NATRApHASE® pHCP

Barrier System to combat Phytophthora Infestans and Alternaria solani

Based on literature research, discussion and field trials the following data has been compiled to highlight the economic devastation caused by "early and late blight in potato, tomato and parsley crops and how this crop disease can be contained using a simple but effective barrier system – **NATRApHASE® pHCP**

Economic Affect and Significance of Phytophthora Infestans (P. Infestans) and Alternaria solani (A. solani)

1. **Phytophthora Infestans (P. Infestans)** is an Oomycetes that causes the serious potato disease known as ***Late Blight*** or potato blight. Late blight was a major culprit in the 1840s European, the 1845 Irish and 1846 Highland potato famines. The organism can also ***infect tomatoes*** and some other members of the Solanaceae.

   Close to 2 million hectares of potatoes are grown in Europe, and the harvest represents a value of about 6 billion euros. According to estimates, late blight causes 1 billion euros of damage in Europe. This damage consists of costs for controlling the disease (costs for purchasing fungicides, plus costs for spray operations) and the costs that result from reductions in harvest and losses during storage. Around the world the disease causes around $6 billion = €7.80 billion of damage to crops each year.

   Phytophthora infestans spores develop on the leaves, spreading through the crop when temperatures are above 10 °C (50 °F) and humidity is over 75%-80% for 2 days or more. Rain can wash spores into the soil where they infect young tubers. Spores can also travel long distances on the wind.

   The spores of this Oomycetes remaining over-winter on infected tubers, particularly those that are left in the ground after the previous year's harvest spread rapidly in warm and wet conditions. This can have devastating effects by destroying entire crops.

   The early stages of blight are easily missed, and not all plants are affected at once. Symptoms include the appearance of dark blotches on leaf tips and plant stems. White mould will appear under the leaves in humid conditions and the whole plant may quickly collapse. Infected tubers develop grey or dark patches that are reddish brown beneath the skin, and quickly decay to a foul-smelling mush caused by the infestation of secondary soft bacterial rots. Seemingly healthy tubers may rot later when in store.

The Result of Phytophthora in affected Potato plants and tubers.

2. Alternaria solani (A. solani) a fungal pathogen, the cause of *Early Blight,* is the most destructive disease of tomatoes in the tropical and subtropical regions. Each 1% increase in intensity can reduce yield by 1.36%, and complete crop failure can occur when the disease is most severe. Yield losses of up to 79% have been reported in the U.S., of which 20-40% is due to seedling losses (i.e., collar rot) in the field.

   A. solani is also one of the most important foliar pathogens of potato. In the U.S. yield loss estimates attributed to foliar damage, which results in decreased tuber quality and yield reduction, can reach 20-30%. In storage, A. solani can cause dry rot of tubers and may also reduce storage length, which both of which diminish the quantity and quality of marketable tubers.

   Because A. solani is one of numerous tomato/potato pathogens that are *typically controlled with the same products,* accurately estimating both the total economic loss and the total expenditure on fungicides for control of early blight is difficult. Best estimates suggest that total annual global expenditures on fungicide control of A. solani is approximately $77 million: $32 million for tomatoes and $45 million for potatoes.

Early and Late Blight:

Early Blight

Alternaria solani pathogen produces distinctive "bull's-eye" patterned leaf spots and can also cause stem lesions and fruit rot on tomato and tuber blight on potato. Despite the name "early," foliar symptoms usually occur on older leaves. If uncontrolled, early blight can cause significant yield reductions. Primary methods of controlling this disease include preventing long periods of wetness on leaf surfaces and applying fungicides.

1. **Geographically,**

   A. solani is also present in most potato production regions every year but has a significant effect on yield only when frequent wetting of foliage favour's symptom development.

2. **Mode of Infection**

- **On potatoes:**

  In potato, primary damage by A. solani is attributed to premature defoliation of potato plants, which results in tuber yield reduction. Initial infection occurs on older leaves, with concentric dark brown spots developing mainly in the leaf centre.

  The disease progresses during the period of potato vegetation, and infected leaves turn yellow and either dry out or fall off the stem. On stems, spots are gaunt with no clear contours (as compared to leaf spots). Tuber lesions are dry, dark and pressed into the tuber surface, with the underlying flesh turning dry, leathery and brown. During storage, tuber lesions may enlarge and tubers may become shrivelled. *Disease severity due to A. solani is highest when potato plants are injured, under stress or lack proper nutrition.* High levels of nitrogen, moderate potassium and low phosphorus in the soil can reduce susceptibility of infection by the pathogen.

