MAXWELL

BioMass SUGAR®

Maintaining a Healthy Balance

A highly refined, premium quality, naturally derived, soil carbon source.

Designed to support a thriving, well balanced, healthy soil ecosystem and optimised carbon to nitrogen ratio; containing 22% furfural.

The Life in your Soil

Plants have evolved a series of mutually reliant relationships with organisms which are not visible to the naked eye. These organisms are referred to as microorganisms and, the field of study which seeks to understand them is microbiology.

Most of these organisms are heterotrophic which means they depend on other living or dead organic organisms for their survival and multiplication.

The majority of these organisms are found in great variation both in quantity and quality throughout a soil, with samples taken only a few centimetres apart, or at different depths showing considerable differences.

Soil ecological habitats are complex, dynamic, interrelated and co-dependant systems. Accordingly, the population density and distribution of microorganisms within a soil is in a constant state of change.

Soil microorganisms most densely colonise certain regions within a soil and have been shown to substantially affect plant health, growth and disease management.

The dominant forms of microorganisms within the soil are:

Bacteria

The most abundant microorganism in soil, bacteria are single celled (unicellular) microorganisms present in soil in three forms; round/spherical, rod-shaped, spiral (long wavy chains).

Soil bacteria are divided into two categories:

Autochnotus: bacteria which are native and whose population is uniformly spread and relatively constant throughout a soil. They derive their food from native soil organic matter (e.g. *Arthrobacter spp.*).

Zymogenous: bacteria which require an external source of energy whose population is lower in soil than the Autochnotus bacteria. The population of Zymogenous bacteria fluctuates and will increase when an external energy source is introduced into the soil (e.g. *Pseudomonas spp.* & *Bascillus spp.*).

Bacteria are further classified in terms of how they obtain their nutrition and energy, particularly carbon and nitrogen.

Autrotrophic: bacteria synthesise food from simple inorganic nutrients and utilise carbon-dioxide (CO_2) from the atmosphere to obtain their carbon. Food is produced from either sunlight, in which case they are referred to as photoautotrophs such as *Chromatrium spp.*, or by the oxidisation of an inorganic molecule such as nitrate (NO_3) which is created from nitrite (NO_2) when it is oxidised by *Nitrobacter spp.* This process of bacteria metabolising and subsequently fixing nitrogen is a key part of the nitrification process within the wider nitrogen cycle.

Heterotrophic: the predominant form of bacteria within a soil, they derive their carbon from consuming complex organic substances such as decaying plant material and other microorganisms. They derive their nitrogen from consuming organic nitrogen compounds such as proteins. Heterotrophic bacteria are the consumers within the soil ecosystem, degrading complex organic substances into their simpler constituent forms, as illustrated in the table below:

Carbohydrates	**>**	**Glucose**
Fats	**>**	**Fatty Acids and Glycerol**
Proteins	**>**	**Amino Acids**

Heterotrophic bacteria release energy in the process producing carbon dioxide (CO_2) and water (H_2O) as waste.

Bacteria are responsible for a variety of biochemical transformations in soil which either assist plants directly, or indirectly, due to the proliferation and function of other organisms.

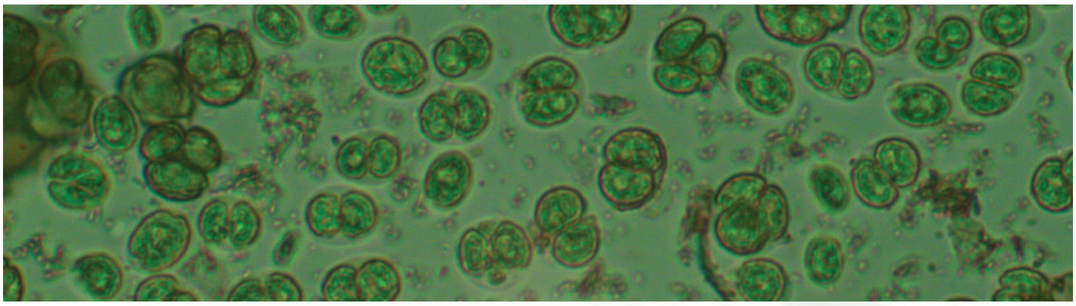
Actinomycetes – a type of bacteria which bear similarities to fungi. Like bacteria they are single celled, and like fungi they produce mycelium. They decompose the more resilient components of organic waste materials such as cellulose, polysaccharides, protein fats and organic acids after those substances have been initially attacked by bacteria and fungi. They are responsible for the dark pigments of humus and the earthy musty smell released by freshly cultivated soil.

Fungi – are present in soils as branching mycelium, parallel structured rhizomorphs and spores. Fungi occur across a wide population range. Fungi require an adequate supply of oxygen and organic matter and favour an optimal pH of 4.5 – 6.5. Fungi play an important role in the decomposition of the organic substances: cellulose, pectin, lignin and starch. Within turf situations an excessive accumulation of these substances is called thatch. Fungi also play an important role in the initial formation of humus as well as the aggregation of soil particles which serves to improve soil structure.

