



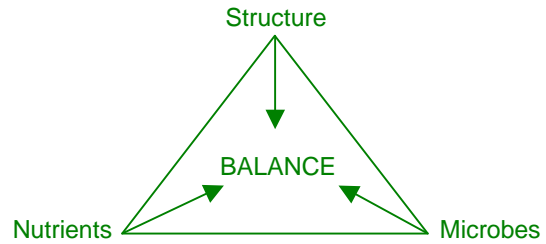
**SWEP** PTY.LTD.

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**ANALYTICAL  
LABORATORIES**

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# Complete Soil Balance Analysis



Sustainable Soil Management with the Mikhail Balanc eSystem

FILENO: **EXAMPLE**  
CLIENT  
ADDRESS  
ADDRESS

DATE ISSUED: 31/07/2007  
DATE RECEIVED: 25/07/2007

CLIENTID:  
PHONE:  
REFERENCE:  
REFERENCEPHONE:

SAMPLEID: LAWN

DEPTH OF SAMPLE(cm): 0 to 15

ANALYSIS REQUIRED: Complete

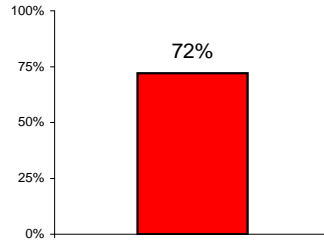
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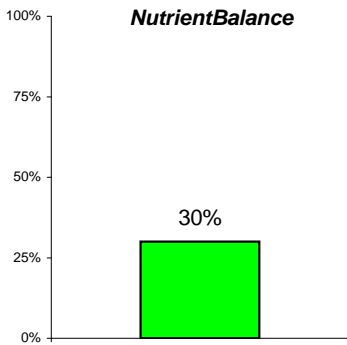
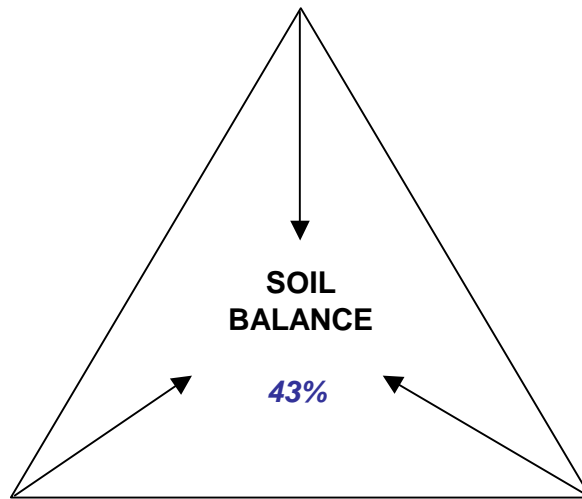
# Summary of Complete Soil Balance Status

asat 25/07/2007

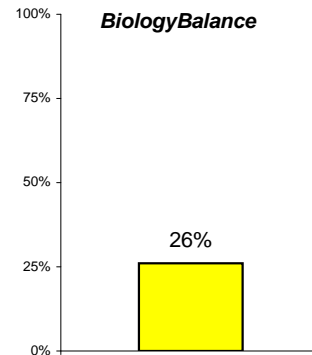
(Changes over time will indicate likely sustainability of production)