- **On tomatoes:**

  On tomato, foliar symptoms of A. solani generally occur on the oldest leaves and start as small lesions that are brown to black in colour. These leaf spots resemble concentric rings - a distinguishing characteristic of the pathogen - and measure up to 1.3 cm (0.51 inches) in diameter. Both the area around the leaf spot and the entire leaf may become yellow or chlorotic.

  Under favourable conditions (e.g., warm weather with short or abundant dews), significant defoliation of lower leaves may occur, leading to sunscald of the fruit. As the disease progresses, symptoms may migrate to the plant stem and fruit. Stem lesions are dark, slightly sunken and concentric in shape. Basal girdling and death of seedlings may occur, a symptom known as collar rot.

  In fruit, A. solani invades at the point of attachment to the stem as well as through growth cracks and wounds made by insects, infecting large areas of the fruit. Fruit spots are similar in appearance to those on leaves – brown with dark concentric circles. Mature lesions are typically covered by a black, velvety mass of fungal spores that may be visible under proper light conditions.

- **Disease cycle**

  Alternaria solani is a deuteromycete with a polycyclic life cycle. Alternaria solani reproduces asexually by means of conidia.

  The life cycle starts with the fungus overwintering in crop residues or wild members of the Solanaceae family, such as black nightshade. In the spring, conidia are produced. Multicellular conidia are splashed by water or by wind onto an uninfected plant. The conidia infect the plant by entering through small wounds, stomata, or direct penetration.

  Infections usually start on older leaves close to the ground. The fungus takes time to grow and eventually forms a lesion. From this lesion, more conidia are created and released. These conidia infect other plants or other parts of the same plant within the same growing season. Every part of the plant can be infected and form lesions. This is especially important when fruit or tubers are infected as they can be used to spread the disease.

  In general, development of the pathogen can be aggravated by an increase in inoculum from alternative hosts such as weeds or other solanaceous species. Disease severity and prevalence are highest when plants are mature.

- **Environment:**

  Alternaria solani spores are universally present in fields where host plants have been grown.
  Free water is required for Alternaria spores to germinate; spores will be unable to infect a perfectly dry leaf. Alternaria spores germinate within 2 hours over a wide range of temperatures but at 26.6-29.4°C (80-85°F) may only take 1/2 hour. Another 3 to 12 hours are required for the fungus to penetrate the plant depending on temperature. After penetration, lesions may form within 2–3 days or the infection can remain dormant awaiting proper conditions [15.5°C (60°F) and extended periods of wetness]. Alternaria sporulates best at about 26.6°C (80°F) when abundant moisture (as provided by rain, mist, fog, dew, irrigation) is present. Infections are most prevalent on poorly nourished or otherwise stressed plants.

Late Blight

P. infestans is still a difficult disease to control today by ordinary methods. There are many options in agriculture for the control of both (1) damage to the foliage and (2) infections of the tuber. Potatoes grow throughout the season, but it is estimated the tubers stop growing when 75% of the canopy has been destroyed.