Some soil fungi form a mutually beneficial (mutualistic) symbiotic association with the roots of higher plants such as the turf grass species bent (*Agrostis spp.*) and fescue (*Festuca spp.*). This symbiotic association is referred to as a mycorrhizal association. The fungi benefit a plant by mobilising immobile soil nutrients, particularly phosphorous and iron which are otherwise difficult for plants to access. In return the plant supplies the fungi with a relatively constant supply of carbohydrates and sugars such as glucose and sucrose.

Plants which form mycorrhizal relationships will also benefit from increased resistance to pests and disease through a variety of signalling mechanisms. They are more resilient to drought because of improved uptake and transport of water due to the production of osmolytes which are organic compounds that lower osmotic potential. Mycorrhizal associated plants also demonstrate increased tolerance to the toxicity of heavy metals due to buffering by the fungi. Collectively these factors result in observable increases in plant growth, establishment and health.

Algae – the most common algae found in temperate soils are the green algae (*Chlorophyta spp.)*. This includes the species which form symbiotic associations with fungi resulting in the lichens. Green algae are situated either just on, (epidaphic) or just below (endedaphic) the surface of the soil where their photosynthesis releases oxygen into the soil environment. Soil algae act as cementing agents, and water stable soil aggregates improving soil structure. They also play a role in nutrient cycling, particularly nitrogen, and contribute to the quantity of organic matter when they die thus providing a source of organic carbon.



Protozoa – a variety of single celled organisms present in the upper 15 cm of soil in a range of sizes. Most species reproduce asexually like bacteria. Situated in the water films which surround plant root tissue, protozoa move in soil using an array of appendages such as flagella (*whip*), cilia (hairs) or pseudopodia (temporary foot) which are used to classify them into categories. The following three are common in soils:

Rhizopoda – usually without appendages but pseudopodia may be present, typically naked protoplasm without a cell wall (e.g. *Amoeba spp.*).

Mastigophora – flagella locomotion, very often saprophytic (feed on dead organisms) but some contain chlorophyll and are autotrophic, producing energy from their surroundings via photosynthesis (e.g. *Testramitu spp.*).

Ciliophora – characterised by the presence of cilia used for locomotion, they are the least numerous in soil (e.g. *Halteria spp.*).

“Protozoa contribute to soil nitrogen levels by excreting the excess nitrogen they consume from eating bacteria and other protozoa back into the soil as plant available ammonium (NH_4^+).”

Protozoa are a food source for various forms of soil life, including other protozoa. They also compete against and feed on pathogens which helps to suppress disease. Like some species of nematode, protozoa process nutrients making them available for use by plants and other soil organisms. By selectively feeding on algae and especially bacteria, (some protozoa can consume 5 million bacteria per day) protozoa help to maintain an ecological balance in the soil bacterial composition and population. By cycling nutrient, which in turn stimulates growth in bacterial populations, protozoa correspondingly promote efficient rates of decomposition and particle aggregation.

Protozoa have a lower concentration of carbon (C) to nitrogen (N) in their cells than the bacteria they eat. With a carbon to nitrogen ratio (C:N) for protozoa at 10:1 this is much more than the 3:1 to 10:1 range for bacteria. Protozoa contribute to soil nitrogen levels by excreting the excess nitrogen they consume from eating bacteria and other protozoa back into the soil as plant available ammonium (NH_4^+) (*see page 6*).

Nematodes – non-segmented worms typically 50 microns (μm) in width and 1 mm in length. Nematodes are ubiquitous within soils where they often outnumber all other animals in both species and number count. Nematodes possess a central nervous system, digestive tract and fertility system so are considered to be the most primitive animal. Being aquatic organisms, nematodes require adequate soil moisture to move effectively. Some nematodes are parasitic to plants and therefore receive frequent attention however; the vast majority of nematodes are not plant parasitic. Five categories of soil nematode are described in two groups:

Nematodes, Free living	**1 Bacterial feeding – consume bacteria.** **2 Fungal feeding – puncture the cell walls of fungi and consume the contents.** **3 Predatory – eat all types of nematode and protozoa.** **4 Omnivores – eat a variety of organisms and may vary their diet at different life stages.**
Nematodes, Not Free living	**5 Root-feeders – plant parasites that either live on plant roots (ectoparasitic), inside the plant root (endoparasitic) or are living both inside and outside the plant root, sometimes at different points in the life stage (semiendoparasitic). The inherent nature of some sports turf rootzones can lead to a severely biologically unbalanced ecosystem. When this occurs a variety of plant parasitic nematode species can proliferate to levels which result in deformed root development and function, adversely affecting overall plant growth and development.**

“The free nitrogen molecule will either be consumed by a bacteria and thus recycled back into the system, or absorbed by a root.”

Free living nematodes are responsible for several important processes within the soil ecosystem. They convert organic matter into minerals and inorganic compounds (mineralisation) that can then be absorbed by plants as nutrition.