**Cation Balance**



**Nutrient Balance**



**Biology Balance**

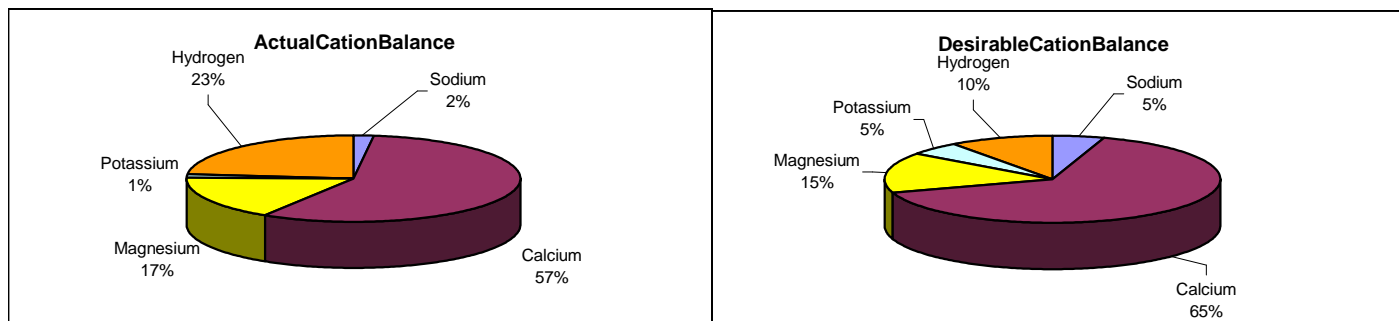
Overall Soil Balance Rating				
Poor	Below average	Average	Above average	Good
<20%	20%-40%	40%-50%	60%-80%	>80%

### CationBalance

ITEM	RESULT	DESIRABLE	COLOUR:	TEXTURE:
pH(1:5Water)	6.6	5.5-7.5	GREYISHBROWN	
pH(1:50.01MCaCl 2)	6.1		LIGHTCLAY	
ElectricalConductivityEC μS/cm	56	<300		
TOTALSOLUBLESALTSS ppm	184.8	<990		
TOTALORGANICMATTER%	5.1	4-6		
TOTALORGANICCARBON%	2.6	2-3		

EXCHANGEABLECATIONS	RESULTS	DESIRABLELEVEL
CALCIUM Ca me/100ofsoil	8.37	9.57
MAGNESIUM Mg me/100ofsoil	2.43	2.21
SODIUM Na me/100ofsoil	0.3	<0.74
POTASSIUM K me/100ofsoil	0.17	0.74
HYDROGEN H me/100ofsoil	6	
ADJ.EXCH.HYDROGEN H me/100ofsoil	3.45	<2.21
CATIONEXCHANGECAPACITY CEC	17.27	
ADJUSTEDCEC Adj.CEC	14.72	
SATURATIONBASEPERCENTAGE BSP	66	

EXCHANGEABLECATIONBALANCE	%OFADJUSTEDCEC	DESIRABLE LE
CALCIUMPERCENTAGE	56.9	65-70%
MAGNESIUMPERCENTAGE	16.5	12-15%
SODIUMPERCENTAGE ESP	2.0	0.5-5%
POTASSIUMPERCENTAGE	1.2	3-5%
ADJ.HYDROGENPERCENTAGE	23.4	<20%
CALCIUM/MAGNESIUMRATIO Ca/Mg	3.44	2-4



### CATIONBALANCECORRECTIONS *(Tooptimisethesoilstructure&condition)*

GYPSUMREQUIREMENT	53 g/m <sup>2</sup>
LIMEREQUIREMENT	91 g/m <sup>2</sup>
DOLOMITEREQUIREMENT	0 g/m <sup>2</sup>
MAGNESIUMSULPHATE	0 g/m <sup>2</sup>

### NOTES ON CORRECTING THE EXCHANGEABLE CATION BALANCE

The recommendations on page 3 are essential to the process of achieving optimum soil balance. All other recommendations in this report have been formulated on the assumption that they have been applied and given sufficient time for their effects to develop. In most cases, six months will be required between application of cation balance correction and fertilisers, however, more time may be required in low rainfall zones or dry seasons. In areas with shallow saline water tables and NO subsurface drainage, no Gypsum should be applied (even if recommended here) until adequate drainage can be provided. It should also be noted that the amounts recommended depend, in part, on the stated sample depth.