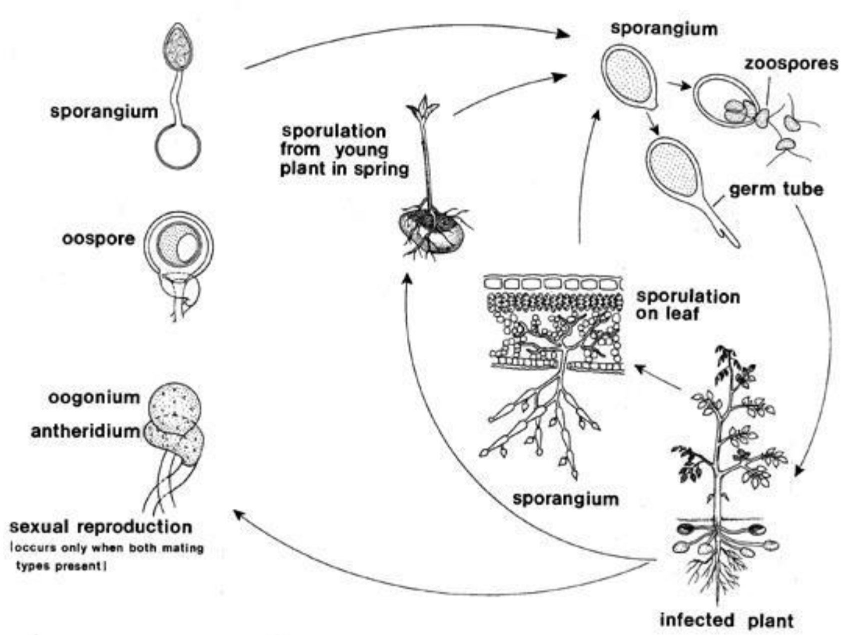
1. **Mode of Infection**

- **On Potatoes and Tomatoes**

The fungus is dispersed by wind-borne sporangia, which are produced on branched hyphae (sporangiophores) that emerge from the stomata of infected leaves in humid conditions (see diagram). When the sporangia land on a new leaf surface they usually undergo internal cleavage of the protoplasm to produce motile, un-nucleate zoospores, which locate the leaf stomata, where they encyst and germinate to initiate infection. Within the leaf, the hyphae produce haustoria in the individual host cells so P. infestans grows initially as a biotroph. However, the infected tissues soon die, and the fungus then spreads through the leaf as a necrotroph.

If P. infestans gets established on the potato foliage then sporangia can be washed down into the soil to infect the tubers, or the tubers can be contaminated with sporangia during crop harvesting. This can lead to rotting of the tubers during storage, and carry-over of inoculum from one season to the next.

- **Disease Cycle**



P. infestans is usually dispersed aerially one to several miles from the overwintering site to living potato or tomato foliage via sporangia which can survive exposure to dry, sunny conditions for up to an hour and even longer under cloudy conditions. Sporangia can germinate within a few hours after landing on potato or tomato foliage if free moisture (e.g., dew, rainfall, sprinkler irrigation, fog) is present. Germination takes place either indirectly via zoospores or directly via a germ tube that penetrates into foliage, stems, or fruit to initiate infections. Infections are visible as small lesions after three to four days. Necrotic areas on some lesions are only 1 to 2 mm in diameter. Lesions enlarge as the pathogen grows through the tissues, and the pathogen can sporulate from older lesions when the environment is favourable (leaf wetness for more than 10 to 12 hours at moderate temperatures [60º-70ºF]). Sporulation may occur on lesions that are only four to six days old. Under dry conditions no sporulation occurs and the lesion has a brown dead centre, surrounded by host tissue that has collapsed and appears either water soaked, grey-green, or yellowed. Both tomato and potato fruits are susceptible. Their stems may be infected (and stem lesions are capable of producing sporangia for a longer time than can lesions on leaves.

Potato leaflets with older (six to eight days old) sporulation lesions.

Tomato fruits infected with P. infestans.

Disease development (growth and reproduction of the pathogen) is favoured by moderate temperatures (60º-80ºF) and wet conditions. It can develop in very warm daytime temperatures (ca. 95ºF) if conditions are extremely wet and night temperatures are moderate (60º-75ºF). Epidemics can be rapid and devastating because of the high reproductive potential of this pathogen. Individual lesions can produce 100,000 to 300,000 sporangia per day. Each sporangium is capable of initiating a new infection that will become visible within three to four days and produce sporangia within another day or two under optimal conditions. Thus rapid reproduction of the pathogen and destruction of leaflets can defoliate potatoes or tomatoes and completely destroy healthy fields in a short time. Such epidemics result from many sequential cycles of infections: every lesion produces many sporangia, each of which can be dispersed to a new leaflet to initiate a new infection, which in turn can produce many sporangia, and so on.

Potato stem infected with P. infestans

Infected tomato plants with lesions on stems and foliage

2. Management

➢ Cultural control

- Clear infected debris from field to reduce inoculum for the next year.
- Water plants in the morning so plants are wet for the shortest amount of time.
- Use a drip irrigation system to minimize leaf wetness which provides optimal conditions for fungal growth.
- Use mulch so spores in soil cannot splash onto leaves from the soil.
- Rotate to a non-Solanaceous crop for at least three years.
- If possible control wild population of Solanaceae. This will decrease the amount of inoculum to infect your plants.
- Closely monitor field, especially in warm damp weather when it grows fastest, to reduce loss of crop and spray fungicide in time.
- Plant resistant cultivars.
- Increase air circulation in rows. Damp conditions allow for optimal growth of A. Solani and the disease spreads more rapidly. This can be achieved by planting farther apart or by trimming leaves.

