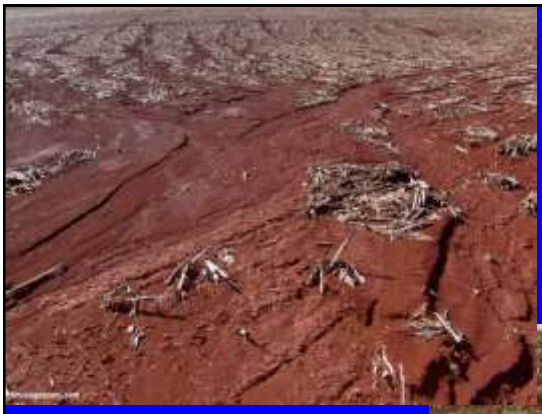
Multi-species cover crops

Colin Seis

Why grow cover crops?

What is wrong with the way crops are grown?



Soil Erosion

Around the world, 10 ton of soil is lost for every ton of grain produced

In Australia & around the world, the way crops are grown

- **Reduced soil carbon levels** ***(More irrigation)***
- **Reduced soil fertility** ***(More fertilizer)***
- **Increasing insect attack.** ***(More insecticide)***
- **Increasing crop disease.** ***(More Fungicide)***

Increasing fertiliser and pesticides will not fix these problems.

- The farm ecosystem is stuffed
- Plants , plants and more plants will fix the problems

How!!!!!!

- Soil microbes require plants for food.
- Microbial food come from plant root exudates and organic matter.
- Bare soil contains very little microbial food.
- Bare soil encourages weeds.

What is Cover Cropping??

Cover cropping can be described as sowing an annual crop between periods of regular crop production with the main purpose being to create thick mulch,

into which the following cash crop is planted using zero till planting methods.

It is a biological soil primer!!!!

Cover Cropping can be either:

Annual Cover Cropping
or
Perennial Cover Cropping

‘Pasture Cropping’ is perennial cover cropping

- Cover Cropping uses an annual crop to create mulch, control weeds and improve soil health.
- ‘Pasture Cropping’ uses perennial grass to create mulch, control weeds and improve soil health.

Single species cover crops only address some of the problems.

Multispecies cover crops address many problems

- It is important to include:

Cereals, Brassica and Legumes in the mix.

Why grow a multi species Cover Crop?

- Prevent soil erosion.
- Improve soil structure *(better water holding capacity)*
- Nutrient scavenging. *(less fertiliser)*
- Weed control *(less herbicides)*
- Control pest and disease *(less pesticides)*
- Legume addition *(less Nitrogen fertiliser)*
- Increase Carbon (*Increased nutrients & water)*
- Prepare soil/paddock for following crop
- Quality stock feed *(healthy stock faster weight gains)*
- More profit.

Using different plants to fix problems

Multi Species Cropping
Soil Structure

- Plants like radish, turnip, sunflower, are excellent 'biological sub-soilers', breaking plough pans and aerating poor structured soil.

- Improved water infiltration

Multi Species Cropping
Weed Control

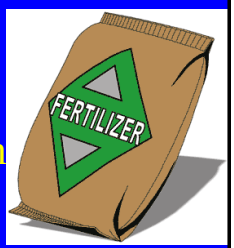
Including plants like forage brassica & cereal rye.

- Some plants produce chemical exudates that can inhibit weed growth. (Allelopathy.)
- Weeds can be controlled. by shading and competition.
- Creating ground cover with plants and litter will control weeds

Multi Species Cropping
Nutrients

Soil nutrients can be made available:

Deep rooted plants like radish, turnips, sunflower and buck wheat can scavenge nutrients from depth and make them available to plants.



Legumes in the mix will produce Nitrogen

Having a C:N ratio of 24:1 will produce Nitrogen

Multi-species crops

Carbon to Nitrogen ratio.

