Environmental Protection Authority
Te Mana Rauhī Taiao

# APPLICATION FORM
**RELEASE**

# Application to import for release or to release from containment new organisms

under the Hazardous Substances and New Organisms Act 1996

**Send by post to: Environmental Protection Authority, PO Box 131, Wellington 6140 OR email to: noinfo@epa.govt.nz**

**Application number**

ERMA200907

**Applicant**

Stefan Pollard

**Key contact**

Stefan Pollard

# Important

This application form is to seek approval to import for release or release from containment new organisms (including genetically modified organisms).

The application form is also to be used when applying to import for release or release from containment new organisms that are or are contained within a human or veterinary medicine.

Applications may undergo rapid assessment at the Authority's discretion if they fulfil specific criteria.

This application will be publicly notified unless the Authority undertakes a rapid assessment of the application.

This application form will be made publicly available so any confidential information must be collated in a separate labelled appendix.

The fee for this application can be found on our website at www.epa.govt.nz.

If you need help to complete this form, please look at our website (www.epa.govt.nz) or email us at noinfo@epa.govt.nz.

This form was approved on 21 September 2011.

## 1. Brief application description

Provide a short description (approximately 30 words) of what you are applying to do.

To import and release three nitrogen-fixing bacteria.

## 2. Summary of application

Provide a plain English, non-technical description of what you are applying to do and why you want to do it.

This application seeks to import three live species of microorganisms that are new to New Zealand which can take nitrogen from the air and convert it to a form that plants can use (nitrogen-fixing bacteria).

New Zealand agricultural and horticultural sectors rely, to a large extent, on synthetic fertilizers to supply nitrogen to crops. However, the use of such fertilizers is a massive cost to these industries. It is also unsustainable and leading to groundwater, rivers and drinking supplies being degraded. Globally, nutrification also contributes to dead zones in the world oceans and can increase greenhouse gas emissions.

The three microorganisms are used successfully in both conventional and registered organic systems in numerous applications around the world. Research shows that these microorganisms pose no risk to the environment.

## 3. Describe the background and aims of the application

This section is intended to put the new organism(s) in perspective of how they will be used. You may use more technical language but please make sure that any technical words used are included in a glossary.

New Zealand agricultural and horticultural sectors rely to a large extent on synthetic fertilizers. For example the Parliamentary Commissioner for the Environment reported in 2004 that "*use of nitrogen fertiliser in New Zealand has soared, as has the proportion of total fertiliser being applied as nitrogen*" (P.C.E., 2004). The report provided alarming figures such as a 670 percent intensity increase in the amount of urea used for the sheep and beef sectors and a 160 percent increase in the dairy sector between 1996 and 2002. Obviously this is a massive cost to these industries. It is also unsustainable and leading to groundwater, rivers and drinking supplies being degraded. Nutrification also contributes to dead zones in the world oceans and can increase greenhouse gas emissions.

This application seeks to import three microorganisms as potential nitrogen fixers for New Zealand agriculture applications. These microorganisms have been proven successful in the international agricultural industry and are commercially available overseas.

The three non-pathogenic species of microorganisms are nitrogen-fixing bacteria that are new to New Zealand. When sprayed onto plants, the microorganisms establish themselves within and around the plant roots, directly providing nitrogen which they bind from the air to the plant.

There are other types of nitrogen-fixing products available in New Zealand in other commercially available fertilizers and seed treatments, however at times these tend to be inconsistent and unreliable. It is intended to develop delivery formulations for these new microbes for effective use in New Zealand. The microbes associated with this application are already being used successfully in other plant and soil applications around the globe.

Overseas research clearly shows that these microorganisms pose no risk to the environment (Appendix 3). Additionally AgResearch were contracted to undertake an extensive program of testing to be doubly sure that the New Zealand environment will not be affected. These results continue to show that there are no known risks. For these reasons it is requested that the three new species be approved for release (Appendix 2).

## 4. Information about the new organism(s)

- Provide a taxonomic description of the new organism(s) (if the organism is a genetically modified organism, provide a taxonomic description of the host organism(s) and details of the genetic modification).
- Describe the biology and main features of the organism including if it has inseparable organisms.
- Describe if the organism has affinities (e.g. close taxonomic relationships) with other organisms in New Zealand.
- Could the organism form an undesirable self-sustaining population? If not, why not?
- What is the ease with which the organism could be eradicated if it established an undesirable self-sustaining population?