➢ Chemical control:

There are numerous fungicides on the market for controlling early blight. Some of the fungicides on the market are Azoxystrobine, Cymoxanil, Furalaxyl Pyraclostrobin, Bacillus subtilis, Chlorothalonil, Copper products, hydrogen dioxide, mancozeb, potassium bicarbonate, and ziram. Specific spraying regiments are found on the label. Labels for these products should be read carefully before applying.

Cymoxanil

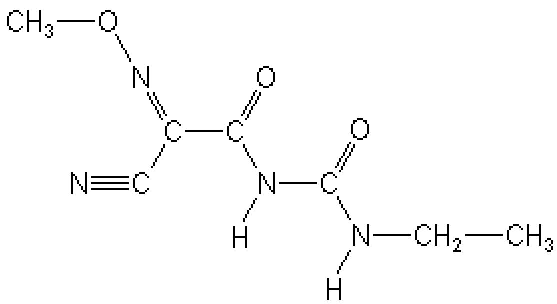
IUPAC: 1-[(EZ)-2-cyano-2-methoxyiminoacetyl]-3-ethylurea
2-cyano-N-[(ethylamino) carbonyl]-2-(methoxyimino) acetamide

CAS NO: 57966-95-7

FORMULA: C7H10N4O3

ACTIVITY: Fungicides (aliphatic nitrogen fungicide)

STRUCTURE:



Cymoxanil was first introduced in 1977. It is an acetimide compound used as both a curative and preventative foliar fungicide. In Europe it is being sold for use on grapes, potatoes, tomatoes, hops, sugar beets and other vegetable crops. Cymoxanil is currently not registered in the U.S.

Cymoxanil's mode of action is as a local systemic. It penetrates rapidly and when inside the plant, it cannot be washed off by rain. It controls diseases during the incubation period and prevents the appearance of damage on the crop. The fungicide is primarily active on fungi belonging to the Peronosporales order: Phytophthora, Plasmopara, and Peronospora

Furalaxyl

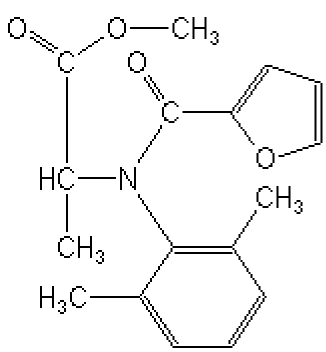
IUPAC: methyl N-(2-furoyl)-N-(2,6-xylyl)-DL-alaninate
methyl N-(2,6-dimethylphenyl)-N-(2-furanylcarbonyl)-DL-alaninate

CAS NO: 57646-30-7

FORMULA: C17H19NO4

ACTIVITY: Fungicides (acylamino acid fungicides; furanilide fungicide

STRUCTURE:



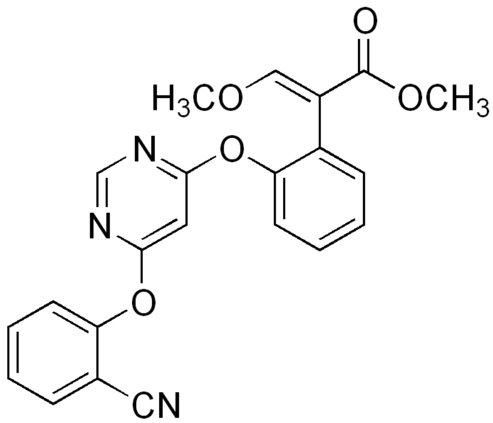
Azoxystrobine,

IUPAC Name: Methyl (2E)-2-(2-{[6-(2-cyanophenoxy) pyrimidin-4-yl]oxy}phenyl)-3-methoxyacrylate.

