Wapaw Bay Humates™

Humic Acids for Agriculture

Product Guide

2019

WAPAW BAY RESOURCES INC. LEONARDITE MINE AT WAPAWEKKA LAKE, SASKATCHEWAN

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Wapaw Bay Humates™

Wapaw Bay Resources Inc. (WBR) was founded to develop a leonardite deposit in northern Saskatchewan, to provide high quality humic supplements at an affordable price for agriculture. **Leonardite, a brown to black naturally occurring organic mineraloid, is the richest source of humic acids.**

Leonardite Mine

Using data from old geological records WBR identified potential leonardite deposits in the La Ronge / Wapawekka Lake area in the boreal forest of northern Saskatchewan. Samples from a number of sites were collected and sent for analysis. The samples collected at **Wapaw Bay** on Wapawekka Lake were found to contain high-grade leonardite.

Using sonic drilling, WBR intersected a significant leonardite seam. Test pits proved the seam to be of good thickness and quality, and reserves sufficient to supply a processing plant for decades.

Once our proposal for a mine was cleared by Saskatchewan Environment and the various Federal Agencies, we built an access road, and in 2007 began mining operations.

Liquid Humic Acid Extraction Plant

From 2005 -2010 we operated a pilot plant at Agrotek Industries Inc. in Burnaby, BC. In 2009 – 2010 we constructed a processing facility for extraction of liquid humic acid from leonardite, at Zenon Park, Saskatchewan.

In 2010 WBR adopted the brand name ***Wapaw Bay Humates*** for its product line.


MANUFACTURING PLANT, ZENON PARK, SASKATCHEWAN

WHAT ARE HUMIC ACIDS?

Humic Acids are soluble organic acids naturally present in **Soil Organic Matter**, and are a major component of soil fertility.

Soil Organic Matter is composed of living plant and animal matter, dead plant and animal matter, and **humus** (decomposed plant and animal matter).

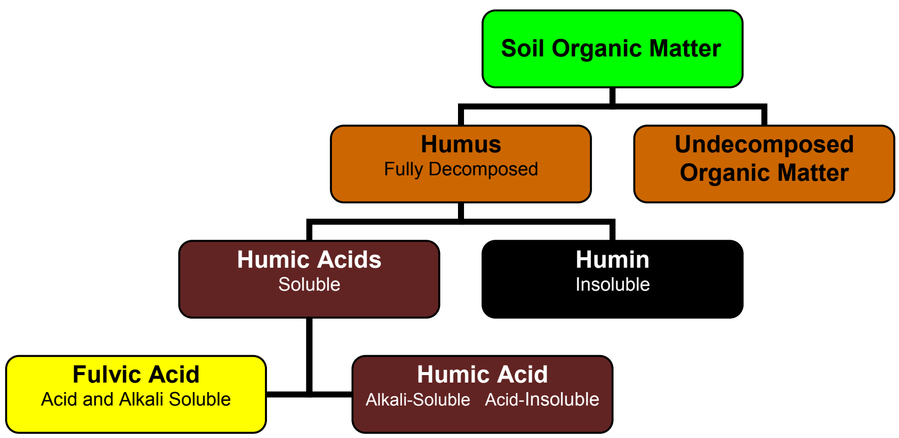
Humus is the part of organic matter decomposed to the point that its parent material can no longer be identified, and which resists further decomposition. Humus can be divided into humic and non-humic.

Humin is the non-humic insoluble portion of humus.

Humic Acids are the soluble portions of humus.

Humic Acids (plural) are normally subdivided into two major fractions:

1. **Humic Acid (singular)** has a high molecular weight, is dark brown, and is soluble in alkaline conditions, but insoluble in acid.
2. **Fulvic Acid** has a lower molecular weight, is yellow in color, and is soluble in both acid and alkali.