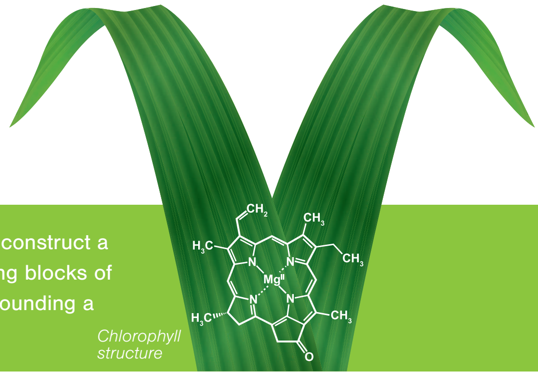
When nematode populations are in balance, their grazing habit plays a pivotal role in regulating populations of other soil microorganisms. In this manner, low, balanced population densities of nematodes increase overall biomass by stimulating the growth of their relative prey populations; bacteria, fungi, protozoa and even roots, where their light grazing can be compared to branch pruning. Nematodes act as carriers of live and dormant bacteria and fungi helping to distribute them through the soil. Their predatory habit can also contribute to the control of disease causing organisms. Because of their size, nematodes tend to be more common in coarser-textured soils.

Nematodes move in water films in large (> 50 μm) pore spaces and in uncultivated soils with mesopores (30 to 100 μm). Nematodes are considered mesofauna because they are larger in size (0.1 to 2 mm) than the microfauna (e.g. protozoa, <0.1 mm).

Like protozoa, nematodes have a lower concentration of carbon (C) to nitrogen (N) in their cells than the bacteria they eat. With a carbon to nitrogen ratio (C:N) for nematodes at 10:1 this is much more than the 3:1 to 10:1 range for bacteria. The result of this variance is that like protozoa, when a nematode eats a bacteria it must expel the excess nitrogen atoms from its system to remain healthy. When expelled, an excess nitrogen atom will be attached to four hydrogen atoms as the compound ammonium ($NH4^+$). Most commonly this occurs close to the root system in a region of interaction referred to as the rhizosphere. The free ammonium molecule will either be recycled back into sustaining the microbial system, should it be consumed by a bacteria or other microorganism, or as a plant available form of nutrition, it will be absorbed into the root...

> “The carbon to nitrogen ratio in plants is crucial for routine cellular activities.”

...If absorbed into the root the plant will then use the nitrogen atom to construct a range of plant metabolic compounds such as amino acids, (the building blocks of proteins) or, it will group together with three other nitrogen atoms surrounding a magnesium atom, and form the heart of a chlorophyll molecule.



Chlorophyll structure

Carbon to Nitrogen Ratio

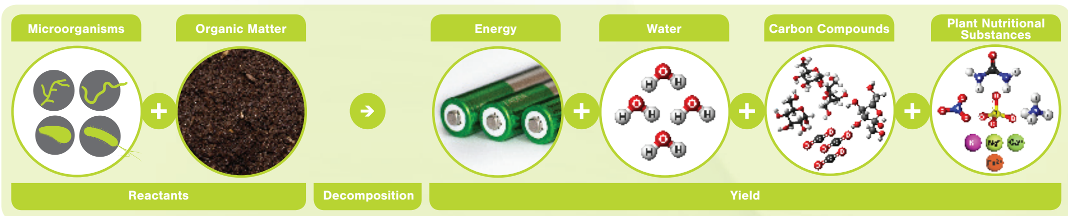
Relative Number and Biomass of Microbial Species at 0–15 cm Depth of Soil

Microorganism	Number per gram of soil	Biomass (g/m^2)
Nematodes	10^2–10^3	10^2–10^3
Protozoa	10^3–10^4	Varies
Algae	10^4–10^5	1–50
Actinomycetes	10^7–10^8	40–500
Bacteria	10^8–10^9	40–500

Carbon
The foundation upon which the cellular function of all soil life is built.

Microorganisms burn carbon as fuel to form new cell material using their stored nitrogen. Those organisms then excrete excess nitrogen as ammonium.

Organic matter is decomposed in soil by microorganisms that use the carbon content as a source of energy to fuel their bodies. This process releases carbon and nitrogen into the soil ecosystem as compounds. Carbon in the form of carbohydrates, and nitrogen in the plant available forms ammonium and nitrate. This process is the foundation of the soil ecosystem.



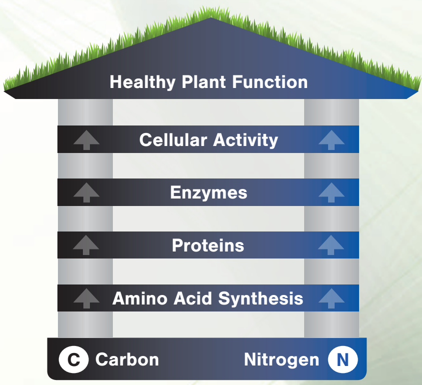
The rate at which this process takes place is influenced by the ratio of carbon to nitrogen present in the organic substances and the surrounding soil.

Optimum rates of decomposition and soil ecosystem function occur at a C:N ratio of 24 parts carbon to 1 part nitrogen (24:1) because of more favourably balanced conditions for stable organic matter decomposition.

This optimum balance brings about an equilibrium between mineralisation (nutrient availability) and immobilisation (nutrient unavailability).

The carbon to nitrogen ratio in plants is crucial for routine cellular activities. Carbon compounds such as the carbohydrates, sucrose and glucose, provide carbon energy for nitrogen assimilation and the resultant creation of amino acids. These amino acids are the building blocks of proteins which plants use to build compounds and in particular enzymes, which are essential for almost all cellular activity and plant function.