CAS No: 131860-33-8

FORMULA: $C_{22}H_{17}N_3O_5$

STRUCTURE:



Other names: Azoxystrobine, USA =Heritage, UK= Amistar

Azoxystrobine was first marketed in 1998 and is a systemic, broad-spectrum fungicide with activity against the four major groups of plant pathogenic fungi including Ascomcetes (eg powdery mildews), Basidiomycetes (eg rusts), Deuteromycete (eg rice blast) and Oomycetes (eg downy mildew). It inhibits spore germination and mycelia growth. It has worldwide uses on cereals, vines, rice, citrus, potatoes and tomatoes. In 1999, Azoxystrobine was the leading proprietary fungicide worldwide with sales of US$415m and is now a world market leader in cereals.

It was given provisional approval for use in the UK on some fungal diseases of wheat and barley in 1997(4), subject to approval at EU level. It was given Annex 1 approval in the EU in 1998 as a fungicide for use on cereals and vines. In the UK it is marketed as Amistar, and in the US as Heritage.

Azoxystrobin is classified by the World Health Organisation as 'slightly hazardous' (Class III). The acute oral LD50 (the dose required to kill half a population of laboratory animals) is more than 5,000 mg/kg for rats.
It is an irritant to skin and may cause sensitization. It is also classed as toxic by inhalation.

- **Use of fungicides**

Fungicides for the control of potato blight are normally only used in a preventative manner, sometimes in conjunction with disease forecasting. In susceptible varieties, fungicide applications may be needed weekly. An early spray is most effective.

Copper is a broad-spectrum fungicide which acts as a protectant – it must be applied to prevent disease. It has been superseded by modern systemic fungicides, which move within the plant and can both protect and eradicate existing infections. These fungicides are much more specific in their mode of action. Chief among these for control of potato blight are the acylalanine fungicides such as metalaxyl and furalaxyl. They act specifically on the RNA polymerase of Phytophthora and closely related fungi. However, resistance to them can develop quickly in the pathogen population – it requires only a single gene mutation leading to a minor change in the RNA polymerase molecule. In many parts of the world, P. infestans is now resistant to these fungicides.

- **Fungicidal control**

Control of potato blight traditionally relied on copper-based fungicides such as Bordeaux mixture (consisting of copper sulphate and calcium oxide). However, copper is potentially phytotoxic, so disease ***forecasting*** was developed to enable growers to predict when the environmental conditions were highly conducive to spread of the pathogen and thus when the growers needed to spray to protect their crops?

Forecasting methods for blight epidemics differ in different countries but in Britain they are based on the "temperature-humidity rule" devised by Beaumont (1947- see definition under Environmental Control P9). After a certain date (depending on locality) blight was found to develop within 15-22 days following a period when the temperature was not less than 10˚C and the relative humidity was over 75% for 2 consecutive days. Radio stations now broadcast warnings of the Beaumont periods or updated versions of these in the early-morning farming programmes.

- **Haulm Destruction**

If P. infestans gets established on the potato foliage then sporangia can be washed down into the soil to infect the tubers, or the tubers can be contaminated with sporangia during crop harvesting. This can lead to rotting of the tubers during storage, and carry-over of inoculum from one season to the next. In order to minimise these problems it is common practice to destroy the foliage (the haulm) with sprays of sulphuric acid or herbicide 2-3 weeks before the tubers are lifted.

➢ **Genetic Engineering**

Potatoes after exposure to Phytophthora infestans: The normal potatoes have blight but the cisgenic potatoes are healthy
In recent years, a resistance gene effective against all known strains of blight has been identified and successfully copied from a wild relative of the potato, Solanum bulbocastanum, and introduced into the genome of cultivated varieties of the potato. This is an example of cisgenic genetic engineering.

➢ **Sources of Inoculum**

Blight can be controlled by limiting the source of inoculum. Only good quality seed potatoes obtained from certified suppliers should be planted. Often discarded potatoes from the previous season and self-sown tubers can act as sources of inoculum.

➢ **Environmental conditions**

There are several environmental conditions that are conducive to P. infestans. An example of such took place in the United States during the 2009 growing season. As colder than average for the season and with greater than average rainfall, there was a major infestation of tomato plants, specifically in the eastern states. By using weather forecasting systems, such as BLITECAST, if the following conditions occur as the canopy of the crop closes, then the use of fungicides is recommended to prevent an epidemic.

- ***A Beaumont Period*** is a period of 48 consecutive hours, in at least 46 of which the hourly readings of temperature and relative humidity at a given place have not been less than 20 °C (68 °F) and 75%, respectively.

