LANDMARK

Landmark Operations Limited
ABN 73 008 743 217

SUMMARY OF OTHER TREATMENTS APPLIED K & R ROBERTS 2018 SEASON

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Aim – To trial a range of products at seeding to get plants established and growing on saline soils.

Lawrie Co VAM –

Increase Vesicular Arbuscular Mychorrizal (VAM) funghi.

Aids in early root development and soil structure.

Helps plants access to locked up soil bound nutrients.

Humates –

Contain natural organic matter that is the key to improving salty and sodic soils.

Amino Kelp -

Mix of Amino Acid and Kelp

In amino acid elite product there is Leucine which helps with drought tolerance and salt tolerance.

Kelp aids early cell division and cell structure.

Calcium Nitrate –

Research indicates it disperses salinity in some soil structures.

Inoculum | Seed Dressing

VAM

MYCHORRIZAL & NUTRIENT SEED TREATMENT WITH BACILLUS SUBTILLUS & TRICHODERMA

Stimulate early root growth, root mass and seedling vigour.

Better moisture access in the seed zone.

Establish natural mycorrhizal fungi colonisation on plant roots.

- Grow stronger, more tolerant and productive plants.
- Increase nutrient availability to plants.
- Promote natural response to disease in crops during the early germination stage.
- Plants can access locked up phosphorus and zinc.
- Improve soil structure in root zone building water holding capacity, aeration and friability.
- More roots aid in building soil organic carbon.
- Potential VAM spore carry over for following crops.
- Bascillus Subtillus (B.Sub) and Trichoderma (Trich) aid plant resilience to plant pathogens.

What is VAM Fungi?

Vesicular-Arbuscular Mychorrizal (VAM) Fungi are naturally occurring fungi that form a beneficial association with plant roots enhancing the plant's mineral absorption and access to moisture.
VAM can increase access to nutrients (P in particular) and moisture from 100 to 1000 times.

TYPICAL ANALYSIS (w/v)

Phosphorous as citrate soluble	0.726%	Manganese as carbonate	1.53%
Phosphorous as citrate insoluble	0.954%	Humic Acid	4.4%
Phosphorous Total	1.68%	Fulvic Acid	3.18%
Potassium as organic	0.71%	AM inoculant 32,500 propagule/L *multiple spec.*	
Pottasium Total	0.71%	Beneficial Bacteria - Bacillus Species *B.subtilis, B.laterosporus, B. licheniformus, B. megaterium, B. pumilus, P. polymyxa*	
Sulphur as organic	0.15%		
Sulphur Total	0.15%		
Calcium as organic	0.28%	Beneficial Fungi - Trichoderma Species *T. harzianum, T. viride, T. koningii, T. polysporum*	
Calcium as phosphate	4.89%		
Calcium Total	5.17%	pH	8.0 - 8.30
Silicon as silicate	2.52%	Specific gravity	1.22 - 1.25
Zinc as oxide	2.40%		

Available in 20L & 1000L containers. Do not store in direct sunlight or for long periods. Check label for more detailed application and handling information.

RECOMMENDATIONS

Seed Dressing	Rate / T of seed	Timing
Cereals	10 L/t	Apply to seed pre-sowing
Brassicas/Canola/ Lupins	20 L/t	*SureCROP VAM gives essential nutrition for non-mychorrizal plants. Or substitute SureCROP Zinc*
Legumes (Beans/Peas)	6-10 L/t	Apply to seed pre-sowing
Pasture/Lucerne/Turf	up to 40 L/t	Apply to seed pre-sowing
Potatoes	5 L/t	Apply to seed potatoes pre-sowing
Onions/Carrots	40 L/t	Apply to seed pre-sowing
Chemically Treated Seed	Ensure 2L BioMAX Liquid Fulvic is mixed in with every 10L of SureCROP VAM prior to application to seed.	

Zinc deficiency: Where additional zinc in required, combine with SureCrop Zinc.

Liquid Inject / Fertigation	Rate / Ha	
Trees/Vines /Turf/Veg	1-2 L/Ha	
Broadacre	100-200 ml/Ha	At seeding

Pre & Planting	Rate	Application
Dormant Tree/Vine	1:5 dilution	Plant dip prior to planting
Tree / Vine	1-2 L / 1000L	Water jet with planting water
Vegetables	1:20 dilution	Seedling drench to point of saturation

Rates and timings may change depending on crop and season.
Always consult a LawrieCo consultant or distributor for specific recommendations.