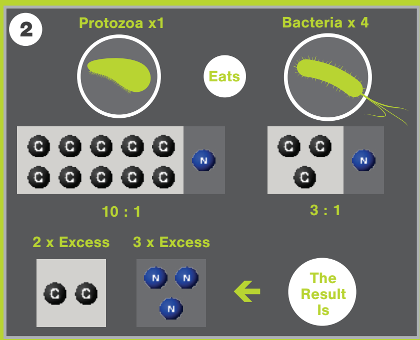
For this reason it is fair to state that the tight coordination between carbon and nitrogen is the central process driving plant and soil function.

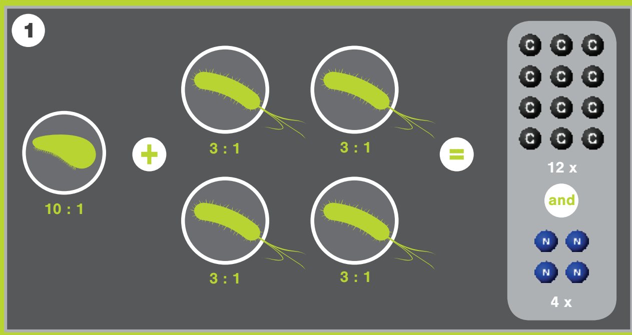


The fundamental relationship between C and N are the twin pillars upon which the substances and processes of plant life depend.

It's a bug's Life....

1 To maintain its C:N ratio a protozoa needs to consume 10 carbon and 3 nitrogen. If the C:N ratio of a bacteria is 3:1 the protozoa will have to consume 4 bacteria to gain enough carbon but; this will lead to three times the quantity of nitrogen it requires. Thus altering the protozoa's C:N ratio; something which it cannot tolerate to sustain its health.





2 By consuming 4 of the 3:1 C:N ratio bacteria the protozoa requires to source enough carbon for itself, it gains a total of; 12 carbon and 4 nitrogen because, 4 × 3 = 12 and 4 × 1 = 4.

If the resultant total of its consumption is 12 C and 4 N, but the protozoa requires a C:N ratio of 10:1, this has created an excess of 2 carbon and 3 nitrogen.

The result of this excess is that the protozoa's body will maintain the 10:1 ratio it requires by excreting the 2 excess carbon and 3 excess nitrogen out into the soil. From here they are utilised by other microorganisms to sustain their bodily systems, or they are absorbed by plant roots where they are either used by the plant for its function, or returned to the soil as root exudates to nourish plant associated beneficial organisms.
As such; the constant cycling of elements and compounds in the soil continues and soil life proliferates.

"Applying carbon, shortcuts carbon compound production..."

A Physiological and biomechanical studies have concluded that when plants are deficient in nitrogen then photosynthesis is reduced; primarily this is due to reduced chlorophyll production. When nitrogen is added to the plant or soil, photosynthesis can be recovered and growth increases.

B In the same way, when carbon is added the increasing carbon supply will promote nitrogen uptake and assimilation, consequently promoting plant response and increasing the efficiency of nitrogen fertilisers.

C Applying carbon, shortcuts carbon compound production – providing plants and microorganisms with an instantly available food source from which to initiate cellular function.

Benefits of applying carbon sources to sports turf surfaces

A Carbon to nitrogen ratios in constructed turfgrass soils are limited for two main reasons:

1. High filtration rate sand dominated rootzones which inherently contain low amounts of organic matter.
2. Limited production of root exudates due to reduced photosynthesis.
   This is because of a limited leaf surface area resulting from short heights of cut.

B Carbon inputs balance the C:N Ratio – facilitating efficient soil ecosystem function resulting in:

1. Optimum organic matter decomposition leading to enhanced nutrient cycling and uptake.
2. Enhanced beneficial plant microbial interactions.