- ***A Smith Period*** is at least two consecutive days where min temperature is 10 °C (50 °F) or above and on each day at least 11 hours when the relative humidity is greater than 90%.

3. Potato Varieties

Potato varieties vary in their susceptibility to blight. Most early varieties are very vulnerable. They should be planted early so that the crop matures before blight starts (usually in July). Many old crop varieties, such as King Edward potato are also very susceptible but are grown because they are wanted commercially. Main crop varieties which are very slow to develop blight include Cara, Stirling, Teena, Torridon, Remarka, and Romano.

Some so-called resistant varieties can resist some strains of blight and not others, so their performance may vary depending on which are around. These crops have had polygenic resistance bred into them, and are known as "field resistant".

New varieties such as Sarpo Mira and Sarpo Axona show great resistance to blight even in areas of heavy infestation. Defender is an American cultivar whose parentage includes Ranger Russet and Polish potatoes resistant to late blight. It is a long white-skinned cultivar with both foliar and tuber resistance to late blight. Defender was released in 2004.

These varieties are likely to gain great popularity as consumers increasingly embrace organically produced crops and reject food items that have been grown using fungicides and other chemicals. Researchers are currently working to develop a variety of potatoes that will be resistant both late and early blight. Researchers have found the wild potato species Solanum verrucosum to resist the late blight disease.

They aim to make cultivated potatoes resistant to late blight by crossing the wild, resistant strain with the vulnerable, cultivated strain. In addition to this, researchers are crossing Solanum verrucosum with another wild potato species that is resistant to early blight, making a hybrid that is resistant to both late and early blight. They plan to cross the hybrid with cultivated potatoes to pass both resistant genes onto the cultivated species.

4. Control of Tuber Blight

Ridging is often used to reduce tuber contamination by blight. This normally involves piling soil or mulch around the stems of the potato blight meaning the pathogen has farther to travel to get to the tuber.

The canopy can also be destroyed around 5 weeks before harvest. This can be done via a contact herbicide or using sulphuric acid to burn off the foliage.

Field Trials to prevent Phytophthora Infestans Infestation on Parsley and Potatoes:

After researching the “pros and cons” of the use of available fungicides it was evident farmers/grower of vegetable crops, in particular potatoes and tomatoes want a product which is:

1. Safe and simple to handle - no fumes liberated, no bad odour facilitating a safer and healthier work environment.
2. Provides a barrier against potential fungi and micro-organism infestation to provide long term protection during the development and growth phase of vegetables.
3. Cost effective
4. Biodegradable
5. There is no effect on the organoleptic and sensory properties of the Pre and Post-Harvest vegetable with any loss in nutritional value.
6. Does not contain synthetic biocides or antibiotics.
7. Non-mutagenic
8. Non - lachrymatory
9. Readily dispersible

A product based on the successful and effective Whole Fruit and Vegetable Decontaminant NATRApHASE® FVS was formulated - NATRApHASE® pHCP to deal specifically as a barrier against Phytophthora fungi. After a number of successful greenhouse trials it was decided to conduct a Field Trial to determine its effectiveness against Phytophthora Infestans. The trial was planned for the 2011 season.

The approach was to test against a very sensitive crop and potato plants.

The 2 chosen plants were:

1. Parsley because it is a very sensitive crop and
2. Potatoes because it is a crop that is treated regularly (On average 10 to 15 times per season for the control of Phytophthora Infestans).

All the tests were done in practical situations in open fields on big plots of several Acres. No phyto-toxicity was evident within the test acreage of Parsley and Potatoes.

Trial (1): Preventative Treatment (No presence of infestation)

The crops of parsley and potatoes were sprayed with NATRApHASE® pHCP equal to 1litre per hectare. Over the season 8 treatments were done. There was no sign of Phytophthora Infestans infection and protection was active until harvest. The Tubers were healthy with no sign of side effects from the treatment. The leaves remained healthy with no sign of chlorosis.

Trial (2): Corrective Treatment (Early evidence of infestation presence)

The crops of parsley and potatoes were sprayed with NATRApHASE® pHCP equal to 2 litres per hectare. Over the season 12 treatments were done. NATRApHASE® pHCP stopped the growth of the Phytophthora Infestans infection and prevented further infestation until harvest. The Tubers were healthy with no sign of side effects from the treatment. The leaves remained healthy with no sign of chlorosis.