Humic acids do not have a single specific structure; rather they are a family of organic compounds with similar characteristics that cause them to function in similar ways. Humic Acids are composed of the elements carbon, hydrogen, oxygen, and nitrogen, with small amounts of phosphorus and sulfur. Structurally they are composed of:

1. Aromatic backbone with ether linkages, carbon-carbon bonds, nitrogen, and straight chain aliphatic carbon. **The aromatic backbone causes humic acids to be biologically active** due to the large number of functional groups on each ring.
2. Oxygen containing functional groups**,** such as carboxylic acids (COOH), Phenolic OH, and Quinones, have a **negative charge.** The oxygen containing functional groups impart the **<u>Cation</u> Exchange Capacity.**
3. Amines (NH_2) which have a **positive charge,** also cause Humic Acids to be biologically active, and explain the **<u>Anion</u> Exchange Capacity** of Humic Acids.

HUMIC TERMINOLOGY

SOIL ORGANIC MATTER: is composed of living plant and animal matter, dead plant and animal matter, and decomposed plant and animal matter (humus)

HUMUS is the product of the decay of organic matter; it contains both humic and non-humic materials.

NON HUMIC Organic Matter is relatively undecomposed organic matter, and is relatively insoluble.

HUMIC MATTER is completely decomposed organic matter, and is readily soluble either in acids or bases.

HUMIC ACIDS (HAs), plural, is the collective name for the organic acid radicals found in humic matter. They may be separated by alkaline extraction. These include humic acid, fulvic acid, and ulmic acid.

HUMIC ACID (HA), singular, is a dark brown acid radical found in humic matter that is soluble in alkali but insoluble in acid.

FULVIC ACID is a yellow to brown acid radical found in humic matter that is soluble in alkali and acid.

ULMIC ACID, also called hymatomelanic acid, is a brown alcohol soluble acid found in organic matter.

HUMIN is the alkali-insoluble fraction of humus.

HUMATES are the salts of humic acids, collectively, or the salt of humic acid, specifically.

FULVATES are the salts of fulvic acid.

ULMATES are the salts of ulmic acid.

LEONARDITE is an organic mineraloid high in humic acids, often found in conjunction with lignite deposits.

Terminology taken in part from: Review of Humus and Humic Acids. Research Series No. 145, 1973 The South Carolina Agricultural Experiment Station, Clemson University, Page 5.

BENEFITS OF HUMIC ACIDS IN AGRICULTURE

Soil Improvement:

- Increases water-holding capacity of soils.
- Increases aeration of the soil.
- Improves soil structure and workability.
- Reduces soil erosion.

Chemical Benefits:

- Prevents leaching of water-soluble fertilizers, retains them in the root zone and slow releases them as the plants need them.
- Promotes the conversion of a number of elements into forms available to plants.
- Possesses very high ion-exchange capacities.
- Increases buffering properties of soil.
- Chelates metal ions.
- Increases uptake of phosphate and other plant nutrients.
- Increases availability of phosphorus and iron in alkaline soils.
- Rich in organic and mineral substances essential to healthy plant growth.

Biological Benefits:

- Stimulates plant growth by accelerating cell division.
- Increases germination of seed and viability.
- Increases the permeability of plant membranes, promoting the uptake of nutrients.
- Stimulates root formation and root growth.
- Stimulates root respiration.
- Stimulates proliferation of beneficial fungi and soil microorganisms.
- Aids in photosynthesis.
- Stimulates plant enzymes.
- Increases vitamin content of plants.

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Model Structure of Humic Acid

LEONARDITE AND HUMIC ACIDS IN AGRICULTURE

Humic acids are organic substances that are naturally occurring in healthy soils. A healthy soil is a productive soil. A healthy soil has a balance of microorganism and nutrients available to plant roots so the genetic yield potential can be achieved by plants, hence maximizing profitability.

The use of leonardite in granular form or humate in liquid form, stimulates plant growth, promotes root formation, improves soil structure, and increases water holding capacity, just to mention a few of the chemical, biological and physical benefits gained by the use of naturally occurring leonardite and Humic Acid extract.

Through cation exchange, humic acids work on the soil by making available to plant roots nutrients that otherwise would not be readily available, reducing the fertilizer input required.

WHAT CAN HUMIC ACIDS DO FOR YOU?

INCREASED YEILDS

The No.1 reason farmers use humic acids is to increase yields and profits.