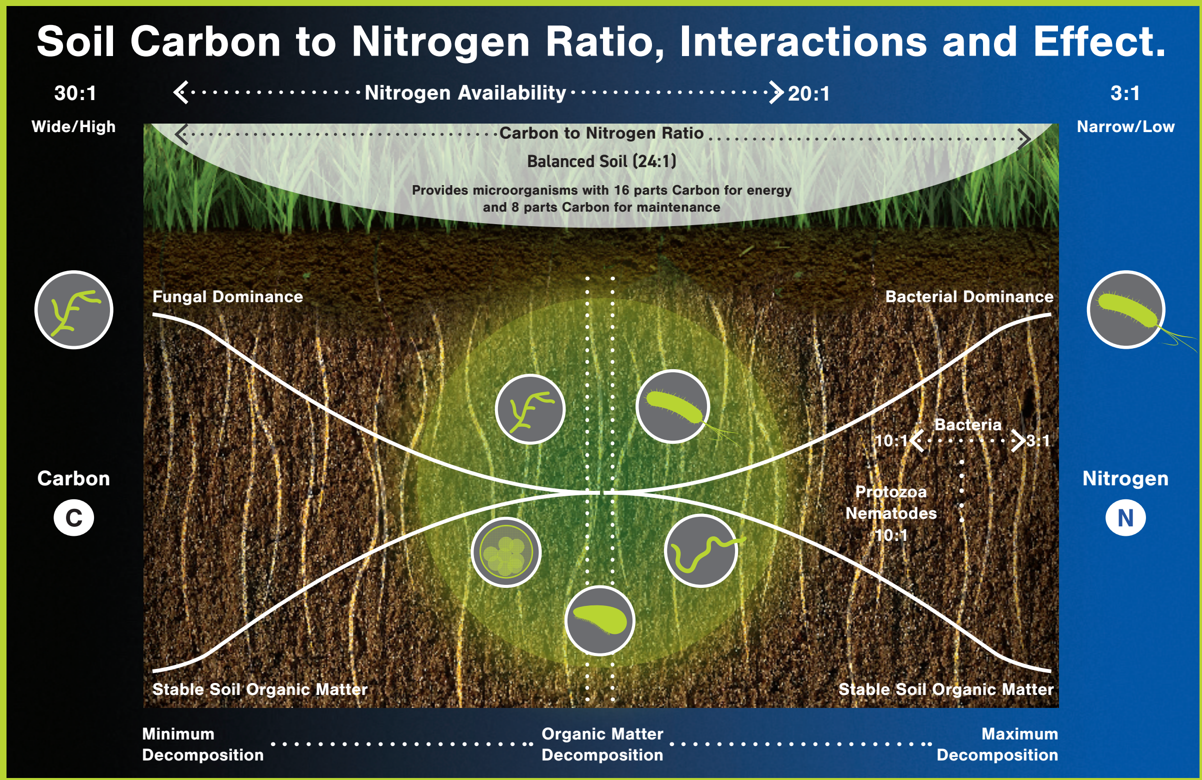
The importance of balance

If the C:N ratio is too low then a soil is bacterially dominated and decomposition of organic matter takes place too quickly, reducing the available menu of balanced organic matter for other soil organisms. This has the effect of reducing efficient soil ecosystem function and limits the plant associated benefits of a flourishing system.

If the C:N ratio is too high, decomposition of organic matter is too slow, nitrogen becomes limited and the balance moves away from bacteria. This can lead to organic matter accumulation, and a further limiting of efficient soil ecosystem function.

High carbon = slower decomposition e.g. lignin, more easily digested by fungi

Low carbon = quicker decomposition e.g. cellulose, more easily digested by bacteria



The overall width of the above diagram represents a range of C:N ratio from a fungal dominant system at 30:1 to a bacterial dominated system at 3:1.

The relative dominance of fungi or bacteria is represented by the inverse bell curve (upper white line) with the pace of organic matter decomposition represented by the bell curve (lower white line).

The optimum ratio is 24:1 as represented by the dotted lines, at this point mineralisation of plant nutrition, rate of stable organic matter generation and the diversity and quantity of microorganisms is at the optimum.

Important areas of Interaction

The specialised and concentrated areas of ecological niche where the interaction between plants and microorganisms occur, is confined to a narrow region of soil which extends several millimetres outwards from plant roots. As a result, the chemical and physical nature of a soil changes as you extend away from this immediate rootzone, with the area of influence by the root diminishing over distance. Consequently; there are 1000–2000 times more microorganisms associated with roots than are living in bare soil.

Rhizosphere:Soil (R:S) ratio is an expression of the increased microbial community and their effect as influenced by plant roots. It is calculated by dividing the number of microorganisms in the rhizosphere soil by the number of microorganisms in the non-rhizosphere soil.

Rhizosphere and Rhizoplane: Effect and Function

The function of these regions is influenced by certain factors such as; soil type, soil moisture, pH, temperature, plant age, plant metabolic state, relative humidity and agronomic inputs such as; fertilisers, wetting agents and pesticides.

The extent by which agronomic inputs effect soil microbiology, either positively or negatively is not currently, fully understood and is the topic of ongoing scientific study.

The interaction between microorganisms and plant roots within these regions is one of mutually beneficial associative activity.

"...there is an intense battlefield like competitive activity between them all, with each responding differently to root exudates."

Plant Contribution

Root Exudates – the outer epidermal (cell) walls of living root hairs are covered with mucilage and cuticle (protective film). Organic and inorganic compounds accumulated in the cytoplasm of root cells are secreted out. These secretions either constitute compounds intended to provide direct plant defence against pathogens or when in the form of carbohydrates, water soluble sugars, organic acids, vitamins and minerals, amino acids, hormones, amino compounds, phenolics and sugar phosphate esters. Collectively they support and promote direct plant microbial interactions. An increase in root exudation is observed by plant roots when in the presence of microorganisms.

Organic tissue – like human skin, root hairs are constantly being shed into the soil, this provides microorganisms with a further food base from which to derive energy.

The excretion and shedding of these materials by plants into the rhizosphere is what allows microorganisms to colonise such regions.