- **Ideal microbial diet 24:1**
- Cereal Rye straw 82:1
- Oat Straw 70:1
- Millet 42:1
- Annual vetch 11:1
- Forage Brassica 12:1
- Clover 21:1
- Daikon Radish 19:1

Nutrients

- Use high C:N ratio crops of 30:1 or greater to increase Soil Organic Matter
- Having a multi species crop with an ideal C:N ratio can supply N and other nutrients and /or maintain ground cover
- A mix of oats, forage brassica vetch and pea will produce a crop with an ideal C:N ratio of 26:1

Recycling of nutrients by Oilseed radish

David Brandt Iowa USA

Nutrient	(lbs/acre)
Nitrogen	265
Phosphorus	23
Potassium	230
Sulfur	60
Calcium	150
Magnesium	20

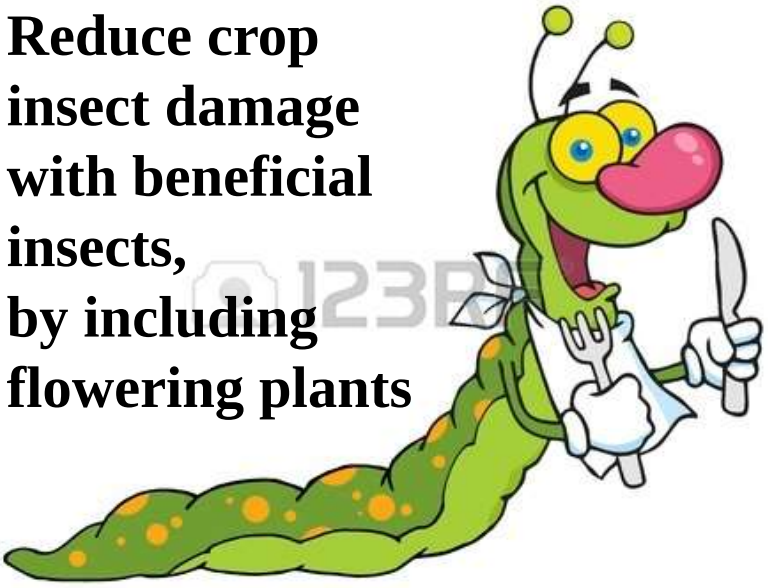
Multi Species Crops

Soil Health - Soil Carbon

A mix of species provides root exudates for soil organisms that are essential for maintaining a healthy soil and increasing soil carbon.

Insect Control

Reduce crop insect damage with beneficial insects, by including flowering plants



Increase in insect numbers and diversity with plant diversity

(*Elise Wenden, Canberra ANU 2007)*

- ***On Winona insects numbers have increased by 600%***
- ***Insect diversity has increased by 125%***
- ***We no longer have insect attack on crops or pasture***

Disease control

In balanced soil ecosystems disease is controlled by their natural enemies

A diversity of soil microbes will interrupt and control many fungal and bacterial crop diseases.

Increasing plant diversity

Total fungi increase 862%
Total bacteria increase 350%
Total protozoa increase 640%
Total nematode increase over 1000%

A functioning soil ecosystem, with a large diversity of soil microbes, will control plant disease.

Multi Species Cropping

Improved Grazing /Better diet

- Healthy animals
- Faster fattening
- Faster growth rates
- More feed

Summer multi-species cover crops

Potential problems with growing summer multi-species crops

- Not enough soil moisture.
- Weeds
- Insects
- Disease
- Nutrients
- Grazing

Not enough soil moisture

During summer soil dries out faster.

- Grow species that tolerate hot and dry conditions
- Maintain good ground cover.
- Increase soil carbon.
- Reduce risk with seed selection. *(low cost seed)*

Weeds

- Fast growing plants (quick canopy closure)
- Maintain good ground cover.
- Weed control (herbicide etc)

Summer Species for Weed Control

- Weeds can be controlled.
  by shading and competition with millet and forage sorghum

- Ground cover with plants and litter will control weeds

Weed Control

Pre Sowing///

If weeds are not going to effect the growth of the cover crop, they may not require controlling, and can become part of the cover crop mix.

Weed control with herbicide may be necessary if weeds are going to effect crop establishment and growth

Multi Species Cover Cropping

In crop weed control

- Herbicide use with Multi Species crop is normally not possible without killing crop species.
- Some weed control is possible with fast growing canopy closure providing a weed smothering effect and allelopathic properties from plants.

