

Soil health cover crop solutions

One of the biggest limitations to agricultural production is the state of soil health:

- > Soil structure
- > Soil pH
- > Nutrient status
- > Organic matter
- > Soil borne pathogens.

Primary producers have addressed soil health through better crop rotations to improve farming systems. More recent crop rotation work has been undertaken to improve subsequent cash crop by using:

- > Green manure crops to increase soil physical properties
- > Cover crops that are non-hosts to certain problem nematodes
- > Cover crops that can actively reduce nematode levels (resistance)
- > Cover crops that can reduce soil borne fungi
- > Cover crops that can achieve multiple outcomes.

In most cases in Australia, producers have chosen cover crop options that may be positive for one specific outcome, but quite negative for others. For example, the use of many cover crops to improve soil physical properties can increase the level of fungal disease and allow multiplication of nematodes. Likewise, crops that can reduce fungal disease may be bad host for nematodes and enable rapid multiplication resulting in reduced following crop yields.

Seed Force has been working closely on cover crops over the past decade with its European partner Joordens Zaden who are based in the Netherlands. Joordens have a state of the art quarantine facility where they can introduce specific pathogens to soil where specific cover crops have been used to test for resistance status and impacts on subsequent cash crops.

Joordens provides specific cover crop solutions to European farmers covering some 80,000ha each year. These solutions are now being undertaken across other parts of the world including USA, South Africa and Australia through the support of Joordens soil health specialist Peter-Jan Jongenelen.

In Australia Seed Force have been involved with research trials from QLD to Tasmania covering problems in crops including carrots, onions, potatoes, brassicas, sweet potatoes, tomatoes, capsicums, wheat, cotton and sugar cane.

This new guide is the outcome of this work on best cover crop options to target the various soil health problems occurring across a wide range of soils and cropping enterprises.



Soil Health Solutions



SF Terranova

oilseed radish (*Raphanus sativus*)



Variety or blend	Components	Improve soil physical status	Active nematode reductions	Active soil borne fungi reductions	BioFumigation potential	Nutrient capture N, P K
SF Cappuccino	Ethiopian mustard	Good	Some	Excellent	Very good	Very good
SF Terranova	Oilseed radish	Best	Excellent	Good	Very good	Very good
SF Trio	Rocket lettuce	Good	Excellent	Good	Excellent	Best
SF FungiSol	60% SF Cappuccino 40% SF Terranova	Very good	Some	Best	Best	Very good
SF NemSol	80% SF Terranova, 20% SF Trio	Very good	Best	Very good	Excellent	Excellent

SF Terranova is suitable for nematode control in both temperate and sub-tropical situations. It contains high levels of various glucosinolates, and it has bio-fumigation potential. As such it could be a safe crop to use as a bio-fumigant against soil borne fungi. It has the best, most dense root structure.



Variety specifications

Early vigour: fast

Flowering: 50-60 days after planting

Main glucosinolates: *Gluconapoleiferin*, *Glucoraphanin*, *Glucotropaeolin*

Nematode control:

- > *Heterodera schachtii* and *betae* (BCN)
- > *Meloidogyne chitwoodi*, *fallax*, *incognita* (RKN) and *javanica* (TRKN)
- > *Trichodorus similis* (Stubby root nematode)

Non host to;

- > *Globodera rostochiensis* and *pallida* (PCN)
- > *Heterodera avenae* (Cereal cyst nematode)
- > *Heterodera goettingiana* (Carrot cyst nematode)
- > *Meloidogyne naasi* (RKN)
- > *Ditylenchus destructor* (Stem nematode)
- > *Tabaco Rattle virus* (TRV)

Sowing rate: 10-15kg/ha

SF Trio

rocket lettuce (*Eruca sativa*)



SF Trio is suitable for both nematode control and for human consumption. The flavour of SF Trio is spicy with a nutty taste.

As the species contains high levels of glucosinolates it has bio-fumigation potential. Together with the secured nematode resistance on specific beet cyst and several root knot nematodes, SF Trio could be a safe crop to use as a bio-fumigant against soil borne fungi.

Variety specifications

Early vigour: slow

Flowering: 50-60 days after planting

Main glucosinolate: *Glucoerucin*

Nematode control: *Heterodera schachtii*, *Meloidogyne chitwoodi*, *Meloidogyne fallax*, *Incognita* and *Javanica*

Sowing rate: 3-5kg/ha

SF Cappuccino

ethiopian mustard (*Brassica carinata*)



SF Cappuccino is a late flowering mustard, which is very leafy but frost susceptible. It has a long tap root that helps to improve soil structure. SF Cappuccino can produce high levels of biomass. Due to its high levels of the glucosinolate sinigrin, SF Cappuccino has very good biofumigation potential. SF Cappuccino performs best in cooler climates.