Building wealth from soil with
Next Generation Fertiliser

Manufactured in Australia by LawrieCo 47 Naweena Road, Regency Park SA 5010 **Ph 08 8260 1134** Fax 08 8260 2263 info@lawrieco.com.au **www.lawrieco.com.au**

AminoElite™

Horticulture Blend

Microbially Active Foliar Fertiliser. Packed with Vital Amino acids. Balanced with trace elements and micro nutrients

Introduction

AminoElite™ is a foliar fertiliser produced by a unique microbial digestion process, which involves the breakdown of deep sea fish emulsion and crustaceans, into a form in which plants can rapidly absorb the available nutrients through their foliage or through their root system.

This unique process, used to manufacture AminoElite™ and developed through 25 years of R&D, allows us to preserve beneficial microbes and creates nutrients in the form of absorbable amino acids.

Plants will rapidly absorb these nutrients in a noticeably shorter time frame than with conventional fertilisers.

Why AminoElite™ works so well

Unlike most other liquid protein sources Amino Elite™ is produced via a unique ambient (room) temperature process. This process involves bacterial digestion, which preserves the protein molecules.

In doing so beneficial microbes are unharmed and continue to increase over time. Increased microbes will improve your soil biology as well as improve your plants nutrition.

Importance of Amino Acids & Trace Elements

Amino Acids are the essential building blocks for plant growth. AminoElite™ has a series of L shaped -Amino Acids. These Amino Acids are good chelating agents, which facilitates nutrient absorption through the foliar surface and through the root system, transporting nutrients more efficiently throughout the plant.

Most soils have deficiencies of trace elements. AminoElite™ is a concentrated source of both macro and micronutrients. It will provide organic nitrogen to your plant and soil and beneficial microbes to your soil.

Inclusion of Crustaceans

Deep sea crustaceans are a good source of Chitin. The presence of Chitin and the enzyme Chitinase, enhance the immune system of the plant.

Amino Acid (AA) Analysis (mg/L) and Benefits

AminoElite™ contains minimum 3.5% (w/v) Amino Acids with the approximate composition of:

AA		Metabolic functions of AA
Aspartic Acid	5%:	Seed germination
Threonine	2.5%:	Improve drought tolerance
Serine	4.5%:	Chlorophyll production, Stomata regulation, Improve Pollination
Glutamic Acid	10%:	Chlorophyll production, stomata regulation, pollination, seed germination
Proline	9%:	Heat, Salt, and Drought tolerance
Glycine	27.5%:	Chelation, Heat tolerance, Chlorophyll production
Alanine	12.5%:	Chlorophyll production, seed germination
Valine	4.5%:	Drought tolerance, seed germination
Methionine	0.2%:	Ripening, stomata regulation
Isoleucine	3%:	Salt and Drought tolerance, Pollination
Leucine	5.5%:	Salt and Drought tolerance, Pollination
Phenylalanine	0.8%:	Humic compound, lignin formation
Histidine	1%:	Aids fruit ripening
Lysine	5%:	Chlorophyll production, seed germination
Arginine	4%:	Root development, induces Flowering and Fruiting Hormones
Hydroxiproline	5%:	Defence against Pathogens attack Water movement through the plant

* Being a microbial product the concentration of the different amino acids may vary.

Grow Green AminoElite™ - Horticulture Blend

Product Benefits

- Healthy plants are better able to resist environmental stresses such as pests, disease and extreme weather conditions.
- The correct balance of Micro and Macro nutrients will aid the plants ability to produce uniformity in fruit size, colour, and shape.
- Microbes and bacteria help supply organic nitrogen to the plant and soil.
- AminoElite™ can enhance the uptake and assimilation of trace minerals to rapidly correct minor micronutrient deficiencies.
- Improving soil microbial activity can aid the reduction of bulk fertilisers use and assist with unlocking built up nutrients.
- AminoElite™ has a Nil with holding period.

Shelf Life and Storage

Shelf Life up to 12 months from manufacture

AminoElite™ should be stored at ambient temperature conditions. It is recommended to be stored out of direct sunlight, but within a well lit area so that the microbial digestion process within the product continues.

Compatibility & Use

AminoElite™ can be mixed and applied with most commonly used pesticides, however AminoElite™ should not be used with selected herbicides.

We strongly recommend checking labels for compatibility as well as pre testing in a small area prior to widespread application.

AminoElite™ is rainfast in 15 minutes. We suggest not applying if rain is expected shortly after application.

Optimising results

Use with GrowGreen's Xtend® plant oil adjuvant for optimum results. Xtend® will maximise the result by reducing drift and increasing adherence to the sprayed surface.