In the United States farmers started using leonardite and humic acids decades ago, starting in California, and later west to Texas and north to Washington, Idaho and North Dakota. During these years **countless trials by the industry, universities, and the USDA have shown application of humic acids can improve yields and profits** for most crops including wheat and other grains, pulses and legumes, potatoes and root crops, alfalfa and forage crops, fruits,berries, and vegetables.

Wapaw Bay Humates has concentrated its research on crops where optimal application rates and methods have not yet been established. **Our trials on canola** in Saskatchewan have confirmed that Wapaw Bay **HA-6** can be used to increase yields and at the same time reduce phosphate and other fertilizer inputs, and increase profits.

Wapaw Bay Humates conducted 3 years of trials on canola. Results were consistent with other trials worldwide on other crops showing increased yields and net profits even while reducing P fertilizer inputs.

TABLE 1: WAPAW BAY HUMATES 2010 HA-6 Humic Acid Test strips on Canola
Canterra 1651H Clearfield Canola - seeded on pea stubble - sprayed with Odyssey

BASED ON 2010 COSTS AND CANOLA PRICES

Fertilizer	6 % HA	Yield	Cost / acre	Cost /acre	Total	Cost/bu	Value/acre	Net Profit
		Bu/ acre	Fertilizer	HA	cost/acre		@$12/bu	
Control - 50-20-0-20	0 litres/acre	38.26	$43.94	0.00	$43.94	$1.15	459.12	$415.18
Strip#1 - 50-20-0-20	7 litres/acre	44.09	$43.94	$7.00	$50.94	$1.16	529.08	$478.14
Strip#2 - 50-20-0-20	15 litres/acre	45.64	$43.94	$15.00	$58.94	$1.29	547.68	$488.74
Strip#3 - 50-20-0-20	30 litres/acre	45.80	$43.94	$30.00	$73.94	$1.61	549.60	$475.66
Strip#4 - 50-0-0-0	7 litres/acre	39.08	$25.91	$7.00	$32.91	$0.84	468.96	$436.05
Strip#5 - 50-0-0-0	15 litres/acre	41.35	$25.91	$15.00	$40.91	$0.99	496.20	$455.29
Strip#6 - 50-0-0-0	45 litres/acre	41.66	$25.91	$45.00	$70.91	$1.70	499.92	$429.01
Strip#7 75-0-0-0	56 litres/acre	41.00	$38.86	$56.00	$94.86	$2.31	492.00	$397.14
Strip#8 no fert.	no HA	23.15	$0.00	$0.00	$0.00	$0.00	277.80	$277.80

Table 2, from a canola trial monitored by Ag Grow Consulting Ltd. shows similar results of increased yields on canola using Wapaw Bay HA-6 even while reducing P fertilizer inputs.

TABLE 2 : Wapaw Bay 2011 HA-6 Humic Acid Trial Results

	(lbs)	(lbs)	(bu/ac)	(%)	(%)	(%)			
Plot	**Yield**	**Dry Yield**	**Yield**	**Green**	**Moisture**	**Dockage**	**Dam**	**Adj. Yield**	**Grade**
A - N Blend	1500.0	1488.0	29.8	9.2	10.8%	1.8%	0.2%	**29.2**	Sample
B - N Blend,10P, 7LT HA	2080.0	2107.0	42.1	5.6	8.7%	1.4%	0.6%	**41.3**	Sample
C - N Blend, 7LT HA	1640.0	1648.2	33.0	5.6	9.5%	1.4%	0.4%	**32.4**	Sample
D - N Blend, 10LT HA	1413.0	1430.0	28.6	4.4	8.8%	2.5%	0.4%	**27.8**	Sample
E - N Blend, 20P	1600.0	1579.2	31.6	4.6	11.3%	4.0%	0.4%	**30.2**	Sample

N blend = 44-0-0-15 Actual, 40lbs NH3 also applied on each plot

How do humic acids help increase yields?

Humic acids help your plants achieve their full genetic yield potential in part through:

1. **Enhanced nutrient uptake.**

2. **Stimulation of seed germination, root formation, and plant growth due to hormonal activity.**

3. **Proliferation of beneficial soil microorganisms.**

4. **Soil Improvement**

INCREASED NUTRIENT UPTAKE

More efficient use of P and other nutrients means you can **save money** by spending less on fertilizer inputs, and **increase yields,** thus maximizing profits (as shown in Tables 1 & 2).