Multi Species Cover Cropping
Nutrients

Soil nutrients can be made available:

Plants like sunflower and buck wheat can scavenge nutrients from depth and make them available to plants.

Legumes in the mix will produce Nitrogen

Having a C:N ratio of 24:1 will produce Nitrogen

Selecting Summer Multi species crops

Crop	Legume	Broadleaf	Other
Japanese Millet	Cow Pea	Sunflower	Brassica
Pearl millet	Lablab Bean	Buckwheat	
Shiroie Millet	Soy bean		
Forage Sorghum	Sunnhemp		
Maize			

Summer Multi Species Crops
Millet

Summer: Multi Species Crops.

- Millet is an ideal base for a multi species summer crop.
- Heat and drought tolerance.
- Low cost seed.

Summer Multi Species Crops

Forage sorghum:

Productive and fast growing.

Heat and drought tolerant.

- Good weed control.

Summer Multi Species Crops
Cow Pea

Cowpea:

- Excellent stock feed.
- Legume that fixes lots of N
- Provides food and habitat for beneficial insects.
- Rapidly shades out weeds.
- Tolerant of hot, dry conditions.

Summer Multi Species Crops
Lablab

- Lablab is a viny, summer growing annual legume.
- Excellent stock feed.
- Good supplier of soil N.

Sunn hemp *(C:N Ratio 30:1)*

- Very fast growing
- Legume, producing large amount of N
- Very large biomass
- Good stock feed
- Good weed control

Summer Multi species crops
Sunflower

- Good stock feed.
- Sunflowers are deep rooted summer growing broad leaf annual plants.
- Very good at 'mining' mobile nutrients deep in the soil profile and making them available to other plants.

Summer Multi species crops

Buckwheat *(C:N Ratio 32:1)*

Very tolerant of poor soil
Good phosphorus scavenger
Weed suppressing
Beneficial insect attracting.

Can be a weed problem in following crops if allowed to set seed

Summer Species for improving Soil Structure

- Tillage radish
- Turnip
- Sunflower

Selecting Multi Species Crops
Winter Multi Species Crops

Cereals	Legumes	Brassica	Other
Oats	Field pea	Forage Brassica	
Wheat	vetch	Radish	
Barley	Lupin	Turnip	
Triticale	Clover	Swede	
Cereal rye	Lentil	Kale	

Multi Species Crops
Cereal Crops

- **Winter: Multi Species Crops**
- Oats, Wheat, Barley, Triticale, Cereal Rye can form the basis of a winter multi species mix.

Multi Species Crops
Winter Legumes

- **Annual vetch**

- Is excellent stock feed.
- Can fix large amounts of N
- Makes soil phosphorus more available.

  Provides excellent habitat for beneficial insects.

Multi Species Crops
Winter Legumes

Field Peas are excellent stock feed and capable of fixing large amounts of Nitrogen.

Multi species crops
Forage Brassica

- **Winter: Multi Species Crops**
- Forage brassica are high protein, and highly digestible feed.
- Swede, turnip and newer varieties. e.g. Winfred is a cross between turnip and kale.
- Varieties like daiken radish and turnip can be used as "biological sub-soilers".

How do costs compare with single species crop??

- The overall cost of seed is more expensive but the seed rates are usually sown at 25% - 50% of recommended rates for single species crops.

Winter Multi species mix

	Kg per Ha	Price per Kg	Price per Ha
Oats	40	.50	$20
Forage brassica	1-2	10	$10-20
Tillage radish	1-2	10	$10-20
Annual vetch	5-10	2	$10-20
Field pea	5-10	2	$10-20
Turnip	0.5 - 1	5	$ 2.5-5
Total			$60 - $100

Sowing Multi Species Crops

Seed drills for

(Zero till or direct drill)

Sowing: Multi Species Seed Mix

A mix of seeds can be more difficult to sow

- Larger seeds like cow peas, sunflowers can be sown with the normal seed box, as a mix.
- Smaller seeds like, turnip, millet etc can be sown with a pasture box.*(small seed box)*

- Seeds can be mixed together with disc seeders because they usually do not place the seed deep.