The notes, below, provide additional information relating to the applications recommended. If you require more information on any aspect of these recommendations, please contact: **SWEP on (03) 97016007.**

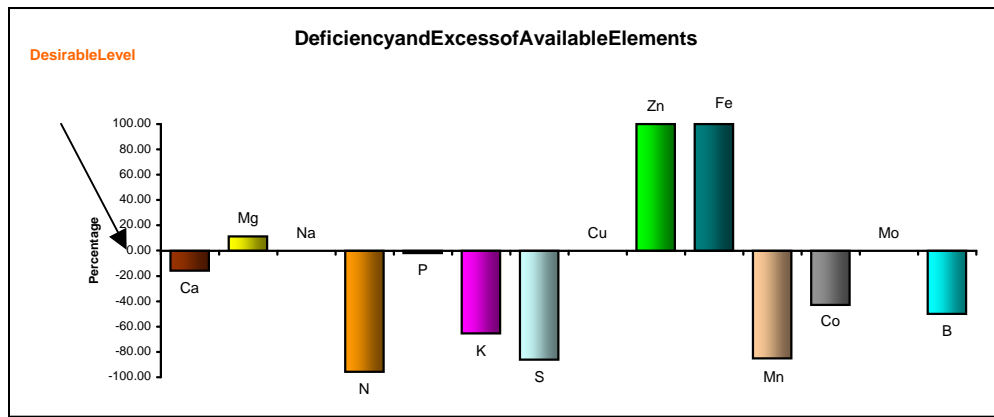
***For all required materials (where surface application is necessary and irrigation is not available), the total applications should be limited to roughly 2.5t/ha per year. This limitation does not apply where materials can be cultivated or irrigated into the soil.***

Lime is recommended to replace any excess of exchangeable Hydrogen with exchangeable Calcium. The calculated application rate is based on Lime containing 40% Calcium (ie. pure Calcium Carbonate). Due to the high level of variation in available materials, this is the only standard we can apply. In practice, any Lime with an ENV of 70 or more should be adequate to apply at the recommended rate, while materials with an ENV of less than 50 may be ineffective even with an adjusted rate of application. However, if you wish to adjust the application rate according to the actual quality of the material you intend to use, call SWEP for a copy of our "Soil Ameliorant Calculator".

Gypsum is recommended in order to replace any excess of exchangeable Sodium or Magnesium with exchangeable Calcium. For best results, use only 'A-grade' Gypsum.

### NutrientBalance

ITEMS	RESULTS			DESIRABLELEVELS		
				LAWN	TREES&SHRUBS	FLOWERBEDS
AVAILABLECALCIUM	Ca	ppm	1734	2058	2058	2058
AVAILABLEMAGNESIUM	Mg	ppm	302.4	272	272	272
AVAILABLESODIUM	Na	ppm	71.3	<174	<174	<174
AVAILABLENITROGEN	N	ppm	1.1	25	50	110
AVAILABLEPHOSPHORUS	P	ppm	24.5	25	80	170
AVAILABLEPOTASSIUM	K	ppm	70.2	202	404	404
AVAILABLESULPHUR	S	ppm	0.7	5-7	5-7	5-7
AVAILABLECOPPER	Cu	ppm	2	2	2	2
AVAILABLEZINC	Zn	ppm	15	5-7	5-7	5-7
AVAILABLEIRON	Fe	ppm	98	>20	>20	>20
AVAILABLEMANGANESE	Mn	ppm	3	>20	>20	>20
AVAILABLECOBALT	Co	ppm	0.4	0.7-0.8	0.7-0.8	0.7-0.8
AVAILABLEMOLYBDENUM	Mo	ppm	0.7	0.7-0.8	0.7-0.8	0.7-0.8
AVAILABLEBORON	B	ppm	0.3	0.6-0.7	0.6-0.7	0.6-0.7
TOTALPHOSPHORUS	TP	ppm	318			
TOTALNITROGEN	N	%	0.22			



**PLANTNUTRITIONREQUIREMENTS** (ForthespecifiedLandUseovertheperiodofits growingseason)

TOTALFERTILIZERREQUIREMENT(g/m <sup>2</sup> )	Nitrogen	Phosphorus	Potassium	Sulphur
LAWN	2	1	8	0
TREES&SHRUBS	10	6	33	0
FLOWERBEDS	11	15	33	0