Reduce your fertilizer inputs and increase yield and revenue.

Phosphorus

It has been common knowledge for decades within the industry and among farmers who use humic substances that humic acids increase P fertilizer efficiency, and availability of soil phosphorus.

This common knowledge was proven in a three year study by Hopkins and Stark at the **University of Idaho** (Humic Acid Effects on Potato Response to Phosphorus), 2003. This study is available online. The University of Idaho trial results proved that:

(1) Addition of humic acid to the fertilizer band tended to increase yields at both high and low P levels.

(2) Increased availability of P due to its increased solubility with humic acid was partially responsible for yield increase.

(3) Humic acids increased P uptake as measured by petiole P concentrations, and that this could also account for increased yields.

(4) Averaged across years and P rates, humic acid application increased total yield of potatoes by 18 cwt/acre, U.S. No. 1 yield by 22 cwt/acre, and **increased gross return by $152/acre** (based on 2003 costs and commodity prices).

(5) They concluded that *"regardless of the reasons"* humic acid application consistently **resulted in improved yield and quality and increased revenues.**

Wapaw Bay's trials on wheat and canola as shown in Tables 1 and 2, have shown the same results as countless other trials on other crops in the United States and other parts of the world: that **humic acids can increase P fertilizer efficiency, as well as make existing soil phosphorus available to plants, resulting in savings on reduced P fertilizer input, while increasing yield and revenue.**

Nitrogen: more efficient and soil friendly use

Anhydrous ammonia (NH_3) is a relatively inexpensive nitrogen source, but it can have negative effects on the soil. Only recently have agronomists discovered that adding humic acid liquids counteracts many of the negative effects of NH_3.

Less N fertilizer loss: NH_3 converts to the NH_4+ ion as soon as it comes in contact with water. The humic acid molecules are high in negatively charged exchange sites that absorb the ammonium ion. The ammonium ions (NH_4+) become attached to the large organic humic molecules. Once attached these nutrient ions are less likely to volatize in the air.

Enhanced N uptake: Humic acid enhances the uptake of monovalent cations like ammonium and potassium by increasing permeability of plant membranes and speeding up the nutrient uptake. Increases of up to 34% in active uptake were observed when humic acids were added to nutrient solutions (Maggioni, A. et. al. 1987). It is now accepted by most agronomists and fertilizer companies where humic acids are used that **adding humic acid to all nitrogen applications is a more effective use of your fertilizer budget.**

Humic Acids increase colonization of Rhizobium nitrogen fixing bacteria (see p. 14).

Micronutrients:
Humic acids are good at chelating metals such as iron, and can make existing soil micronutrients available even in acidic or alkaline soils.

Wapaw Bay HA-6 liquid humic acid contains 0.3% humic chelated iron as well as other humic chelated micronutrients.

Use HA-6 with every micronutrient application.

STIMULATION OF SEED GERMINATION AND ROOT FORMATION

Early robust rooting helps plants absorb water and nutrients, resist drought and stress, and increase yields. Enhanced seed germination and root formation by the application of humic acid is well documented.

- **Hormonal Activity:** This biological activity partially explains why humic acids stimulate seed germination and viability, promote root formation and growth, and aid plant growth. **The hormonal auxin-like effect of humic acids was demonstrated by R. W. O'Donnell working for the Saskatchewan Research Council, in 1972.** Since then it has been verified in countless trials that **humic acids enhance root formation through biological activity.**
- **Seed Germination:** Enhanced seed germination and viability with the application of humic acid is also well documented. Wapaw Bay Humates' own seed soak trials on rice conducted by Central Luzon State University and Vast AgroSolutions Inc. in the Philippines. showed increased yields of up to 19%.
- **Proliferation of Mycorrhizae:** Humic Acids have been shown to increase growth and proliferation of Mycorrhyzae. Roots with Mycorrhizae spread over the available space more rapidly. The root extension filaments provided by Mycorrhizae provide more surface area to absorb water and nutrients more effectively. **(Ghazi Al-Karaki B. McMichael · John ZakField . Online publication).**