The exact species' identities are outlined below.

**Organism 1**

| | |
|---|---|
| Latin binomial: | *Azorhizobium caulinodans* |
| Common name(s), if any: | |
| Type of organism (eg bacterium, virus, fungus, plant, animal, animal cell): | Bacterium |
| Taxonomic class, order and family: | Alphaproteobacteria Rhizobiales, Xanthobacteraceae |
| Strain(s) if relevant: | N/A |
| Other information, including presence of any inseparable or associated organisms and any related organisms present in New Zealand: | Organism 1 will be imported in freeze dried form and will not contain any associated organisms |

**Organism 2**

| | |
|---|---|
| Latin binomial: | *Azoarcus indigens* |
| Common name(s), if any: | |
| Type of organism (eg bacterium, virus, fungus, plant, animal, animal cell): | Bacterium |
| Taxonomic class, order and family: | Betaproteobacteria Rhodocyclales, Rhodocyclaceae |
| Strain(s) if relevant: | N/A |
| Other information, including presence of any inseparable or associated organisms and any related organisms present in New Zealand: | Organism 2 will be imported in freeze dried form and will not contain any associated organisms |

**Organism 3**

| | |
|---|---|
| Latin binomial: | *Azospirillum brasilense* |
| Common name(s), if any: | |
| Type of organism (eg bacterium, virus, fungus, plant, animal, animal cell): | Bacterium |
| Taxonomic class, order and family: | Alphaproteobacteria Rhodospirillales, Rhodospirillaceae |
| Strain(s) if relevant: | N/A |
| Other information, including presence of any inseparable or associated organisms and any related organisms present in New Zealand: | Organism 3 will be imported in freeze dried form and will not contain any associated organisms |

The microorganisms concerned are non-genetically modified nitrogen-fixing bacteria. These bacterial species either survive as free-living organisms or in mutual symbiosis within the rhizosphere of a plant root system or within the plant. These microorganisms are Biosafety Level 1 organisms (American Type Culture Collection [ATCC] and Belgian Coordinated Collections of Microorganisms [BCCM]), which means they do not cause disease in healthy adult humans. They are not known to vector any diseases (Appendix 3).

We are not aware of any inseparable associated organisms related to our desired species.

There are numerous nitrogen-fixing bacteria already present in the New Zealand environment. For example, members of genus *Rhizobium* (e.g. *Rhizobium leguminosarum*) and genus *Burkholderia* (e.g. *Burkholderia cepacia*) (Landcare Research, 2011).

The three microbes, and others like them used in international agricultural applications, are required to be applied to plants every two to three months due to the decline in population levels of the microbes that occur (Appendix 3).

In the absence of regular "top-ups", the microorganisms are unlikely to be the predominant microorganisms present within the soil/plant microcosm unless specific conditions occur where the microorganisms have a selective advantage. However, it is possible that these microorganisms will still be present if only at very low levels.

Like all microorganisms, they would be difficult to eradicate once released.

## 5. Detail of Māori engagement (if any)

Discuss any engagement or consultation with Māori undertaken and summarise the outcomes.

As part of the research to ensure that these micro-organisms would not harm New Zealand an investigation was undertaken to ensure that no native plants would be adversely affected. Iwi across New Zealand were consulted for advice on the native plants that should be tested. Combined with feedback from the Department of Conservation, a shortlist of twenty-four native plant species was determined. AgResearch (Ruakura) carried out this research in a contained glasshouse laboratory and found that these three micro-organisms were completely harmless.

Prior to submitting this application, further consultation with Māori was undertaken, describing the microbes, their benefits and the outcome of our safety testing done at AgResearch for potential effects on native flora and fauna. The Māori National Network list provided by the EPA was used, which is made up of approximately 150 representatives.

From this consultation nine replies were received. There was general interest in the proposal along with a number of questions raised. Support was received from two consultees who noted that these microbes are shown to be environmentally friendly with few risks to native organisms. Only one response opposed the proposal. Their belief was that there was no evidence to show that the environment would not be harmed.