WITH		LAWN	TREES&SHRUBS	FLOWERBEDS	
	COPPER	0	0	0	g/m <sup>2</sup>
	ZINC	0	0	0	g/m <sup>2</sup>
	COBALT	0	0	0	g/m <sup>2</sup>
	MOLYBDENUM	0	0	0	g/m <sup>2</sup>
	IRON	0	0	0	g/m <sup>2</sup>
	MANGANESE	0.4	0.4	0.4	g/m <sup>2</sup>
	BORON	0.05	0.05	0.05	g/m <sup>2</sup>

**NOTES ON ACHIEVING BALANCED PLANT NUTRITION**

The recommendations on page 5 are for provision of **Balanced Plant Nutrition** to the stated Land Use, but it is important that neither the major elements nor Trace Elements are supplied at the same time as the Cationic Corrections (page 3) could limit the availability of nutrients to the crop or pasture.

SWEP does not recommend or promote specific products, so all recommendations are given in kg/ha of actual nutrient. These must be converted into applications of fertiliser. For assistance in doing this, consult your local supplier.

The notes, below, provide additional information relating to the applications recommended. If you require more information on any aspect of these recommendations, please contact: **SWEP on (03) 97016007.**

For Pasture, it is important to maintain the proper relationship between Copper (Cu) and Molybdenum (Mo). Where 'Moly' is required, you may see we have also recommended Cu, even though the soil test may not indicate Copper requirement. This will protect against the risk of any subsequent animal health problems. If you wish to avoid applying this Copper (when soil levels are adequate), you MUST ensure AT LEAST 6 WEEKS between the application of Molybdenum and the introduction of livestock.

If the soil pH (water) is below 5.7, Trace elements should not be applied until the Lime &/or Dolomite applications have had time to raise the pH above this level.

For soils with a pH (water) of 8.0 or more, apply Trace Elements as a foliar spray only.

Phosphorus fixation effects if Iron is more than 300 ppm

Manganese will be at toxicity level if it reaches 500 ppm

## UNDERSTANDING SOIL BIOLOGY

## Indicators of Soil Biological Activity

The biological community in the soil is extremely diverse. To get a proper understanding of its 'health' we look at a few so-called "Indicator" groups. These have important functions upon which plants and other organisms depend.

The first thing to remember is that SWEPE results are for ACTIVE micro-organisms only. This means only those that will immediately grow under ideal conditions (generally about 7-10% of total soil biomass). This allows us to analyse samples year-round, since the microbes that are active in spring will still be present in summer or winter, but at very reduced levels of activity. Given the ideal conditions in our cultures, they will spring back to life and grow much more quickly than others.

Also in assessing the results from your test, bear in mind that the soil is a complex ecosystem, but ecosystems are more than just biological communities, they are the product of environmental factors, available resources AND biology, disturbance in one or more of these areas will effect what happens in the biological community. The greater the disturbance, the more potentially variable the results, with higher total populations, dominated by one or two groups.

### Active Indicator Organisms

**Photosynthetic bacteria** like *Rhodospirillum rubrum* and *Bradyrhizobium* spp require only sunlight, carbon dioxide and mineral nutrients to survive. They are important in recycling organic matter, particularly pesticides and petrochemical residues. They are also important for synthesis of bio-active compounds that are now used to stimulate plant growth.

**Yeasts** such as *Saccharomyces* spp, *Debaryomyces* spp, *Torulopsis* spp and *Rhodotrya* spp synthesise plant growth substances from amino acids and sugars that are produced by photosynthetic bacteria. These substances also promote the growth of Lactic acid bacteria and Actinomycetes.

**Lactic acid bacteria** such as *Lactobacillus* spp, *Leuconostoc* spp, *Lactococcus* spp and *Pediococcus* spp produce Lactic Acid from sugars and carbohydrates. Lactic acid is a strong bio-suppressive compound that helps control harmful micro-organisms. This effect, together with other trace nutrients produced by members of this group, is particularly beneficial to the growth of Photosynthetic bacteria and Yeasts.

