Green manure crops

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Tas Farming Futures

Fact Sheet

Green manure crops are cover crops specifically grown to incorporate into the soil. They provide soil cover and improve the soil's physical, chemical and biological conditions. They can improve cash crop performance. Green manure crops can also help to reduce greenhouse gas (GHG) emissions.

Benefits

Green manure crops as part of your farm's rotation have the potential to improve overall production efficiency and productivity, as well as reduce GHG emissions. With the right choice and management green manure crops can improve soil health and water holding capacity, reduce weed competition, and reduce pest and disease populations. Benefits are dependent on local climate and soil conditions, the type of green manure crop used and its management.

Soil organic matter

By working in green manure crops you can increase soil organic matter (OM) and carbon (C) levels. Although C levels in OM vary with different soils, types of OM and soil depth, C can account for 50% or more of OM.

For every additional tonne of C sequestered in the soil, 3.67t CO_2e are removed from the atmosphere.

OM improves soil structure and provides a protective cover for the soil surface, protecting it from erosion. As microorganisms break down OM they produce sticky substances that bond soil particles together into soil aggregates. This, in turn improves:

- Water infiltration and, water and air holding capacity;
- Structural stability, reducing the risk of compaction and erosion;
- Soil friability, making the soil easier to work;
- Nutrient holding capacity;
- Root growth, therefore loosening and aerating the soil and
- Overall microbial activity.

OM buffers against changes in ρH, salinity and sodicity, and inactivates or filters toxic elements.

Nitrous oxide (N_2O) is a powerful GHG. By reducing soil compaction and improving soil drainage with the use of green manure crops N_2O emissions can be reduced. Compacted and poorly drained soils create anaerobic conditions leading to denitrification and N2O losses.

Soil biology

The added plant biomass from green manure crops causes soil organisms to multiply in order to breakdown the material. The root exudates from cover crops provide food for microorganisms. Some cover crops can also maintain the population of mycorrhizal fungi in the soil.

Nutrient cycling

The breakdown of green manure biomass by a boost of soil microbes releases nutrients, leading to improved nutrient cycling and availability to crops. Green manure crops capture nutrients, especially nitrogen, left over from cash crops. They can access previously leached nutrients from deep within the soil profile and make them available to the root zone of the next crop.

In the right conditions, nitrogen fixation by leguminous cover crops can increase soil nitrogen (N) levels by more than 300kg / ha, however they generally fix between 100kg and 200kg N / ha. This has to be considered for fertiliser programs to avoid excess soil N that may lead to emissions, other losses or reduced crop performance.

Fallow periods can result in N_2O emissions as microbes continually break down soil N into nitrate; denitrification losses increase after heavy rainfall.

Weed control

Dense green manure crops smother weeds through competition for water, light and nutrients. Weeds are prevented from colonising bare ground after the preceding crop has been harvested. Populations of weeds that thrive in compacted soils are also suppressed as green manure crops have a soil loosening affect.

Emissions intensity (EI), or emissions per unit of product can be reduced through optimal soil fertility, weed control and, pest and disease management as more is produced per ha without the need for extra inputs.

Pest and disease management

An improved level of soil humus through the addition of OM via cover crops provides food for predatory nematodes and mites, parasitic fungi and other beneficial microbes. The increase in crop diversity can also provide a desired habitat for beneficial insects, leading to more balanced population levels. Green manure crops act as a break in the rotation and can help disrupt pest and disease life cycles.

Things to consider

In order to get the most out of using green manure crops here are some points to consider:

1. Choose the right crop (see table 1)
2. Plant at the best time within your rotation (see table 2)
3. Have the necessary equipment and resources to manage the crop correctly
4. Test soils to ensure appropriate nutrient management for the green manure crop
5. Seed at the rate recommended by the seed supplier to get the most benefit. Seeding below this rate results in lower density and coverage, therefore less OM is incorporated and weeds have a better chance of establishing. If conditions at seeding are not ideal, e.g. poor soil condition, then seeding rates may need to be increased.

Crop incorporation requires correct timing. The crop needs to have enough time to fully breakdown before the cash crop is planted. If green manures are incorporated too late they could set seed and add to the seed bank, potentially becoming a weed in the next cash crop. For leguminous green manures, if they are incorporated too late, they become tougher, drier and relatively low in nitrogen. Subsequently, soil nitrogen levels may drop as the soil microbes use the nitrogen already available in the soil to decompose the carbon-rich green manure crop residues.

If the sole purpose of your cover crop is as a green manure crop, it is important to not bale or cut the crop as the aim of the crop is to add as much OM to the soil as possible.

This fact sheet provides general information for green manure crops. For specific information relevant to your situation you should seek further advice.

As well as providing the traditional benefits of a green manure crop, biofumigants such as Caliente Mustard (pictured above) also have naturally occurring compounds that can suppress various soilbourne pests, diseases and weeds.

Annual ryegrass (pictured above) provides a fast-growing green manure crop option.

Things to consider

Table 1—Winter cover crops for southern regions[1]

Main aim	Crop	Comments
Build soil structure	Ryegrass—a clear favourite. All other crops below will also build soil structure, but to a lesser extent.	High root activity stabilises soil. Foliage protects soil surface, mulches well and provides excellent OM input. Encourages mycorrhizal (VAM); good for some crops, e.g. onions.
Add cheap nitrogen	Peas Clovers Lupins Vetch	Use a rhizobium inoculate. For legumes to fix nitrogen, nitrate levels in the soil should be below 150kgN/ha. Expect legumes to fix between 100 and 200kgN/ha—the bigger the crop, the more nitrogen fixed.
Recover and store left over fertiliser	Mix of fibrous and deep rooted crops, e.g. ryegrass and brassica.	Capture and store nitrogen to prevent leaching or loss to the air over winter. Recycle nutrients from deep in the soil. Use these cover crops when soil nitrate levels are above 150kgN/ha.
Soil pest and disease control	Biofumigant brassicas (typically canola, B. Napus, Indian Mustard, B Juncea)	Use high glucosinolate varieties. Aim to incorporate 100t/ha fresh biomass. Incorporate when flowering, mulch finely and incorporate into the soil rapidly. Soil should be moist.
Weed control	Fast early growth crops, e.g. wheat, barley, oats, Brassicas	Use 30% greater sowing rates than normal to outcompete weeds. Brassicas can suppress weeds over and above the direct competition of the fast growing crops listed above.
Protect the soil surface from wind and water erosion	Ryegrass, wheat, barley, oats	High biomass crops are good. Management of the mulch varies depending on the following crop.

Table 2—Green manure calendar: an annual timetable for growing green manure crops in Tasmania[2]

	Feb	Mar	Apr	May	June	July	Aug	Sep
Short-term ryegrass Tama, Tetila, Concord	Early start for maximum benefits					Spray off	Turn in	
Cereals Oats—quick growing Ryecorn—bulk			A good option if short of time			Spray off	Turn in before seed set	
Legumes Lupins, tickbeans	Sow early						Late turn in for maximum benefits	
Brassicas Canola, rape, mustard	Sow early				Turn in 6 weeks before next crop			

[1] http://www.soilwealth.com.au/imagesDB/news/WinterCoverCropsFactSheet.pdf
[2] http://dpipwe.tas.gov.au/agriculture/land-management-soils/soil-management/soil-structure/green-manure/green-manure-calendar

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