It is hoped that this application addresses any residual concerns around harm to the environment. After looking at international experience it has been found that there are no risks to the environment (Appendix 3). New Zealand specific research has been done in order to be doubly sure (Appendix 2).

## 6. Identification and assessment of beneficial (positive) and adverse effects of the new organism(s)

Adverse effects include risks and costs. Beneficial or positive effects are benefits.

- Identification involves describing the potential effects that you are aware of (what might happen and how it might happen).
- Assessment involves considering the magnitude of the effect and the likelihood or probability of the effect being realised.

Consider the adverse or positive effects in the context of this application on the environment (e.g. could the organism cause any significant displacement of any native species within its natural habitat, cause any significant deterioration of natural habitats or cause significant adverse effect to New Zealand's inherent genetic diversity, or is the organism likely to cause disease, be parasitic, or become a vector for animal or plant disease?), human health and safety, the relationship of Māori to the environment, the principles of the Treaty of Waitangi, society and the community, the market economy and New Zealand's international obligations.

## Beneficial effects

## Environment

### Potential beneficial effects

There are the following potential long-term environmental benefits from the release of these organisms:

- Improvement in the health of New Zealand waterways
- Reduced carbon emissions from New Zealand's agricultural system

More specific information on these potential long-term benefits is outlined in Appendix 1.

However, these benefits are based on a significant level of adoption of the use of these microbes in the future.

Highly localised benefits to the environment (through the reduced use of nitrogen fertilizers) might be seen at an individual user's level. These benefits are **likely** to occur and depending on the crop being grown include decreased on-farm nutrient run-off and leaching problems, improved soil quality and plant health, as well as a readily available, consistent source of nitrogen for both organic and conventional growers. This is ascertained by evidence seen in the use of these microbes in agricultural applications overseas.

### Potential adverse effects

All three micro-organisms have been used and studied for many years with no reports of causing adverse environmental effects.

This leaves the only potential risks to New Zealand as being harm to plant growth and displacement of native soil microbes. These two topics are addressed below under the relationship of Māori and their culture and traditions with the environment.

## Human health and safety

### Potential beneficial effects

These microbes interact only with plants, they have no known health benefits to people.

### Potential adverse effects

These three species have been used in many places around the globe. All three micro-organisms have been used in human food / agriculture applications (i.e. wheat, corn, rice, alfalfa, legumes etc) for many years with no reports of causing ill health to people.

Therefore any potential adverse effects cannot be identified

## The relationship of Māori and their culture and traditions with the environment

### Potential beneficial effects

No benefits specific to Māori were identified. The benefits of this release will accrue to all New Zealanders.

### Potential adverse effects

***Potential to harm native plants***

As part of the research to ensure that these micro-organisms would not harm the New Zealand environment, tests were undertaken to ensure that no native plants would be adversely affected. Iwi across New Zealand were approached and sought advice on the native plants that should be tested. Combined with feedback from the Department of Conservation it allowed a shortlist of twenty-four native plant species. AgResearch (Ruakura) carried out this research in a contained glasshouse laboratory and found that these micro-organisms had no adverse effects. The AgResearch report is included as Appendix 2.

***Potential to displace native soil microbes***

Additionally, to ensure that the three species did not damage any native soil micro-organisms, New Zealand specific research was carried out to see if the addition of the three species would affect microbial diversity. These laboratory studies again showed that the micro-organisms are harmless and were outcompeted by the resident micro-organisms (see Appendix 2).

Therefore any potential adverse effects cannot be identified.

## Society and communities

### Potential beneficial effects

A potential long-term benefit to society is considered to be linked with the environmental benefits of predominantly reducing nitrogen leaching into New Zealand streams, rivers and lakes (e.g. Rotorua lakes, Lake Taupo) of which have major recreational benefits to our communities plus lowering the carbon footprint of the agricultural sector. The microorganisms are registered as organic in international applications which allow for a readily usable form of nitrogen for New Zealands organic industry.

However, the potential short term benefits from the approval of these organisms could be:

- consumers (including the organic agricultural industry) will have access to another nitrogen product to use.
- reduced transport costs (i.e. small concentrated volumes of microbes vs large bulk products already on the market)

These benefits are **likely** to occur and would affect the agricultural, horticultural and arable sectors throughout the country.