Variety specifications

Early vigour: moderate

Flowering: approximate 80 days after planting

Plant height: up to 1.6m

Main glucosinolates: *Sinigrin*, *Gluconasturtiin*, *Gluconapoleiferin*

Sowing rate: 10-15 kg/ha



Soil health cover crop selection guide

CROP	SITUATION	PROBLEM	COVER CROP OPTION 1	COVER CROP OPTION 2	BEST COVER CROP SOWING TIME
Wheat	No till	Cereal cyst nematodes Pratylenchus neglectus Pratylenchus thornei	SF Terranova radish	SF NemSol	December - January
	Cultivation between crops				
Cotton	Cultivation between crops	Black root rot Verticillium wilt Fusarium	SF FungiSol		May
Peanuts	Cultivation between crops	Sclerotinia	SF FungiSol		May
Sugar cane	Cultivation between crops	Root knot nematode Tropical Root Knot Nematode	SF NemSol	SF Terranova radish	April - July
		Root lesion nematode	French marigold		
		Pachymetra	SF Cappuccino ethiopean mustard		
Potatoes	Usually with low organic matter	Scab Rhizoctonia	SF FungiSol	SF Cappuccino ethiopean mustard	May
		Potato cyst nematode Root knot nematode	SF NemSol	SF Terranova radish	May
Vineyards	Inter-row only, brown manure option Capturing nutrient leaching	Fungal diseases	SF FungiSol	SF Cappuccino ethiopean mustard	May - June
VEGETABLES					
Tomato, eggplant, capsicum, melons, sweet potatoes	Cultivation between crops	Root knot nematode Beet cyst nematode	SF NemSol	SF Terranova radish	March - May
		Potato cyst nematode Root knot nematode	SF NemSol	SF Terranova radish	March - May
		Sclerotinia only	SF FungiSol		March - May
		Sclerotinia Plus nematodes	SF NemSol	SF Terranova radish	March - May
Cabbage, broccoli, cauliflower	Cultivation between crops	Clubroot	SF NemSol	SF Terranova radish	Sept-Dec (S) March-May (N)
Peas, beans	Cultivation between crops	Beet cyst nematode Fungal diseases	SF NemSol	SF Terranova radish	Feb-May (S)
Carrots, onions	Cultivation between crops	Beet cyst nematode Fungal diseases	SF NemSol	SF Terranova radish	Feb-May (S)
Strawberries	Cultivation between crops	Nematodes To be identified	SF NemSol	SF Terranova radish	March - May
		Fungal diseases	SF FungiSol	SF Cappuccino ethiopean mustard	April-June

SF NemSol

soil health solution



SF FungiSol

soil health solution



FEATURES	BENEFITS
Non-host status to many nematodes	Provides active resistance to specific nematodes
High winter yields	Provides high levels of organic matter
High levels of glucosinolates	Can be used for biofumigation, by macerating and quickly incorporating into the soil
Good nutrient accumulation	Highest level of nutrients accumulated for subsequent crops

General Description

SF NemSol is a specific soil health solution focussed on providing the highest levels of non-host status to a number of nematodes that can significantly impact agricultural crops. This prevents specific nematodes from reproducing within the cover crop cycle, thus providing resistance to the nematode.

SF Terranova oilseed radish is a strong non-host (resistance) for a number of nematodes including:

- > Root knot nematode
- > Tropical root knot nematode
- > Beet cyst nematode

It is also a poor host for many other nematodes including root lesion nematode.

It will provide fast establishment, and good levels of organic material, including increased nitrogen and potassium capture into soils, plus some good levels of glucosinolates important in reducing soil borne pathogens.

Areas of use:

Can be sown in rotation between vegetable crops or broadacre crops, where it is desirable to target problem nematodes.

This blend can also be used as a Biofumigant crop when macerated and incorporated.

Sowing rate: 10-15kg/ha

Time of sowing:

- > From early spring until mid-winter, depending on location
- > Sub-tropical regions: autumn to mid-winter
- > Temperate regions: early spring until late autumn



FEATURES	BENEFITS
Fast establishment	Quick coverage blocks out potential weeds
High yields	Provides high levels of organic matter
Bio-diverse mix	Attractive to many beneficial insects
Good nutrient accumulation	Nutrients available to subsequent cash crops

General Description

SF FungiSol is a blend of SF Terranova oilseed radish and SF Cappuccino ethiopean mustard. It has been designed to provide a fast establishing and high yielding rotation crop blend aimed at reducing levels of soil borne fungal pathogens.