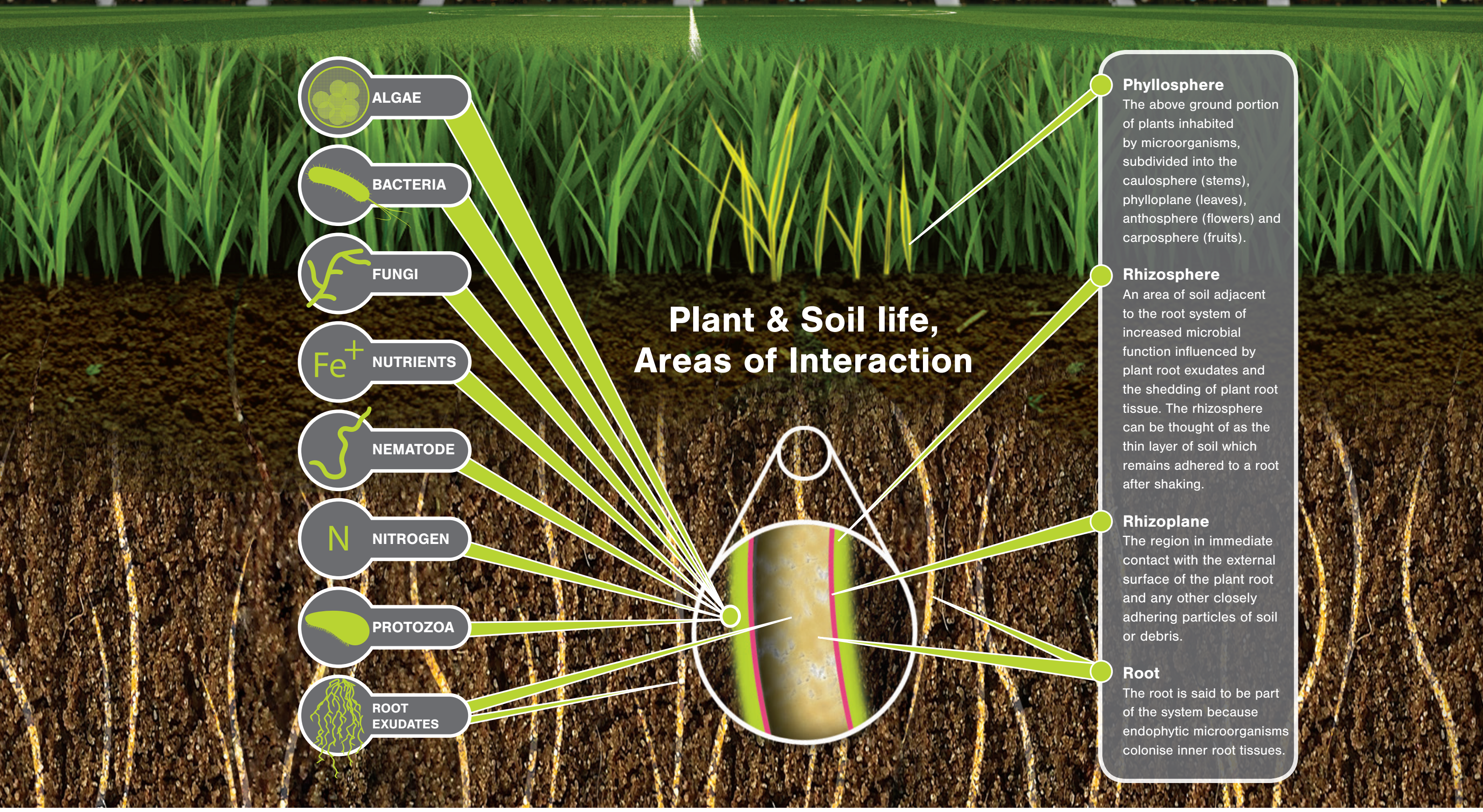
Beneficial Microorganism Contribution

Defence – microorganisms in the rhizosphere can be beneficial, harmful and neutral towards plants. However, there is an intense battlefield like competitive activity between them all, with each responding differently to root exudates. As a result, plants have evolved mechanisms with beneficial microorganisms which promote plant defence. For example, to successfully interact with plant tissue a root pathogen will have to successfully negotiate past plant symbiotic fungi in the rhizosphere and rhizoplane.

The same plant symbiotic fungi will recognise this attack, show antagonism to the pathogen and check its advancement to the benefit of both itself and the plant. Alternatively, in response to pathogens plant associated bacteria may induce activation of plant defences, a system referred to as induced systemic resistance (ISR) which is differentiated from pathogen induced plant systemic acquired resistance (SAR).

Plant Growth Promotion – microorganisms catalyse reactions which form organic acids that in turn solubilise inorganic nutrients into plant available forms. They produce growth stimulating substances and release otherwise locked up elements such as phosphorus through the process of mineralisation. They also reduce the toxicity of elements like sulphur.

In addition, plant associated bacteria can produce phytohormones and growth regulators. Examples of which include cytokinins, gibberellins and auxins such as Indole-3-acetic acid. These substances are involved in root initiation, cell division, and cell enlargement. The effect of this activity on plants can be direct by means of plant growth promotion, or indirect through better water and nutrient availability due to improved root systems.



Sugars and the role they play

The Limitations of a Turf Rootzone Environment

Depending on the life stage of the plant it has been estimated that between 12–40% of the total amount of carbohydrates produced by photosynthesis are released into the rhizosphere as root exudate. Even at 12% this is a significant amount of the plant's carbon resource, illustrating how important the promotion of relationships with beneficial microorganisms are to plants.

