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 Jongenen.

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.

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.
SF Cappucchino

**Ethiopean mustard (Brassica carinata)**

**Variety specifications**
- **Early vigour**: late
- **Flowering**: 50-60 days after planting
- **Main glucosinolates**: Sinigrin, Glucoraphanin, Glucotropaeolin
- **Nematode control**:
  - Heterodera avenae (Cereal cyst nematode)
  - Heterodera schachtii and betae (BCN)
  - Meloidogyne chitwoodi, fallax, incognita (RNK) 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 (RNK)
  - Ditylenchus destructor (Stem nematode)
  - Tobacco Rattle virus (TRV)
- **Sowing rate**: 10-15kg/ha

SF Terranova

**Oilde radish (Raphanus sativus)**

**Variety specifications**
- **Early vigour**: fast
- **Flowering**: 50-60 days after planting
- **Main glucosinolates**: Glucopoleiferin, Glucosphorin, Glucopareolin
- **Nematode control**:
  - Heterodera schachtii and betae (BCN)
  - Meloidogyne chitwoodi, fallax, incognita (RNK) 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 (RNK)
  - Ditylenchus destructor (Stem nematode)
  - Tobacco Rattle virus (TRV)
- **Sowing rate**: 3-5kg/ha
## Soil health cover crop selection guide

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

The table above provides a selection guide for cover crops based on different crops and potential issues they face. Each row details the situation, problem, and recommended cover crops with their corresponding sowing times.
**SF NemSol**

**soil health solution**

**FEATURES**
- Non-host status to many nematodes
- High winter yields
- High levels of glucosinolates
- Good nutrient accumulation

**BENEFITS**
- Provides active resistance to specific nematodes
- Provides high levels of organic matter
- Can be used for biofumigation, by macerating and quickly incorporating into the soil
- 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 desired 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

**Nutrient uptake (per t DM)**

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>P</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mustard</td>
<td>20</td>
<td>4</td>
<td>21</td>
</tr>
<tr>
<td>Radish</td>
<td>21</td>
<td>5</td>
<td>30</td>
</tr>
</tbody>
</table>

*Based on unfertilised crops
*Typical crop yields 5-12t DM/ha
*Around 60% will be available to following crop

**SF FungiSol**

**soil health solution**

**FEATURES**
- Fast establishment
- High yields
- Bio-diverse mix
- Good nutrient accumulation

**BENEFITS**
- Quick coverage blocks out potential weeds
- Provides high levels of organic matter
- Attractive to many beneficial insects
- Nutrients available to subsequent cash crops

**General Description**

**SF FungiSol** is a blend of SF Terranova oilseed radish and SF Cappuccino ethiopian 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 borne 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
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 glusosinolate 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

\[
\text{Biofumigation effect} = \text{Biomass (yield)} \times \text{Concentration (genetics)} \times \text{Activation in the soil.}
\]

**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