It will provide highest levels of a range of glucosinolate compounds important in reducing soil bore pathogens in various crop rotations. It will also provide high levels of organic material, including increased nitrogen and potassium capture into soils ahead of the next rotation of cash generating crops.

This blend is ideally suited for use as a Biofumigant crop when macerated and incorporated.

Areas of use:

Can be sown in rotation between vegetable crops, or used inter-row in vineyards and orchards where it is desirable to increase organic matter.

Sowing rate: 10-15kg/ha

Time of sowing:

- > From early spring until mid winter
- > Sub-tropical regions: autumn to mid-winter
- > Temperate regions: early spring until late autumn

Nutrient uptake (per t DM)

	N	P	K
Mustard	20	4	21
Radish	21	5	30

*based on unfertilised crops
*typical crop yields 5-12t DM/ha
*around 60% will be available to following crop

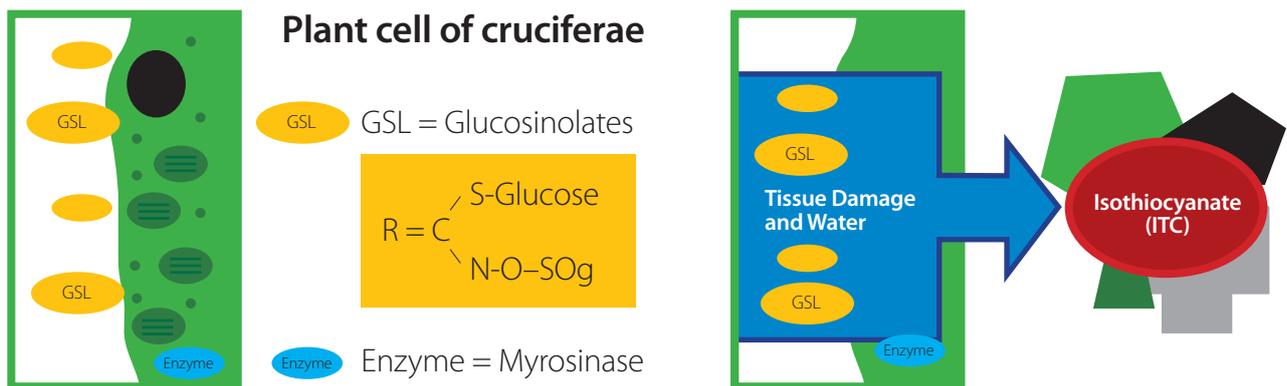


Biofumigation with brassicas. How does it work?

Glucosinolates are chemicals that occur naturally, stored in the vacuoles in brassicas that contribute to defence against pests and disease in the plant. The enzyme Myrosinase is also present in the plant, but in the cytoplasm.

When the plant is macerated, cells and the vacuoles are destroyed. The enzyme Myrosinase meets the glucosinolate and cuts the sugar-part (glucose) from the molecule. The residue-molecule of the glucosinolate is the aggressive part, Isothiocyanate (ITC).

These ITCs in the presence of adequate soil moisture naturally produce an organic fumigant compound similar to metham sodium.



Maximising the biofumigant effect

To maximise the biofumigation potential of a crop, the following describes the function

Biofumigation effect = Biomass (yield) x Concentration (genetics) x Activation in the soil.

SOWING RATE

- > Depends on soil type
- > Heavy open soils - 12-15kg/ha
- > Light soils – 10-12kg/ha
- > Prepare fine firm seedbed. Ideally roll pre and post sowing roll, roll and roll!
- > Drill considerations
- > Sow to depth of 0.5 cm

FERTILISER USE

- > Glucosinolates are S & N based compounds
- > The varieties recommended have been selected for highest levels of various glucosinolates
- > To drive highest levels in the growing crop, use S/N based fertiliser
- > Ideally SOA (Sulphate of Ammonia)
 - > 80-100kg/ha N
 - > 40kg/ha S

MULCHING AND INCORPORATING THE CROP

- > Ideally 60-80% flowering is time to incorporate, but can time to suit following crop planting
- > Flail chop and then incorporate with a rotary cultivator
- > Between chopping and incorporation there should be a maximum of 30 min, faster is best
- > Watering or rainfall is needed after incorporation.
- > Approx. 10mm is sufficient on soils with a normal moisture condition
- > It is desirable to work the paddock 2 weeks post incorporation
- > Wait 3-4 weeks before sowing new crop to allow fumigant levels to dissipate