A turf surface and rootzone is not a natural environment, surface traffic combined with low heights of cut and agronomic inputs place continual stress on both the plant and the rhizosphere. Photosynthesis potential is effected as a result of the small leaf area from low heights of cut. This reduces plant derived carbon in the form of root exudate secretions which form the basis of the rhizosphere food chain.

Due to necessarily high infiltration rates, open structured sand based rootzones contain a low level of organic matter. As a result, soil environments such as turf rootzones can be described as carbon reduced environments.

In a natural soil ecosystem microorganisms utilise organic matter for energy as they cycle it via decomposition into simpler organic carbon and nitrogen compounds. A process which underpins the food chain as nutrients are slowly released back into the soil to support further microorganisms.

The Role of Sugar

Plants have evolved to live alongside microorganisms in the soil for mutual benefit but constructed sand/soil sports turf rootzones are limited by a lack of organic material and root exudates. This results in a lack of available carbon sources which would otherwise underpin the ecosystem. As a result, there is a necessity to introduce a carbon source to supplement this inherent deficiency.

Biostimulants such as BioMass Sugar® containing 22–23% sugar cane hydrolysate and carbohydrates, which comprise 14.50–17.50% sugars, inject a turf rootzone with a readily available source of easily digestible carbon energy from which a more diverse and efficiently functioning soil ecosystem can begin to operate. In turn, this benefits plant growth response, establishment and tolerance to biotic (pathogen) and abiotic (environmental) stress. This is because of increased availability of nutrition, microbial synthesis of plant beneficial compounds and systemic acquired resistance mechanisms.

BioMass SUGAR® Formulation

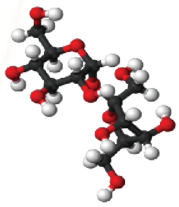
BioMass Sugar® is a unique highly refined water emulsion formulation of sugarcane extracts and sugarcane hydrolysates.

A proven product with fifteen years of research and developmental use across Europe, BioMass Sugar® is specially formulated to promote a healthy and balanced soil ecosystem, increasing grass plant health and resilience when experiencing biotic and abiotic stress.

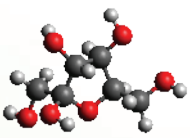
Unlike simpler molasses extracts, BioMass Sugar® has been refined and developed to effortlessly pass through spray tank systems and maintains its stability when in storage.

Available in **10 L**, **500 L** & **1000 L** containers.

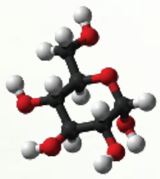
Key Ingredients



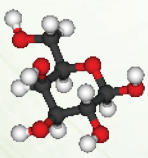
Sucrose



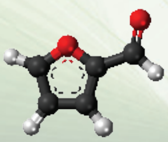
Fructose



Glucose



Galactose



Furfural

Sugarcane extract

Highly refined sugarcane extracts, also referred to as molasses, are used in the formulation of BioMass Sugar®. These contain a range of beneficial sugars including sucrose, fructose, glucose and galactose. The refined extract also contains a range of other plant beneficial materials including protein, wax, macronutrients and micronutrients.

Sugarcane hydrolysate

The steamed distillation of bagasse, the fibrous residue remaining after the extraction of juice from sugarcane, contains a solution with a naturally high percentage of furfural, an organic compound with the odour of almonds. For maximum derived benefit the unique formulation of BioMass Sugar® is further fortified with furfural, resulting in the high 22% content analysis.

Nutrition

BioMass Sugar® contains macronutrients and micronutrients all sourced from an annually renewed sugarcane crop.

Surfactant

A surfactant is included to facilitate even distribution of the beneficial ingredients throughout the rootzone.

BioMass Sugar® will:

- ✓ Optimise soil carbon to nitrogen ratio permitting soil microorganisms to better metabolise excess nitrogen thereby resulting in their population increase.
- ✓ Contribute to a healthier balanced soil ecosystem and optimise the growing environment through the increased presence of soil microorganism diversity and population.
- ✓ Increase the resilience of plants to biotic and abiotic stress as a result of induced systemic resistance brought about by increased presence of plant beneficial microorganisms.
- ✓ Promote the mineralisation of elements into plant available nutrition through microbial enzymatic activity, stimulating healthy growth of the grass plant sward and root systems.
- ✓ Increase the efficient uptake of plant applied nutrition and tolerance to drought due to better developed root systems.

BioMass Sugar® is particularly effective when used as part of a comprehensive nutrient and integrated turf management strategy.