GrowGreen Pty Ltd
6089 Cunningham Highway Kalbar Qld 4309

Analysis (W/V)

		Hort
Nitrogen (N)	as protein	1.10%
	as nitrate	0.20%
	as urea	1.80%
	as ammonium	0.20%
	Total	3.30%
Phosphorus (P)	as water soluble	0.70%
Potassium (K)	as protein	0.30%
	as phosphate	0.20%
	Total	0.50%
Sulphur (S)	as sulphate	0.55%
Calcium (Ca)	as nitrate	0.20%
Magnesium (Mg)	as sulphate	0.02%
Zinc (Zn)	as sulphate	0.10%
Manganese (Mn)	as sulphate	0.025%
Iron (Fe)	as sulphate	0.005%
Boron (Bo)	as sodium borate	0.04%
Molybdenum (Mo)	as sodium molybdate	0.01%
Cobalt (Co)	as sulphate	0.0025%

Packaging

AminoElite™ is available in the following containers:

- 20L and 1000L

Application Details

AminoElite™ is suitable to use on a wide range of horticultural crops – for example tomatoes, grapes, almonds, walnuts, citrus, bananas, mangoes, apples, and many other vegetables and fruits.

Crop	App. Rates/Ha	No. of applications
Horticultural crops	1.5 – 2L	3-4 foliar applications, pre flowering, post flowering & fruit enlargement stage
Broad acre Winter crops	1.5 – 2L	Liquid injection at seed sowing stage, 2 foliar applications (mid tillering & booting – grain filling stage)
Broad acre Summer crops	1.5 – 2L	2-3 foliar applications, pre flowering, post flowering and grain filling stage
Annual & perennial pasture	2 – 3L	3-4 foliar applications post grazing

To be diluted in a minimum of 100L of water p/Ha
** Spray to point of run off.*

For information about specific application rates, please contact our technical staff

Telephone: +61 7 5463 9900
OR 1800 355 913
Email: sales@growgreen.com.au
www.growgreenfertiliser.com

Humic Substances as Amendments for Poor Fertility Soils

Cornelia Bos-VanderZalm, Dr Antonio Patti, Dr Aravind Surapaneni & Prof Roy Jackson

PhD student, Corrie Bos-VanderZalm

Natural organic matter (NOM) occurs abundantly in soils, waters and sediments, and is the key to improving the fertility of degraded soils affected by salinity and sodicity. Humic substances are the main components of NOM. By characterising the physical, chemical and biochemical nature of humic substances, we hope to gain an improved understanding of their role in soil fertility.

Humic substances are a main component of the natural organic matter that occurs in soils, water and sediments. A complex mixture of organic compounds derived from decaying biomass, humic substances play an important role in soil fertility, binding soils together and controlling the release of nutrients.

This project assessed the viability of different sources of humic substances as organic amendments for poor fertility soils. Field trials were conducted initially, but difficult drought conditions limited the results, and work was continued with glasshouse based experiments.

Field trials

Six commercially available organic amendments were assessed for their physical and chemical properties, including total humic substances (HS), fulvic acid (FA) and humic acids (HA). The characteristics of the carbon present in amendments were determined by Solid State $Carbon^{13}$ Nuclear Magnetic Resonance (SS C^{13} NMR) spectroscopy. FA and HA from soils and amendments were separated by alkaline extraction according to the International Humic Substances Society (IHSS) method. Infra Red (FTIR) spectra, microanalyses and Thermo-Gravimetric Analysis (TGA) of the freeze dried HA samples completed the organic carbon picture for the selection of amendments. The three amendments chosen were 'Omnia' organic humate, 'Swanpool vermicast', and Coles supermarket waste.

Figure A. Field Trials at Mooroopna, Victoria.
Photo: Cornelia Bos Van-derZalm

A field trial was conducted on 40 plots of clover and rye pasture at Mooroopna, Victoria (Figure A). The field trial was started in December 2001 and was planned to continue for a 2.5 year period so that a statistical assessment could be made of any improvements in organic carbon content and soil structure. However, due to severe drought conditions and irrigation prohibitions, the lease of the field trial land was terminated in July 2002 and the study was moved to glasshouse experiments. Preliminary results (after 8 months) indicated that there is potential for commercial humates and other organic waste products to improve soil properties and yields.

Glasshouse experiments

One component of HS that may play a significant role in soil fertility is a reported glycoprotein, 'glomalin'. Glomalin is thought to be produced in the hyphae of mycorrhizal fungi and may reside in the humin fraction of HS. This compound was reported in the literature but its structure was unknown and its identity not clearly supported by scientific evidence.