SOIL PROTECTION AND REMEDIATION

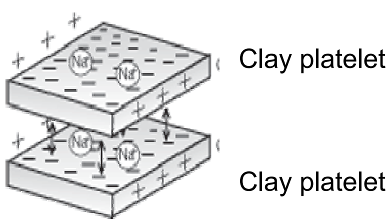
Humic acids are organic acids that are naturally occurring in healthy soils. Application of humic substances results in **long term soil improvement,** including:

- Enhancement of soils depleted in organic matter.
- Through cation exchange, the remediation of alkaline soils and soils salted from long term application of chemical fertilizers.
- Holding soluble fertilizer in the soil and thus minimizing leaching and the resulting contamination of groundwater, rivers and other water bodies.
- Increasing the water holding capacity of soil.
- Improved soil structure and prevention of clay soil compaction.
- Increased proliferation of beneficial soil microorganisms.

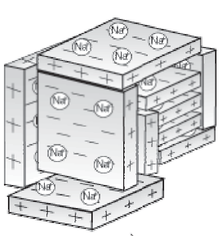
Preventing or reversing soil salt overload due to long term use of ammonia nitrogen and other chemical fertilizer: Ammonium is the same size and charge as sodium and has a similar dispersing effect on soil clays. Long term use of ammonia fertilizers can lead to deteriorated soil structure, crusting, and seedbed problems.

Ammonia can sterilize the soil by killing beneficial algae, bacteria, and fungi. Humic acids can alleviate this problem by promoting beneficial soil microorganisms and by absorbing the ammonia based fertilizers.

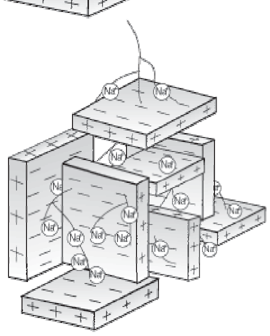
How do humic acids prevent clay compaction?



Clay structure: Clay particles normally lie together flat, repelled by negative charges across their face. Salt overload caused by long term application of chemical fertilizer neutralizes the negative electrical charge that cause clay particles to repel each other causing the platelets to move closer together.



Clay compaction: In soils with a high percentage of clay, and an excessive amount of salt present, the positive charge on the edge of the clay particles attracts the negative charge on the flat surface of one another, forming a tight structure.



Humic Acid removes salts from the surface of the clay particle. The resulting net negative charge causes the clay particles to repel each other loosening the soil structure. Carboxyl groups on the humic molecule bond with the edge of the positively charge particles, breaking the attractive force between the platelets.

As humic acid penetrates compacted clay platelets it segregates salts, removing them from the clay particle surface, restoring a negative charge to the face of the platelets causing them to repel one another. **The result is that humic acids loosen the soil, encourage water penetration, and let roots penetrate more easily.**

ALKALINE SOILS

Alkaline soil is a soil with a pH greater than neutral (more than 7). The bioavailability of P is strongly tied to soil pH. At low pH the formation of iron and aluminum phosphates results in reduced solubility of P. The maximum solubility and plant availability of P occurs at pH 6.5 ±. As a result of the reaction of P with calcium to form a calcium phosphate bond **P solubility declines again as the soil pH becomes alkaline.**

The result of low P solubility in alkaline and calcareous soils is poor fertilizer P efficiency. Simply adding P at normal rates with conventional methods may not result in optimal yield and crop quality (Stark and Westerman, 2003). Several strategies including higher fertilizer rates have been found to improve P nutrition in alkaline soil.

Phosphorus complexed in organic materials such as manure increases phosphorus solubility and availability to plants. **Humic acids have been found to be the best organic material to complex P in forms available to plants.**

Increased uptake of P, and increased yield and profit, with humic acids:
A three year study at the University of Idaho found an increase in petiole P with the addition of humic acid. Averaged over three years humic acid application increased the yield of potatoes by 18 cwt/acre, and gross return by $152/acre (Hopkins and Stark, 2003).

Micronutrients: Likewise, the availability of iron and other micronutrients in alkaline soil increases with the application of humic acid.