Trial (3):

In 2012 season the product was applied by farmers and the results were/are very positive.
There is also strong interest from organic farmers for whom it seems to be one of the rare remaining possibilities to control the disease.

Conclusion:

1. These trials indicate quite strongly the effectiveness of NATRApHASE® pHCP as a safe and easy to use alternative to current available fungicides inhibiting fungal infection.
2. It is very important to begin treatment as soon as presence of fungi is evident – when first symptoms are visible. Based on historic data, treatment should perhaps be applied prior to fungal infection occurring.
3. Spraying needs to be done in an orderly manner ensuring coverage is evenly managed.
4. The trial demonstrated that NATRApHASE® pHCP is a very safe product to use, easy to prepare by handlers and cost effective compared to the more sophisticated fungicides available on the market.

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NATRApHASE® pHCP

(Patent Pending)

Natural Pre-Harvest
Potato, Tomatoes and Parsley Barrier Control
against the Fungi
Phytophthora Infestans and Alternaria solani

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PRODUCE DESCRIPTION AND SPECIFICATION

Description: NATRApHASE® pHCP is a clear liquid formulated using EU and FDA Food Approved products from natural sources. It is an extremely effective Barrier System when applied to fresh Pre-Harvest potato, tomato and parsley crops with potential infection from the Fungi Phytophthora Infestans and Alternaria solani. All ingredients are classified GRAS (Generally recognized as Safe) and natural by the FDA.

Potential Benefits:

- NATRApHASE® pHCP is a new, natural (patent pending) innovative Barrier System (against Fungi Phytophthora Infestans and Alternaria solani) specifically and synergistically formulated using EU and FDA Food Approved products from natural sources.
- Has been independently tested and validated within the market.
- Provides long term protection during the development and growth phase of vegetables.
- It is safe and simple to handle - no fumes liberated, no bad odour facilitating a safer and healthier work environment.
- There is no effect on the organoleptic and sensory properties of the Pre-Harvest vegetable with any loss in nutritional value.
- Maintains efficacy when exposed to organic matter,
- Does not contain synthetic biocides or antibiotics.
- Non-mutagenic
- Non - lachrymatory
- Biodegradable
- Very soluble in water
- Readily dispersible

Usage Levels:

The exact dosage cannot be stated in general since it depends on the application and degree of infection. We generally suggest:

1. For **Preventative Treatment:** 1 litre per hectare for plant crops where there is no presence of Phytophthora Infestans infection.

2. For **Corrective Treatment**: 2 litres per hectare for plant crops where there is early evidence of Phytophthora Infestans presence. This is, infection has become visible.

Materials Safety Data Sheet

NATRApHASE® pHCP

I. PRODUCT DESCRIPTION AND SPECIFICATION

Description: NATRApHASE® pHCP is a natural clear liquid Processing Aid. It consists of intermediates derived from natural sources which are approved for use in the food chain.

Specifications:

Appearance:	Clear
Taste:	Acidic
Odour:	Fresh
Solubility:	Completely soluble in water
pH: as 30% @ 15˚C	0.40 – 0.42
Bulk Density (@20^{0}C):	1.12 – 1.14
Stability:	Very Stable

II. SAFETY INFORMATION

1. IDENTIFICATION

Name: NATRApHASE® pHCP
Product Code: NBPHCP025, NBPHCPIBC (25 Litre, 1000 Litre)
Supplied by: Natural Biotechnology Sprl
Rue De Liege 1, 6180 Courcelles, Belgium
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2. COMPOSITION

NATRApHASE® pHCP is a natural clear liquid Processing Aid.

Synonyms: None
CAS Number: 72968-50-4

3. HAZARD INDENTIFICATION

NATRApHASE® pHCP is classified as non-hazardous.

4. FIRST AID MEASURES

Eye Contact:	Irrigate thoroughly with water, open eyelids forcibly.
Skin:	Wash affected area with water; report any skin irritation to a medical advisor.
Excessive Ingestion:	Drink copious amounts of water. Contact medical physician if discomfort occurs or persists.
Inhalation:	Non Volatile liquid product: consult medical physician if discomfort occurs or persists.

5. FIRE FIGHTING MEASURES

Product is non-combustible.