Three soils and six organic amendments were investigated for Glomalin Related Protein (GRP). Organic material was extracted with a sodium citrate solution and autoclaved at 120°C for 4 hours. The extracts were centrifuged and the remaining pellets dialysed in dilute Na-borate solutions followed by dialysing in water, centrifugation and freeze drying.

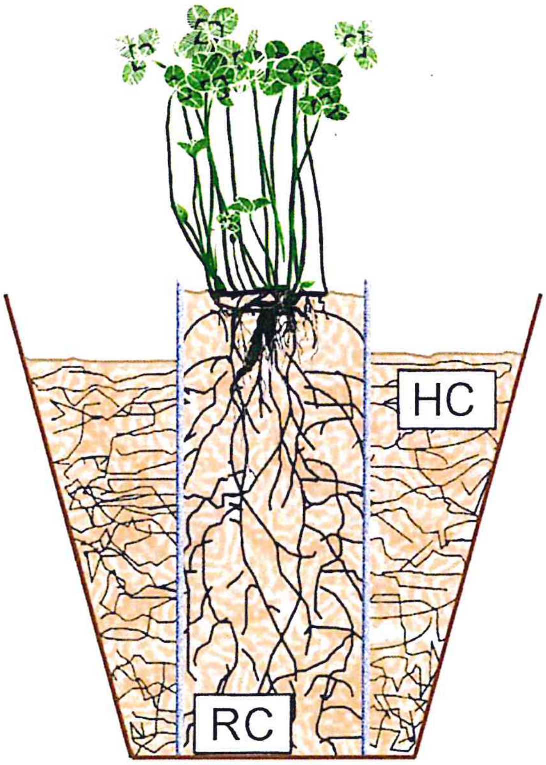


Figure B. Clover growth experiment. Isolation of mycorrhizal hyphae by 25µm membrane. HC = hyphae compartment. RC = Root compartment

A direct investigation of the hyphae of mycorrhizal fungi was also conducted to establish the presence of GRP. A clover growth experiment was set up with a membrane barrier which contained clover roots in sterilised sand, but allow hyphae to penetrate into the sterilised soil / sand (Figure B). The hyphae are less than 25µm in size and were encouraged to penetrate into the hyphae compartments (HC) by careful placement of fertiliser. After nine weeks the sand of HC, sand/soil of RC, mesh bag and clover roots were citrate extracted by the method previously described.

All samples were then analysed using Pyrolysis-Gas Chromatography Mass Spectrometry (Py-GC-MS). The products present in HC and clover root extracts indicated that a complex mixture is produced by clover plant roots, spores and hyphae of mycorrhizal fungi. The pyrolysis products were fragments of polysaccharides, minor proteins, fatty acids, and plant hormones. This illustrates that 'glomalin' appears to be a combination of many compounds which may all induce healthy soil microbial activity.

This research has implications for the sustainable management of soil fertility through the use of organic amendments derived from waste products otherwise destined for disposal.

Improved knowledge of the speciation of the organics in these amendments can lead to more specific and efficient fertiliser applications. Use of organic carbon compounds to improve microbiological activity, soil structure and fertility, are a potentially important step in the replacement of the non sustainable practices of super phosphate and gypsum fertilisation.

Centre of Green Chemistry award for Research Excellence November 2004.

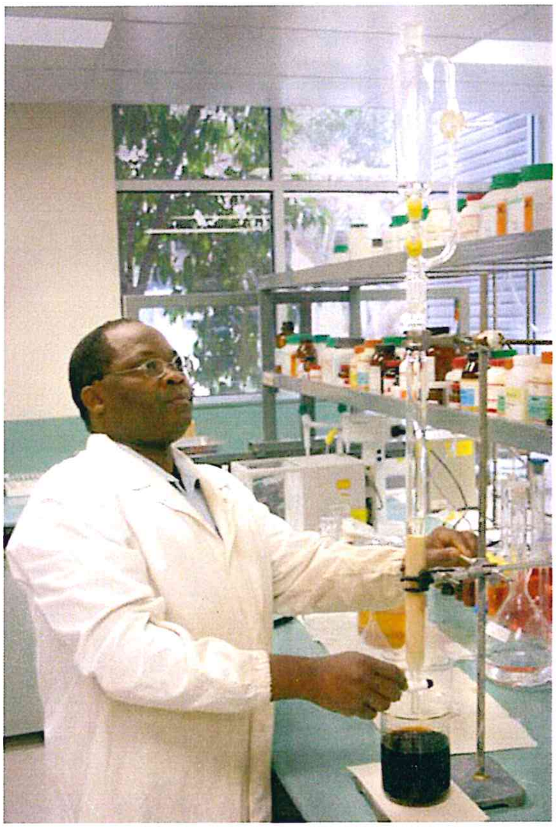
Poster presentation: XI International meeting of IHSS, Boston, USA, 2002.