Remediation of alkaline soil with leonardite: Leonardite typically has a low pH and can be used to lower soil pH. Wapaw Bay leonardite has a very low pH of ± 2.9. Regular application of Wapaw Bay leonardite will adjust soil pH to less alkaline. Once soil pH is adjusted, the buffering properties of leonardite will help maintain pH at an acceptable level.

EFFICIENT WATER USE

If you are paying for water, farming arid land, or experiencing drought conditions, you want to make the best use of your water. Humic acids can help by:

- Increasing water holding capacity of the soil.
- Decreasing water loss due to evaporation.
- Decreasing water loss due to leaching, especially in sandy soil.
- Increasing Mycorrhizae colonization, increasing plants ability to absorb water.

Adding humic acids to your irrigation water can result in substantial water savings. Application of leonardite ore to the soil has been shown to result in further water savings.

PROLIFERATION OF BENEFICIAL MICROORGANISM

A healthy soil is rich in beneficial fungi and microorganisms. Today many farm soils are dead due to a lack of beneficial microorganisms**.** The increased proliferation of beneficial microorganisms such as Rhizobia and other nitrogen fixing bacteria, and Mycorrhizae and Trichoderma fungi, by the addition of humic acid, is well documented.

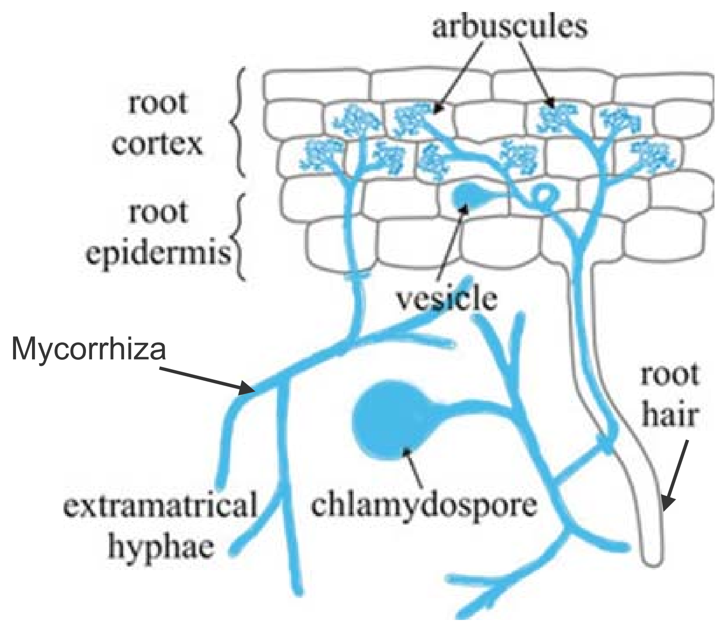
Rhizobia

Rhizobia are soil bacteria that fix nitrogen after becoming established inside root nodules of legumes. Application of humic acid aids colonization of Rhyzobia (Rao, 1977). Humic acid has been shown to increase nodule mass on most legumes. (Tan& Tantiwiranond, 1984).

Mycorrhizae

A mycorrhyza is a symbiotic association between a fungus and the roots of a plant. When mycorrhyzal fungi colonize the plant's root system, they create a network of filaments that increase the plant's capacity to absorb water and nutrients such as nitrogen, phosphorus, calcium, and micronutrients.

Figure 1: Arbuscular Mycorrhiza



How do Mycorrhizae boost plant growth and vigor?

- Promotion of faster root development. Roots with Mycorrhizae spread over the available space more rapidly.
- Roots with Mycorrhizae have more surface area to absorb water(Ghazi Al-Karaki · B. McMichael · John ZakField . Online publication).
- Increased phosphorus uptake (Li H, Smith SE, Holloway RE, Zhu Y, Smith FA. 2006) and other essential nutrients. Much of the phosphorus absorbed by plants is by Mycorrhizae.
- Increased survival due to a greater capacity to absorb nutrients from the soil resulting in plants that are healthier, more vigorous, and more resistant to stress.
- Improvement of soil structure and reduction of erosion. The root extension filaments provided by Mycorrhizae holds soil particles together, which reduces erosion and allows for better water penetration.

