed nightshade)
Solanum hirtum (huevo de gato)
Solanum hispidum (devil's fig)
Solanum integrifolium (eggplant, tomato)
Solanum intrusum (garden huckleberry)
Solanum jamesii (wild potato)
Solanum jujuyense
Solanum kesselbrenneri (phureja)
Solanum kurtzianum
Solanum lanciforme (heartleaf nightshade)
Solanum lapazense
Solanum lechnoviczii
Solanum leptostigma (potato)
Solanum longipedicellatum (now S. stoloniferum)
Solanum luteum (red-fruited nightshade)
Solanum macolae
Solanum macrocarpon (African eggplant)

Solanum maglia
Solanum mamilliferum (chauca)
Solanum miniatum (red-fruited nightshade)
Solanum multidissectum
Solanum muricatum (pepino melon)
Solanum nitidibaccatum (Argentinian nightshade)
*Solanum ochroleucum (*syn. *S. nigrum)*
Solanum ottonis (divine nightshade)
Solanum pampasense
Solanum parodii
Solanum pennellii
Solanum phureja (chauca)
Solanum photeinocarpum (terimini inuhoozuki)
Solanum pinnatisectum (tansyleaf nightshade)
Solanum platypterum
Solanum platense
Solanum polyacanthos
Solanum polyadenium (potato)
Solanum prinophyllum (forest nightshade)
Solanum radicans (cusmayllo)
Solanum raphanifolium (wild potato)
Solanum rostratum (buffalobur nightshade)
Solanum rybinii (phureja)
Solanum salamanii
Solanum saltense
Solanum sanctae-rosae
Solanum schenckii
Solanum simplicifolium
Solanum sinaicum (nightshade)
Solanum sisymbriifolium? (sticky nightshade)
Solanum sodomaeum (apple of Sodom)
Solanum soukupii
Solanum sparsipilum
Solanum stenotomum (pitiquina)
Solanum stoloniferum
Solanum subandigenum (Andigena)
Solanum tarijense
Solanum tenuifilamentum (chauca)
Solanum toralopanum (apharuma)
Solanum triflorum (cutleaf nightshade)
lanum tuberosum ssp. andigena (potato)
Solanum tuberosum ssp. tuberosum (Irish potato)
Solanum utile- South American genus-strongly attacked
Solanum vernei (purple potato)
Solanum verrucosum
Solanum villosum (red-fruited nightshade)

Solanum violaceimarmoratum
Solanum wittmackii
Solanum xanti (chaparral nightshade)
Solanum yabari (pitiquina)
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