6. ACCIDENTAL RELEASE MEASURE

Personal Precautions:	Wear rubber gloves if prolonged contact with concentrated solution. Avoid contact with skin and eyes.
Environmental:	No particular/specific measures required. Can wash to drains with large amounts of water. Absorb large spillage with sand and neutralize with lime or sodium carbonate then place in a closed container for transfer to an approved waste site.

7. HANDLING AND STORAGE

Sensible precautions should be taken to avoid contact with the eyes and skin, inhalation or accidental ingestion. Observe strict cleanliness and personal hygiene at all times. Keep container tightly closed. Store in a cool, dry area at ambient temperature. Protect from excess heat, keep away from Odour us and toxic substances.

8. EXPOSURE, CONTROL AND PERSONAL PROTECTION

No specific measures are required for NATRApHASE® pHCP provided the product is handled in accordance with general rules/regulations of occupational hygiene and safety. Eye protection and PVC or rubber gloves should be worn as appropriate.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance/Colour:	Clear Liquid
Odour:	None
Molecular Mass:	Not Relevant – Mixture
Bulk Density (30% @20^{0}C):	1.12 – 1.14
Solubility:	Completely soluble in water
Flash Point:	Non combustible
Degradability:	>98% biodegradable

10. STABILITY AND REACTIVITY

NATRApHASE® pHCP is stable under normal storage conditions. Protect from excess heat for quality reasons. Protect from frost.

11. TOXICOLOGICAL INFORMATION

Acute Toxicity:	Non-hazardous substance when used correctly
Local effects:	Mild eye irritation on contact. Unlikely to cause eye damage. Skin irritation: may give rise to a mild rash and de-fatting effect.
Ingestion:	No known effects
Inhalation:	No known effects
Sensitization:	No known effects
Special effects:	Not mutagenic (Ames-test) Not phototoxic

12. ECOLOGICAL INFORMATION

No adverse Eco-toxicity effects.
Greater than 98% biodegradable.
Product dissolves completely in water
No known accumulation

13. MICROBIOLOGICAL ANALYSIS

NATRApHASE® pHCP Barrier prevents the following organisms and fungi from populating on Pre-Harvest Potato, Tomato and Parsley crops.

Bacterial Coliforms, Pseudomonas Aeruginosa ATCC, Escherichia coli ATCC 10536,
Staphylococcus aureus ATCC 6538, Enterococcus hirae ATCC 10540, Salmonella typhimurium ATCC 13311
Listeria monocytogenes, Bacillus cereus NCIMB 11925, Candida Albicans NCYC 1363
Aspergillus Niger IMI 104215, Penicillium, Cladosporium, Yeasts and the fungi, Phytophthora Infestans and Alternaria solani

14. DISPOSAL CONSIDERATION

Discharge: Treatment must be disposed/treated in accordance with The Special Waste Regulations at a licensed incinerator or landfill site.

15. TRANSPORT INFORMATION

Not classified as hazardous for transport. Unless containers are palletized never stack more than 2 high.

16. REGULATORY INFORMATION

European Union Classification and Labelling is in accordance with Directives (1) EU Directive 89/107/EEC Processing Aid Definition and (2) EU Directive 2000/13/EEC Labelling Regulation.

17. ADDITIONAL INFORMATION

NATRApHASE® pHCP satisfies:
Food Chemical Codex 5th Edition specifications
Categorized: Generally Recognised as Safe (GRAS) by the FDA
Produced under ISO9001:2000 Certified Quality Management Systems, GMP, BRC accredited

18. INFORMATION ON USE

Uses: NATRApHASE® pHCP is a natural Barrier Control Processing Aid.
Pack Size: Supplied in 5 litre, 25 litre jerry cans and 1000 litre Intermediate Bulk Container (IBC) or tanker.

19. ADDITIONAL INFORMATION

Country of Manufacture: United Kingdom

DISCLAIMER: Natural Biotechnology used every possible care in compiling, preparing and issuing this information. The information contained in this publication is based on our own research and development work and is to the best of our knowledge reliable. Manufacturers should, however, conduct their own test to determine the suitability of our product for their own specific purposes having regard to all relevant obligations therewith, whether under the Food Safety Act, Feeding Stuffs Regulations, and Health & Safety at Work Act, Control of Substances Hazardous to Health Regulations or any other relevant legislations or common law requirement. Statements contained herein should not be considered as a warranty of any kind, expressed or implied and no liability is accepted for the infringement of any patents.

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