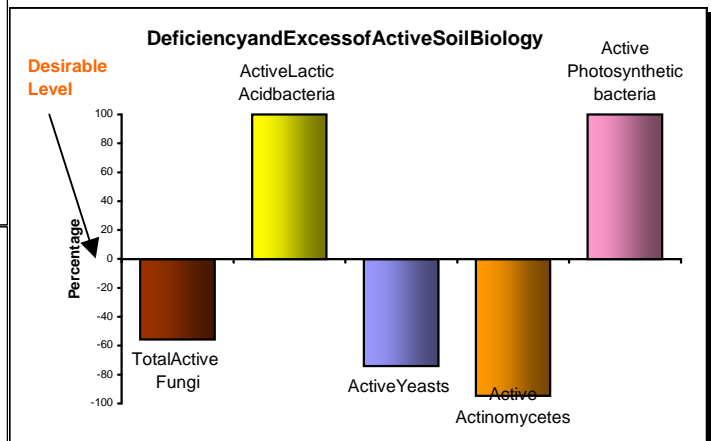
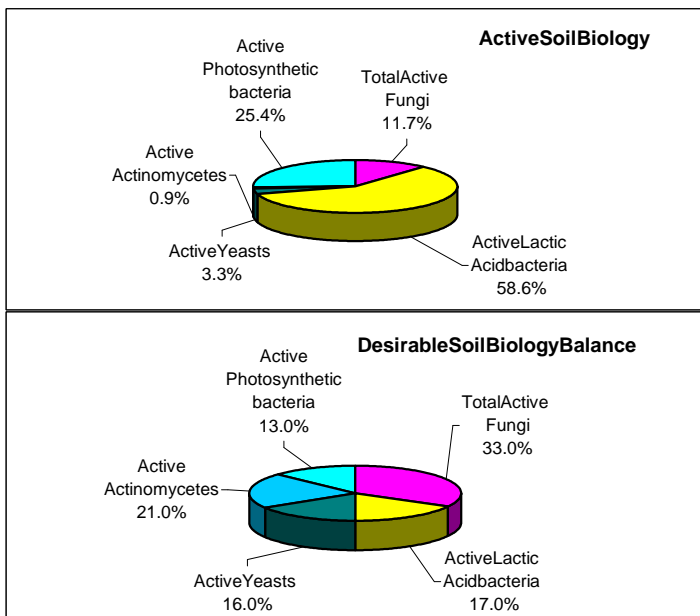
**Actinomycetes** such as *Actinomyces* spp and *Streptomyces* spp produce antibiotic compounds that are effective suppressants of pathogenic organisms. They have also been shown to produce plant hormones - especially when treated with kelp extracts.

**Fungi** such as *Aspergillus* spp, *Penicillium* spp, *Mucor* spp and *Rhizopus* spp have many beneficial effects on plant growth. These include the production of enzymes, antibiotics and various growth regulators. They are also important in the conversion of organic matter to humic substances. Some of the less complex compounds produced from this process are also important food sources for some bacteria.

**Cellulose Utilisers** like *Trichoderma* spp require only minerals and cellulose for growth. These fungi break down plant remains into organic materials that are beneficial to other micro-organisms such as Protozoa.

### BiologyBalance

ITEM		Result	%Total	Desirable	%Desirable
ACTIVELACTICACIDBACTERIA	cells/gsoil	530,000	58.6%	123,289	17.0%
ActiveFungi	cells/gsoil	35,000			
Celluloseutilisers	cells/gsoil	71,000			
TOTALACTIVEFUNGI	cells/gsoil	<u>106,000</u>	11.7%	239,326	33.0%
ACTIVEYEASTS	cells/gsoil	30,000	3.3%	116,037	16.0%
ACTIVEACTINOMYCETES	cells/gsoil	8,000	0.9%	152,298	21.0%
ACTIVEPHOTOSYNTHETICBACTERIA	cells/gsoil	230,000	25.4%	94,280	13.0%
TotalActivePopulation:	cells/gsoil	904,000		725,229	
CARBON/NITROGENRATIO		11.6		10-15	