Combined national conference of the Australian Organic Geochemists and the IHSS, Blue Mountains, NSW, Australia, 2004. (Poster and Oral presentation).

Poster presentation: XII International meeting of IHSS, Sao Pedro, Brazil, 2004.

Effect of Potassium Humates on Soil Fertility

Albert Imbufe, Dr Antonio Patti, Dr Aravind Surapaneni and Prof Roy Jackson



PhD student, Albert U. Imbufe, eluting fulvic acid extracts from a XAD-8 column with an alkaline solution

This research project focused on humic acids, and how the potassium salts of these naturally occurring organic compounds can be used to improve soil fertility. The investigation included field trial applications in an acidic vineyard soil, laboratory analyses of treated samples, characterisation of soil and soil extracts and plant growth experiments.

Humic substances are formed naturally when biomass materials undergo natural decomposition and transformations to form a complex mixture of organic molecules. They vary in composition, depending on their origin and method of extraction, and are generally classified into three sub-fractions known as fulvic acids, humic acids, and humin according to their molecular size fraction and solubility in alkaline or acid media. Humic acids occur extensively in the environment, particularly in soils where they constitute 65-70% of the soil organic matter. High levels of humic acids are also present in composts, chicken manure, sewage sludge, and in low rank coals, such as Victorian Brown Coal. These complex organic materials are rich in acidic functional groups, and are believed to exert a beneficial influence on soil fertility and plant growth.

Appropriate application of humic acids, based on the 'green' approach, with an understanding of their properties such as poly-electrolytic nature, nutrient chelating ability, buffering properties, and ability to promote of soil microbial activity and plant growth. They may provide viable, and environmentally friendly additives to chemical fertilisers and enhance sustainability in modern agriculture.

Soil and plant treatments with very small amounts of Potassium Fulvate (KF) and Potassium Humate (KH) in both field and laboratory greenhouse experiments resulted in highly significant differences between treatment and control samples.

Beneficial effects on soil included increases in total organic carbon, increased pH, improved cation exchange capacity, water permeability and aggregate stability.

Beneficial effects on tomato and silverbeet plant growth were observed in seed germination, growth rates, biomass weight, and nutrient uptake. Compared to the controls, treatment of soil with small amounts of KF and KH resulted in highly significant increases in the fresh and dry biomass of shoot and fruits, with a foliar spray application giving the best overall yields (Figures A & B).

Figure A. Potassium Humate (KH) growth response of tomato in sand culture. Growth is significantly enhanced in treated plants (left and right), relative to the control (centre). Photo: Albert Imbufe

Figure B. Potassium-Fulvate (KF) growth response of tomato in an acidic soil medium. Chlorosis (yellowing) is observed in the control due to Fe or Mg nutrient deficiency. Photo: Albert Imbufe

Results from analysis of plant shoot nutrient content indicate that treatment of soil with low rates of KF and KH products significantly increased the concentration of the major nutrients (N,P & K). The highest increases were observed after the foliar spray treatment with 96% (N), 55% (P) and 29% (K) for KF, and 61% (N), 100% (P) and 42% (K) for KH.

Concentration of micronutrients (S, Ca, Na, B, Fe, Mn, Mg, Zn & Cu) in treated samples also increased significantly over the controls. The highest observed uptake was for Fe. A similar trend was observed in the uptake of other micronutrients, with the exception of Na where the uptake decreased with both the fulvate and humate treatments, relative to the controls.

Results from this study, coupled with a better understanding of the chemistry of these complex organic mixtures, their stimulatory growth effects and nutrient uptake mechanisms, may provide potentially viable strategies for more sustainable agricultural practices.

Aspects of our work with humic acids have been published in the “Geoderma” Journal, as well as in the refereed Conference Proceedings “SuperSoil 2004” at the University of Sydney in December 2004, where a poster paper was also presented.

Imbufe, A.U., Patti, A.F., Burrow, D., Surapaneni, A., Jackson, W.R. and Milner, A.D., “Effects of potassium humate on aggregate stability of two soils from Victoria, Australia”, Geoderma 2005, 125, 321-330.