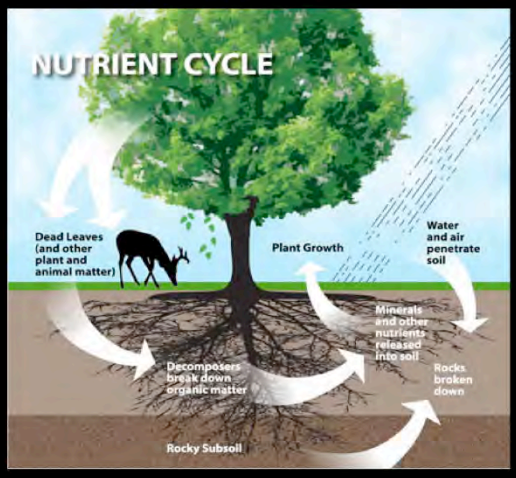
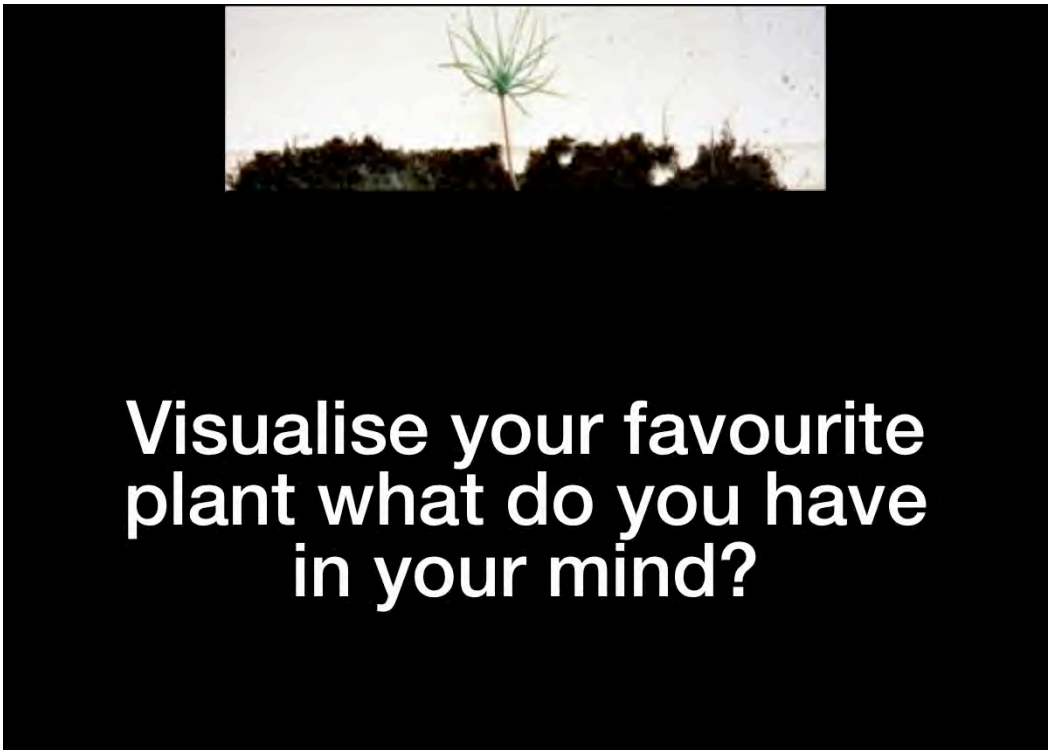
Nutrient Pathways in a Natural System



Dave Hunter

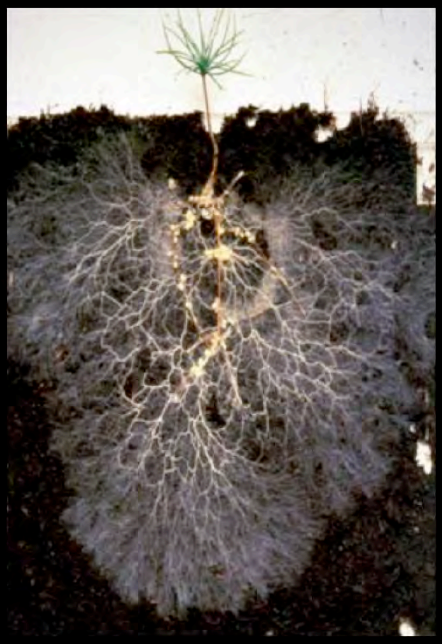
Thank you and acknowledgement to Dr Christine Jones and Gabe Brown for the use of their images and information.

I would like to acknowledge the content borrowed from a presentation done by Dr Christine Jones in Moama earlier this year and images from Gabe Brown



Dr Elaine Ingham asks us to visualize what our favourite plant would look like, if you don’t have an image that is a least equal parts above and below ground you are only seeing half the picture.