ORGANIC FARMING

Leonardite and humic acids extracted from leonardite are **allowed in Canada for use on certified organic farms.** Humic Acids are listed in the **Canadian Organic Standards Permitted Substances List** (available at CFIA website).

Humic acids are rich in organic and mineral substances essential to plant growth. Humic acids maximize absorption of nutrients. Humic acids can increase yields, and help maintain soil health in an organic farming system. A healthy soil is a productive soil.

Ways humic acids can help plants access nutrients in an organic farming system:

- Increase nitrogen reserves through enhanced colonization of Rhizobia and other soil fixing bacteria.
- Convert soil phosphate and micronutrients into forms available to plants.
- Increase P uptake by maximizing proliferation of Mycorrhizae.

RESEARCH

Over the past decades, trials in the United States and other countries have consistently demonstrated that leonardite and its derivatives can improve yields, quality, and profitability for most crops on most soil types and climatic conditions.

Wapaw Bay Humates **is concentrating its research on crops commonly grown in Canada, and crops where optimal application rates and methods have not yet been established.** We have sponsored trials for canola in Saskatchewan, berries in BC, seed treatment in the Philippines, and foliar application on field tomatoes. Our trials confirm that humic acid can be used to reduce fertilizer inputs while increasing yields, quality, and profits for the grower. ***Wapaw Bay Humates*** will continue to sponsor trials to improve knowledge and make the information gained available to our customers. We will continue to work to develop new environmentally friendly humic products for agriculture and soil remediation.

HA6 APPLICATION RATES AND METHODS

Effective application methods include **soil applied, foliar, seed soak, and seed coat.**

SOIL APPLIED

Before seeding: You can apply HA6 prior to seeding, with or without herbicide.

During seeding: For maximum benefits, if you are equipped for liquid fertilizer application, apply during seeding, either alone or mixed with your liquid fertilizer. If mixing with acidic fertilizer you may have to agitate the mix to avoid precipitation**.**

Humate distributors generally recommend between 1 and 10 gallons (4 - 40 litres) of 6% humic acids per acre for most crops, during seeding. University of Idaho trials showed increased phosphorus uptake, and increased yields and revenue at rates of 1.5 and 3 gallons **(6-12 litres) 6% HA per acre.**

Wapaw Bay trials on wheat and canola showed increased yields and revenue with application rates of 7, 15, 30, and 45 litres HA-6 per acre during seeding. Although yields tend to increase as humic acid rate is increased, the higher rates may not always be the most cost effective.

Recommendation: 6-15 litres HA-6 per acre for canola, wheat, and most field crops.

Trickle or drip irrigation: Add to irrigation water throughout the growing season to reduce water loss and improve yields. The greatest plant response is from **10 ppm to 100 ppm HA** in irrigation water. **For 100 ppm add 1.6 litres HA-6 per 1000 litres water.**

FOLIAR

Foliar application methods include: Boom sprayer
Overhead Irrigation
Sprinkler system
Hand Pressure Sprayer

HA-6 can be foliar applied alone or with micronutrients, and with most herbicides and pesticides on most crops. If unsure of mixing compatibility perform a jar test first, mixing each product in the same ratio as to be field applied. **Exceptions:** Do not mix with 2 4D-B. Do not mix with herbicides on potatoes, onions, or grapes.

- Mixed with herbicides, pesticides, or nutrients, apply **1-4 litres HA-6 per acre.**
- Applied alone, use **2- 4 litres HA-6 per acre, diluted with enough water to get good coverage.** We recommend you use a 10 gallon nozzle.

In our 2013 trials on field tomatoes, at Los Banos National Crop Research and Development Center in the Philippines, Wapaw Bay humic acid foliar applications outperformed other treatments in almost all parameters. **Three foliar applications of 2 litres per hectare per treatment** plus recommended rate of fertilizer increased yields by almost double as compared to recommended rate of fertilizer alone.

Foliar applications can be in addition to soil applications and/or seed coat.

SEED SOAK

Increased germination rates and yields are reported with potatoes, tomatoes, cucumbers, rice, and other field and greenhouse crops. Positive results have been achieved with 1 litre 6% humic acids per 15 to 40 litres seed soak solution.