Application Guidance

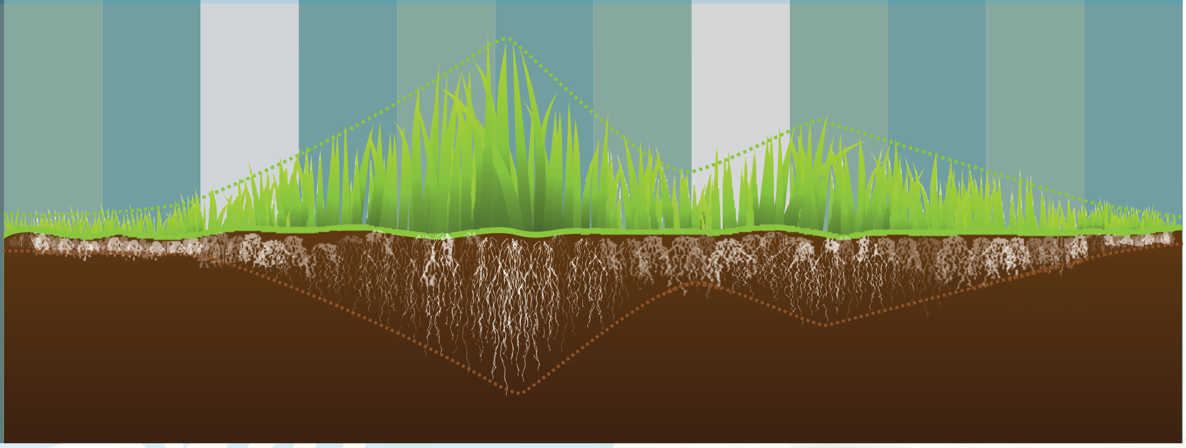
- Apply to soil at no less than 70% moisture content.
- Apply immediately after mixing. Do not let tanks stand for extended periods of time.
- If no rain is imminent, irrigate post application.

Product Analysis

Ingredient	Organic N	Elemental
Total Nitrogen (N)		0.20–0.30%
Organic Nitrogen (N)		0.20–0.30%
Phosphorus Pentoxide (P_2O_5)	0.10–0.15%	0.04–0.07%
Potassium Oxide (K_2O)	1.10–1.60%	0.91–1.33%
Magnesium Oxide (MgO)	0.10–0.20%	0.06–0.12%
Calcium Oxide (CaO)	0.15–0.25%	0.11–0.18%
Iron (Fe)		40–70 mg/kg
Manganese (Mn)		20–25 mg/kg
Zinc (Zn)		10–20 mg/kg
Copper (Cu)		1–2 mg/kg
Boron (B)		60–70 mg/kg
Molybdenum (Mo)		1–5 mg/kg
Cobalt (Co)		1–2 mg/kg
Organic Content		46–50%
Total Sugars (Sucrose, Glucose and Fructose)		14.50–17.50%
Furfural		22%
Proteins		0.75–1.50%
pH (1% solution)		6.5–7.5
Specific Gravity		1.18

Optimum Application Protocol

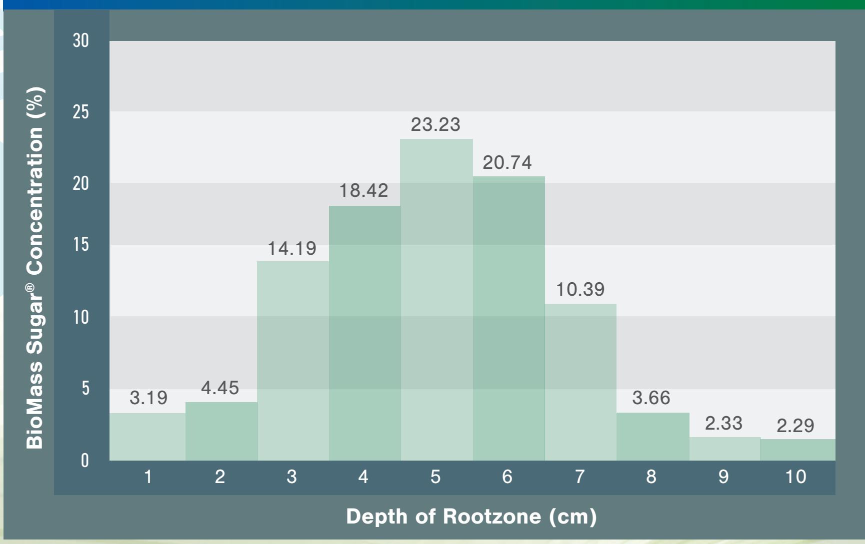
MONTH	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
Standard Application (L/ha)	20 L	20 L	40 L	20 L	20 L	20 L	20 L	40 L	20 L	20 L	20 L	20 L
Application Frequency (wk)	4–5	4–5	3–4	3–4	3–4	3–4	3–4	3–4	3–4	3–4	4–5	4–5
Highly Stressed Turf (L/ha)	40 L	40 L	80 L	40 L	40 L	40 L	40 L	80 L	40 L	40 L	40 L	40 L
Application Frequency (wk)	4–5	4–5	3–4	2	3–4	3–4	3–4	3–4	2	3–4	4–5	4–5
Water Volume (L/ha) 300–500												



Surfactant

A surfactant is incorporated into the formulation to improve movement of the solution over the plant and into the soil. This leads to efficient dispersal of the beneficial compounds throughout the soil profile where they are more accessible to a broader range of microorganisms.

BioMass Sugar® Distribution in Moist Soil



BioMass SUGAR®

Maintaining a Healthy Balance

BioMass Sugar® is also compatible with a broad range of Maxwell liquid nutrition, soluble nutrition and complimentary biostimulants.

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