95% of life on land resides in the soil



In actual fact if you are only looking above the ground you may only be seeing 5% of what is going on

We were always taught that photosynthesis was something that happens above the ground , taking in carbon dioxide releasing oxygen into the atmosphere end of story but we now know it is far more complicated than that

Photosynthesis supports all life on earth

Without photosynthesis there would be no soil

Microbes in the vicinity of the plant roots make nutrients from the soil available in exchange for liquid carbon exudates, forgive me if you think I keep talking about carbon but without it we wouldn’t have the mineralisation that builds fertile soils

NUTRIENT AVAILABILITY MANAGEMENT COMPARISON

Management	N	P	K	WEOC
Organic	2	156	95	233
No-Till, Low Diversity	27	244	136	239
No-Till, MD, High Syn.	37	217	199	262
No-Till, HD, NS, Lvst,	281	1006	1749	1095

- Tested by Dr. Rick Haney, ARS, Temple, TX

water extractable organic carbon, this slide demonstrates the adverse effects of excessive cultivation and chemicals and mineral fertilisers on the natural nutrient store and the correlation between soil carbon and nutrient availability.

NUTRIENT AVAILABILITY

Minerals are present in the soil but plants need microbes to make them available

85% - 90% of plant nutrient uptake
is enabled by microbes

The majority of microbes involved in nutrient acquisition are plant dependent

Rarely are minerals and trace elements completely absent from soil. Most deficiencies in plants, humans and animals are due to soil conditions not being conducive to nutrient uptake

Nitrogen

availability of synthetic N
stops the plant putting out exudates to feed microbes

Synthetic N applied subsurface prior to planting, it is assumed that all N comes from either mineral fertiliser or legumes however all plants are capable of growing in association with nitrogen fixing microbes. Only 10 to 40% of N applied is taken up by plants with 60 to 90% lost to a combination of volatilization and leaching.

THE ECONOMICS

78,000 tonnes of free nitrogen over every hectare
you can create the conditions for nature to convert it

80% of applied Phosphorous binds with aluminum
and iron and becomes unavailable to plants

if P has been applied in the previous 10 years there
will be sufficient for the next 100 years

Mycorrhizal fungi can supply up to 90% of a plants N and P requirements. It is more economical to activate soil microbes in order to access the P already in the soil. Remember how P is stored in the laboratory.

(without microbes activity) *It is often assumed..

HOW TO SUPPORT A DIVERSITY OF LIFE IN THE SOIL

Each plant supports its own colony of microbes , the greater diversity of plants the greater diversity of microbes. Triticale mono crop, in the cocktail mix contained oats, tillage radish, sunflower, field peas, faba beans, chickpeas, proso millet and foxtail millet.