### SOIL BIOLOGY MANAGEMENT *(To help accelerate changes in soil structure and nutrient availability)*

Kelp extract	0.5 ml/m <sup>2</sup>	To encourage Actinomycetes, Yeast, Photosynthetic and/or discourages Fungi
Molasses	0.2 ml/m <sup>2</sup>	To encourage Yeasts, Fungi & other fermenters
Worm leachate	0 ml/m <sup>2</sup>	
Fish emulsion	0.2 ml/m <sup>2</sup>	Helps improve the C:N ratio & discourages Lactic Acid Bacteria
Liquefied humate	0.5 ml/m <sup>2</sup>	Helps improve the C:N ratio & encourages Actinomycetes
Mulch or Green Manure	<b>Beneficial</b>	To encourage various Fungi

**NB. Use only good quality materials & for best results, apply twice annually.**

### PREVIOUS APPLICATIONS DATE OF APPLICATION

GYPSUM APPLIED	g/m <sup>2</sup>						
LIME APPLIED	g/m <sup>2</sup>						
DOLOMITE APPLIED	g/m <sup>2</sup>						
Trace elements	Cu	Zn	Fe	Mn	Co	Mo	B
	g/m <sup>2</sup>						
Date of application							

## NOTES ON IMPROVING SOIL BIOLOGY MANAGEMENT

The recommendations on page 8 are not intended to directly adjust the numbers of microbes in the soil, but rather to encourage the activity of particular groups in order to help accelerate carbon balance changes and optimise nutrient availability.

The notes, below, provide additional information relating to the applications recommended. If you require more information on any aspect of these recommendations, please contact: **SWEPOn(03)97016007**.

**Kelp extracts** contain high concentrations of plant hormones (auxins, cytokinins, etc.). These have been shown to significantly increase the biological activity in soils, and especially that of Actinomycetes and Cellulose utilisers. Cellulose utilisers (as the name suggests) are important in the breakdown of cellulose and certain other resistant materials, thus increasing the formation of humus and helping to improve soil structure. Actinomycetes also help provide protection against soil-borne pathogens.

**Molasses** provides a readily metabolisable carbon and energy source for soil organisms. Although most soil organisms can utilise this, it is of particular value to fermenters like Yeasts and Lactic Acid Bacteria. However, being quickly utilised, it will provide only a short-term benefit unless other actions have been taken to improve the soil environment.

**Worm leachate** contains a range of growth promotants that are of particular benefit to Photosynthetic Bacteria and Actinomycetes. Photosynthetic bacteria are of particular importance in the breakdown of highly resistant organic compounds (including some pesticides). They can exist to some depth in soil as they utilise different wavelengths of light to green plants. It is this energy source that allows them to perform their vital role in the soil.

**Fish emulsions** are a source of readily available organic Nitrogen and can be especially useful when this is needed to improve the carbon-nitrogen ratio in the soil. They are also beneficial in stimulating growth and activity of many micro-organisms, but especially Yeasts and Bacteria. Their effect is an increase in the potential for nitrogen cycling and so also a somewhat reduced requirement for nitrogen input to some crops and pasture. For this potential to be realised, however, other corrective measures must be applied first. You should also be aware that some fish emulsion products contain other added nutrients to render them appropriate for use as conventional fertilisers and that the concentration of products can vary significantly. For best results with these products talk to your supplier about a nitrogen adjustment to our recommended application rates and/or change to your nutrient application that may be appropriate.

**Liquefied humate** adds carbon to the soil in the form of humic substances. It is a useful material where adjustment of the carbon-nitrogen ratio is required. It is also important in releasing bound nutrients into plant available forms and helping to improve soil structure. The direct effects on soil biology are similar to those of Kelp extracts in that many humic substances appear to have an auxin-like activity. Like Fish Emulsions, concentration and inclusion of added nutrients may need to be taken into account for specific products.

**Mulching or Green Manuring** is an effective means of improving organic matter levels and protecting soil structure in cultivated soils. The breakdown of this material is initially conducted by soil Fungi (especially in clay soils). For pasture, alternatives include regular light harrowing (after grazing) and adjustments to normal grazing practices, etc.