Wapaw Bay Humates sponsored two years of seed soak trials on rice conducted by Central Luzon State University and Vast Agro Solutions in the Philippines. Results showed increased yields of up to 19% with the seed soak treatment. Best results were obtained with a **12 hour soak** in equivalent of **1 litre HA-6 per 15 litres water.**

SEED COAT

Easy to apply using **trickle flow and auger mixing techniques**.

For most seed varieties **dilute HA-6 1:1 with water.** For some species 1:1 dilution is too strong: **dilute 1 part HA-6 to 5 parts water.**

Different varieties of the same species may respond differently**. Too high an HA concentration can have an inhibitory effect on seed germination in some species. If unsure, dilute 1 part HA-6 to 5 parts water.**

Note: HA seed coat is not suitable for flax.

We recommend doing a germination test with HA-6 at different concentrations plus one sample as a control with no HA coat:

1. Prepare 3 samples:
   (1) HA-6 diluted 1:1 with water, (2) 1 part HA-6 to 5 parts water, (3) no HA-6.
2. Dip the seeds, making sure they are well coated.
3. Germinate in wet paper towels.
4. Check once a day, and note % germinated each day and final percentage germinated.

Leonardite Application Rates

Field crops: Apply 20 Kg or more, per acre, spring or fall, in conjunction with liquid HA applications. Used alone, or for remediation of alkaline soil, apply 100 – 200 kg per acre.

Side dressing row crops: Apply 10 - 40 Kg leonardite per acre spring or fall.

Nurseries, potting soils, soiless media: Add 3 kg per cubic meter or 3 - 5 grams per kg. of soil or soiless medium, or up to 1 part leonardite to 50 parts soil or soiless medium.

Ground preparation for sod, turf, and golf courses: Apply 1 - 2 kg. per 10 square meters worked into a depth of 15 cm (6 inches).

Top dressing for lawns, golf greens and tees: Blend into top dressing at a rate of 4 kg. per 100 square meters, spring and fall.

Tree transplanting: Blend in 100 – 200 grams into the backfill.

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Wapaw Bay Humates

HA-6™

HA-6 can be applied to field crops, row crops, feed crops, hydroponic crops, vegetables, berries, fruits, vines, trees, ornamentals, turf, and landscaping.

HA-6 can be applied to all soil types and pH ranges.

HA-6 can be mixed with almost all liquid fertilizers, pesticides, fungicides, and defoliants. It may be necessary to agitate your mix to obtain even distribution. If unfamiliar with a particular application perform a jar test, mixing each product in the same ratio as to be field applied.

Mix HA-6 with water or solutions that have a pH of 6 or more. Fertilizers with a low pH will cause the humic fraction to precipitate. It will be necessary to agitate your mix to obtain even distribution.

Lot #

Guaranteed Min. Analysis
Soluble Potash (K2O).. 1.5 %
Iron (Fe) ……………….. 0.3 %

Also contains non plant food:
Humic Acids …………. 6.0 %

Derived from Leonardite

Notice: Buyer assumes all risks of use, storage, or handling of this product not in strict accordance with directions. Wapaw Bay Resources Inc. does not make any guarantee concerning this product or use thereof, except in conformity with the statements on the label.

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1000 Litres

Directions:.Apply 6-30 Litres (1.6 - 8 US Gal.) per acre per growing season.

Soil Applied: Add HA-6 to partially filled tank. Use with every fertilizer application.

When sprayed or applied without mixing with fertilizer, HA-6 should be mixed with at least five times its volume of water.

Sprinkler or Drip Irrigation: Smaller amounts of HA-6 may be applied in every irrigation instead of a single application.

Transplanting: Mix 1.3 Litres HA-6 per 40 Litres (1 quart per 10 US Gal.) solution.

Seed Treatment: Add 1 Litre HA-6 per 15 Litres seed soak solution.

Foliar: 2-4 Litres per acre mixed with foliar applied materials. When spraying alone dilute 1:20 in water.

Potted Plants: Use 4-6 ml per Litre fertilizer solution.

Hydroponic: 1-2 Litres per 200 Litres nutrient solution.

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