Multi Species Cover Cropping

By adding more species:

Improved Grazing /Better diet

- **Healthy animals**
- **Faster fattening**
- **Faster growth rates**
- **More feed**

Grazing Multispecies crops

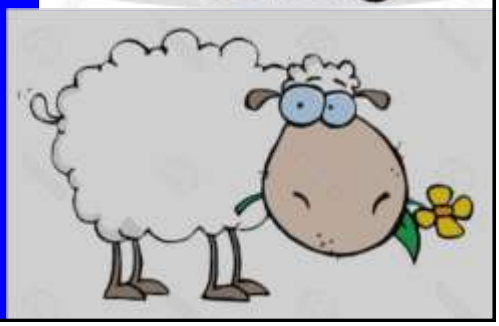
- First graze should not start until all plant species are well established.

Allow plants time to recover from the initial graze before re- grazing.

(3-4 grazings are possible)

Use electric fencing to manage grazing.

Maintain good ground cover.



Terminating cover

- Terminate existing cover crop with a combination of grazing and crimp rolling.
- Sow directly into existing cool season crop.
- Herbicide.

Terminating

Multispecies Pasture Cropping

- Perennial Cover Cropping
- Perennial grass is the cover.
- Zero till into dormant Summer grass.

"Pasture Cropping" is a perennial Cover Cropping technique where annual crops are zero - tilled into dormant perennial grass or grassland.

Multi Species Pasture Cropping

After grazing & mulching with sheep and/or Cattle, zero-till a multi species crop into litter and mulch of dormant warm season perennial grass.

Sowing multispecies crop

Emerging Multi Species Crop

- **Oats**
- **Forage Brassica**
- **Vetch**
- **Daikon Radish**
- **Clover**
- **Field pea**
- **Turnip**

Oats, vetch, radish, pea, turnip, clover, forage brassica sown into grassland. (September 2015)


Harvest multi species crop for grain.
November 2015


Grain from Multi species Harvest

Jim Moll
Shepparton Vic

Myles & Julie Balentine
Banana
Queensland

Frazer Pogue
Tatura Vic

Grazed multi-species crop

Frazer Pogue
Tatura Vic

Gulgong NSW

C:N Ratios of Summer Multispecies Crops

Species for Animal performance (C:N 28)

Good C:N ratio for animal performance

- Millet 4kg/ha
- Lab-Lab 5kg/ha
- Cow pea 4kg/ha
- Sunflower 1kg/ha

Species to improve following crop (C:N ratio 24)

(increase nutrients, improve soil health)

- Millet 4kg/ha
- Lab-Lab 5kg/ha
- Cow pea 4kg/ha
- Sunflower 1kg/ha
- Buckwheat 10kg/ha
- Soy bean 10kg/ha

Species for increasing soil Carbon. (C:N 35)
(increasing organic matter and root exudates.)

- Forage Sorghum 2kg/ha
- Millet 4kg/ha
- Lab- Lab 5kg/ha
- Sunflower 1kg/ha
- Buckwheat 10kg/ha
- Sunn hemp 5kg/ha

C:N Ratios of Winter Multispecies Crops

- **Species for Animal performance (C:N 23)**

  Good C:N ratio for animal performance

- Oats 50kg
- Field pea 8kg
- Vetch 8kg
- Forage Brassica 3kg
- Turnip/swede 1kg

Species for compacted soil (C:N 31)

(Biological sub soilers)

- These species sown as a multispecies mix will help penetrate compaction layers and add organic matter as roots and ground cover

- Oats 30kg
- Cereal Rye 30kg
- Tillage Radish 5kg
- Turnip 2kg
- Vetch or pea 8kg

- **Species for increasing soil Carbon. (C:N 32)**
  (increasing organic matter and root exudates.)

- Oats 30kg
- Cereal Rye 40kg
- Vetch 10kg
- Forage brassica 2kg

Species to improve following crop (C:N ratio 24)
(increase nutrients, improve soil health)

Soil Biology priming

- Oats 50kg
- Field pea 10
- lentil 10kg
- Vetch 10kg
- Tillage radish 3 kg
- Turnip 2kg

Don Murray.
Orange. NSW.