**Potential adverse effects**

The addition of these micro-organisms to the environment will have no adverse impact on people or communities.

Therefore any potential adverse effects cannot be identified.

## Market economy

**Potential beneficial effects**

There are the following potential long-term market economy benefits from the release of these organisms:

***Improved primary sector productivity due to:***

- Reduction in farm inputs costs
- Increased availability of nitrogen for plants
- Increased plant root growth
- Improved plant mineral uptake
- Improved plant defences against pathogenic fungi and bacteria

More specific information on these potential long-term benefits is outlined in Appendix 1.

However, these benefits are based on a significant level of adoption of the use of these types of microbes in the future.

**Potential adverse effects**

There are many nitrogen fixing micro-organisms already present in New Zealand soils. These have no negative impacts on our economy. The addition of three extra species will not create additional risks or costs to our economy.

Therefore any potential adverse effects cannot be identified.

## 7. Could your organism(s) undergo rapid assessment?

**7.1.** **If your application involves a new organism that is or is contained within a veterinary or human medicine, could your organism undergo rapid assessment (s38I of the HSNO Act)?**

Describe the controls you propose to mitigate potential risks (if any). Discuss what controls may be imposed under the ACVM Act (for veterinary medicines) or the Medicines Act (for human medicines).

Discuss if it is highly improbable (after taking into account controls if any):

- the doses and routes of administration of the medicine would have significant adverse effects on the health of the public or any valued species; and
- the organism could form an undesirable self-sustaining population and have significant adverse effects on the health and safety of the public, any valued species, natural habitats or the environment.

Do not include effects of the medicine or new organism on the person or animal being treated with the medicine.

Not applicable as the organisms are not contained within a human or veterinary medicine.

**7.2.** **If your application involves a new organism (excluding genetically modified organisms), could your organism undergo rapid assessment (s35 of the HSNO Act)?**

Discuss if your organism is an unwanted organism as defined in the Biosecurity Act 1993.

Discuss if it is highly improbable that the organism after release:

- could form self-sustaining populations anywhere in New Zealand (taking into account the ease of eradication)
- could displace or reduce a valued species
- could cause deterioration of natural habitats,
- will be disease-causing or be a parasite, or be a vector or reservoir for human, animal, or plant disease
- will have adverse effects on human health and safety or the environment.

While the microorganisms are not unwanted, it cannot be said that it would be highly improbable that they could form self-sustaining populations anywhere in New Zealand. Therefore the organisms do not qualify for rapid assessment.

## 8. Other information

Add here any further information you wish to include in this application including if there are any ethical considerations that you are aware of in relation to your application.

## 9. Appendices(s) and referenced material (if any) and glossary (if required)

**References**

Khan, S. A., Mulvaney, R. L., Ellsworth, T. R., and Boast, C. W. (2007): The Myth of Nitrogen Fertilization for Soil Carbon Sequestration. Journal of Environmental Quality. Vol. 36, 1821-1832.

Landcare Research 2011. NZFUNGI http://nzfungi.landcareresearch.co.nz/ - accessed October 2011.

Parliamentary Commissioner for the Environment 2004): Growing for good: Intensive farming, sustainability and New Zealand's environment. New Zealand Government, Wellington.

Saikia, S.P. and Jain, V. 2007): Biological nitrogen fixation with non-legumes: An achievable target or a dogma? Current Science, Vol. 92, No. 3, 317-322

**Appendices**

Appendix 1: Potential long-term benefits
Appendix 2: AgResearch containment trial report
Appendix 3: Literature Review 2.2

## 10. Signature of applicant or person authorised to sign on behalf of applicant

☒ I request the Authority to waive any legislative information requirements (i.e. concerning the information that shall be supplied in my application) that my application does not meet (tick if applicable).

I have completed this application to the best of my ability and, as far as I am aware, the information I have provided in this application form is correct.