FOR PHOTOSYNTHESIS

every green plant is a solar powered carbon pump

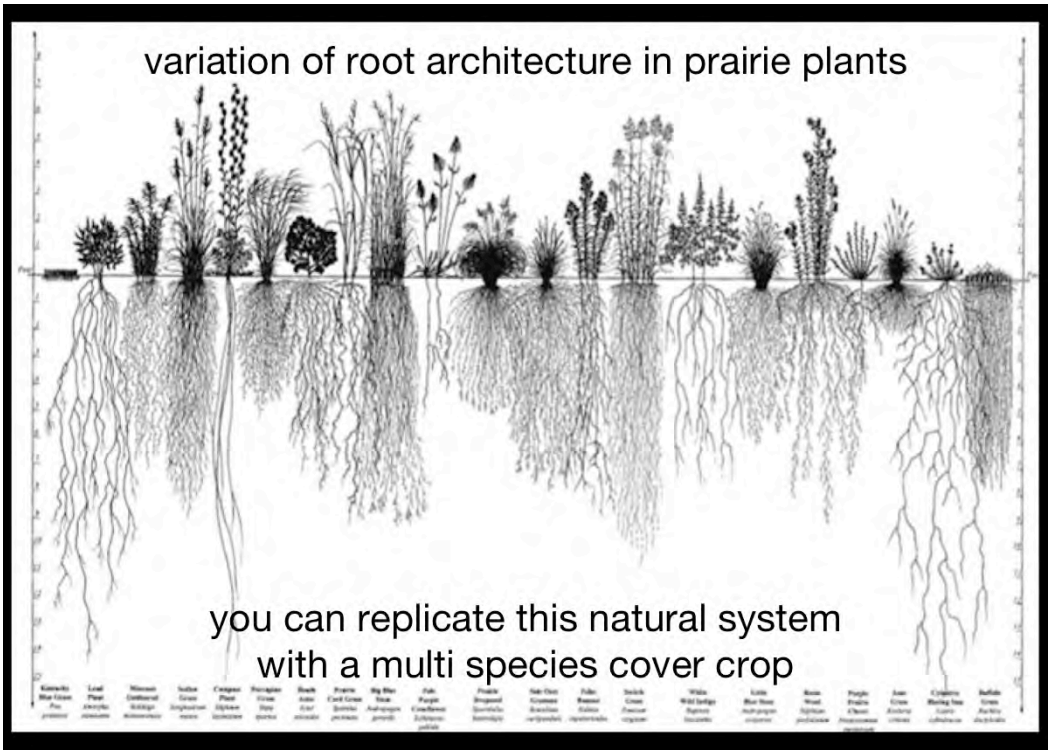
aim for 100% cover 100%of the time

large diversity of species

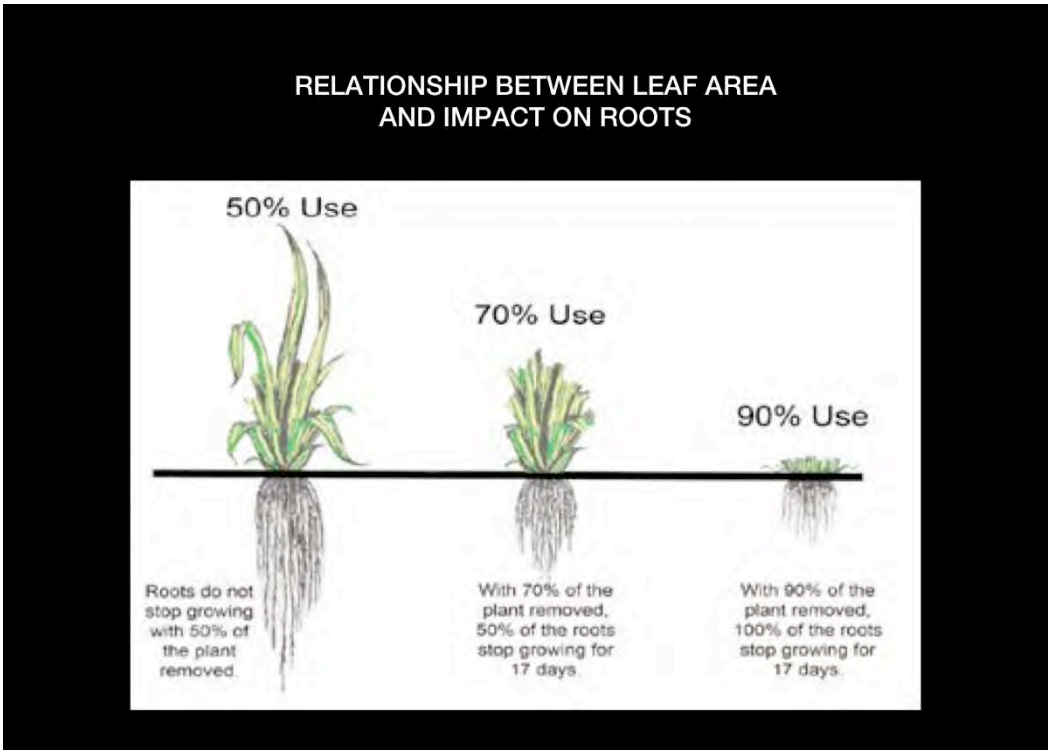
including flowering plants

100% cover 100% of the time – preferably through plants instead of mulch because more opportunity for photosynthesis therefore to build nutrient stores below the soil Increase opportunities for photosynthesis by having a wide diversity of plants of different heights and leaf shapes it is desirable to have flowering plants in the mix.

flowering plants act as insecories for our beneficials



With a variety of root structures it is possible to occupy more of the soil profile. In our situation we don’t worry about weeds unless they present some physical impairment to the management of the crop.



To build soil carbon and consequently remineralisation of the soil it is important to include managed grazing. We simulate this by setting our slasher as high as possible and allowing the plants to put on as much new growth as practical between slashings. To stimulate microbes you need a carbon source, N, sugar and TE . Carbon source , mulch, N something smelly, sugar Molasses , TE seaweed.

RELATIONSHIP BETWEEN LEAF AREA
AND IMPACT ON ROOTS

leaf area removed	root growth inhibition
40%	none
50%	2 - 4%
60%	50%
70%	78%
80%	100%
90%	100%

Remember if you don’t have a living root in the soil you are not building soil or adding to the mineral and nutrient bank, it is the photosynthetic capacity and photosynthetic rate not biomass that drives the sequestration of carbon in soil.

COVER TO LOWER SOIL TEMPERATURE

SOIL TEMP	IMPACT
60°C	soil bacteria die
54°C	100% moisture lost through evaporation and transpiration
38°C	15% moisture used for growth 85% moisture lost through evaporation and transpiration
21°C	100% moisture used for growth

You never want to be able to see bare soil. If you maximise the amount of moisture available for growth , save money by not having to irrigate as frequently.

Every year photosynthesis draws down hundreds of billions of tones of carbon from the atmosphere

An increase of 5% global photosynthetic rate would be sufficient to counter the CO2 flux from the burning of fossil fuels

provided the extra carbon was sequestered in a stable form.

WE CAN DO IT