8th February 2012

**Signature** **Date**

# Appendix 1: Potential long term benefits

## Potential long-term environmental beneficial effects

***Improvement in the health of New Zealand waterways***

Most of the nitrogen made available for plants is the result of hardworking soil micro-organisms. Globally, they account for up to 60% of the total nitrogen available to plants. New Zealand's agricultural system is a highly modified system that relies significantly on chemical fertilizers. For example the average New Zealand dairy farm has 66% of its nitrogen inputs met by chemical fertilizers and soil micro-organisms only contribute 33%[1]. Not only is the process costly to our dairy farmers (discussed under market economy) it increases the chances of excess nitrogen leaching to ground and surface waters.

These micro-organisms have the potential to reduce New Zealand's reliance on synthetic fertilizers. Should fertilizer use decrease as a result it will benefit our nations waterways.

***Reduced carbon emissions from New Zealand's agricultural system***

The reduction in nitrogenous fertilizer for an agricultural system will result in a reduced carbon footprint for that system and a more sustainable method of applying nitrogen. Chemical nitrogen fertilizers incur a carbon footprint cost in relation to its manufacture, transport and application. Additionally these fertilizers release vast amounts of nitrous oxide gas emissions once applied to the soil.

Use of high levels of nitrogen fertiliser reduces soil carbon over time. A study by Khan et al., (2007) from the University of Illinois showed substantially increased depletion of soil organic carbon levels in plots receiving higher nitrogen fertiliser rates and studied over more than 50 years. Reducing rates of nitrogen fertiliser application directly results in increased sequestration and retention of soil carbon.

Reduction of nitrogen fertiliser rates is one of the few actions farmers can take to reduce the carbon footprint of their farming system and increase soil carbon sequestration. This action is quantifiable, verifiable, and effective. Inputs such as these microbes allow for the direct reduction in nitrogen fertilizer rates to farming systems while maintaining the plant nitrogen requirements for healthy growing crops.

## Potential long-term market economy beneficial effects

***Improved primary sector productivity***

The major benefit of the application is improved plant growth and health leading to reduced reliance on added synthetic nitrogen fertilizers. Lower costs will increase the productivity for New Zealand's agriculture (including horticulture) sector. This benefit has been demonstrated from the commercial use of the microorganisms overseas.

The improved plant growth and health can also increase the yield, size, quality and value of the produce.

[1] OECD Soil Surface Nitrogen database (2004)

Plant growth and health is enhanced through four main actions of the bacteria:

- Providing plant available nitrogen to the plant
- Increased plant root growth
- Improved plant mineral uptake
- Improved plants defense against pathogenic fungi and bacteria

*Increased availability of nitrogen for plants*

The nitrogen cycle is at the core of our agricultural industry. Apart from water, nitrogen is one of the most important nutrients that can limit crop yields in soils (Saikia and Jain, 2007).

Plants rely on the chemical or biological conversion of nitrogen gas present in the atmosphere into a more readily available form for uptake by plants. The majority of this nitrogen is converted by micro-organisms present in the soil, around plant roots and even within the plants themselves.

The goal is to introduce three new species of soil micro-organisms which have been proven to enhance the conversion of this atmospheric nitrogen for plant use.

*Increased plant root growth*

These bacterial species are able to produce / stimulate a range of natural plant growth promoting substances (i.e. auxin) within the plant. These types of substances specifically help facilitate lateral root growth in plants. Lateral roots in a plant system are responsible for anchoring the plant, water uptake, and facilitates the extraction of nutrients required for the growth and development of the plant. A better root system enables greater capture of applied N fertiliser which decreases leaching and improves profitability

*Improved plant mineral uptake*

With plant root growth increasing within the soil, the mineral uptake of the plant is also greatly increased. Roots are the main source of mechanism which the plant uses to extract nutrients out of the soil. With more roots being formed, the greater the surface area of soil is covered drawing more nutrients into the plant.

*Improved plant defenses against pathogenic fungi and bacteria*

Studies have shown the bacteria to aid in the plant defences against pathogenic fungi and bacteria. This is achieved by the mutual interactive relationship of the bacteria with native mycorrhizal fungi which is present in the majority (approx. 80%) of plants. Mycorrhizae are known to aid the defence mechanisms of a plant against disease.

# Appendix 2: AgResearch Containment Trial Report

# Appendix 3: Literature Review 2.2