# COVER CROPS

## FOR AUSTRALIAN VEGETABLE GROWERS

## INTRODUCTION

This table provides a starting point for helping you choose a cover crop for your farm. Adapt the information to suit your farming operations, climate and cover crop objective. Also look for local guidance on suitable varieties for your conditions.

## SPECIES

The cover crops are grouped into 1) Cereals & Grasses, 2) Legumes, and 3) Broadleaves. In choosing your cover crop you should also consider your crop rotation to minimise potential pest and disease issues. Use the **Cover Crops and Soilborne Disease** table for additional guidance.

The most common cover crop species are listed at the top of the groupings, with some less used options at the bottom.

## RATINGS

The table provides the user with a summary of cover crops benefits and tolerance of growing conditions, relative to each other. Varietal differences and growth stage at the time of any environmental stress will influence the relative rating. Specific local information should be sought on varieties. This is particularly important for biofumigants.

A 5-star rating system is used in the table:

⋆⋆⋆⋆⋆ EXCELLENT

⋆⋆⋆⋆ VERY GOOD

⋆⋆⋆ GOOD

⋆⋆ FAIR

⋆ POOR

## COOL AND WARM SEASONS

The cover crop groups are divided into cool and warm season. Use the map to help guide your choice of cover crops for your season. Growing cover crops in their optimal time of year will typically maximise the benefits and reduce potential insect and disease issues.

### COOL SEASON

Cool season cover crops can be grown in most areas over winter. Germination and early growth will be affected by soil temperatures in autumn. Early sowings will establish quicker and lower sowing rates can be used. As the soil temperature declines, increase sowing rates to get good establishment and cover.

### WARM SEASON

In the warm to hot summer areas (see map), warm season cover crops can be grown to produce high levels of biomass. Look for greater heat tolerance for hot areas in the north and inland regions.

In the mild/warm summer areas, warm season cover crops will grow, once the minimum soil temperature is reached, but will produce biomass at the bottom end of the range. Most cool season cover crops will produce more biomass than warm season cover crops during the summer in this area. Look for cool season cover crops with greater heat tolerance for growing over summer in these areas. Also, choose cover crops which aren't affected by daylength. Daylength sensitive cover crops, e.g. radish, cereal rye, will bolt and produce less biomass if sown in early summer.

## 1. WHAT BENEFITS?

### PROTECT SOIL AND ADD BIOMASS

A key role of cover crops is to protect the soil from water and wind erosion, as well as adding biomass to help maintain and build soil organic matter. Only the above ground biomass is considered in this table - add another 20-25% for root biomass. Active growing roots also add microbe stimulating exudates, especially in the early stages of growth.

The biomass range (t/ha above ground dry weight) will be influenced by conditions and management. Low biomass will be produced when a cover crop is stressed due to a poor match to growing conditions, is not well supplied with water and nutrients or sown at low rates. Early terminated cover crops will also result in low biomass. Use the **Cover Crops and Termination** table for guidance on cover crop termination methods and impact on biomass quantity and quality.

### SUPPRESS WEEDS

The most successful cover crops for weed suppression typically establish quickly and/or form a dense canopy. The rating assumes that the cover crop is sown in the right season and is well supplied with fertiliser and water to ensure a competitive stand.

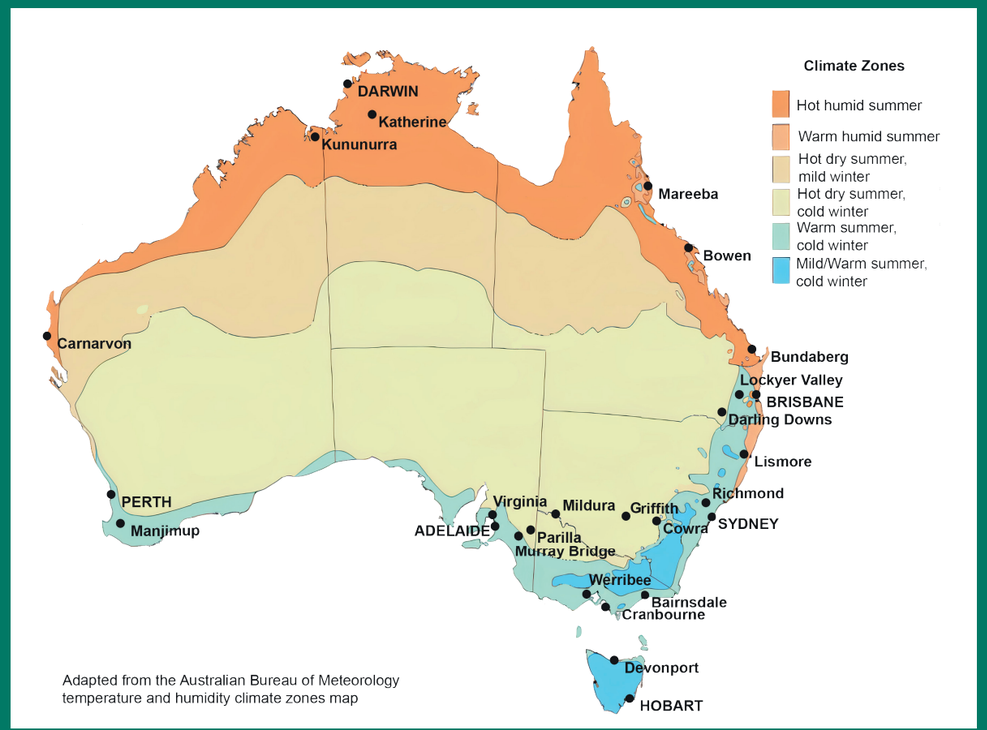
Cover crops that germinate and grow quickly tend to be more effective in suppressing early-germinating weeds. Canopy density can be influenced by sowing rate, and fertiliser and water supply. Dense canopies allow less light to penetrate to the soil surface, reducing the number of weeds that germinate, grow and set seed.

All cover crop choices will benefit from effective weed management in the period leading up to sowing, by reducing the impact of early weed germination and competition during cover crop establishment. Use the **Cover Crops and Herbicides** table for guidance on herbicides.

Use the **Integrated Weed Management for the Australian Vegetable Industry** manual, due for publication in 2021, for detailed guidance.

### ADD NITROGEN

Legume cover crops can add up to 150-200 kg/ha of nitrogen when grown well with the right rhizobium.




Adapted from the Australian Bureau of Meteorology temperature and humidity climate zones map

The ratings for the legumes are based on above ground biomass produced and assume a nitrogen fixation rate of 20 kg nitrogen per tonne of biomass.

⋆ indicates that the cover crop does not add nitrogen.

### RECOVER NUTRIENTS

Cover crops can play an important role in recovering and storing nutrients remaining in the soil after a vegetable crop. The ratings summarise a cover crop's ability to scavenge for nutrients in the soil and to access nutrients below the root zone of vegetable crops through deep rooting. The nutrients recovered and stored in the cover crop biomass are released to benefit the following vegetable crops and help reduce the off-farm environmental impacts.

### BIOFUMIGANTS

Biofumigation is the use of specialised cover crops which are grown, mulched and incorporated into the soil prior to cropping. High biomass can provide the traditional benefits of cover crops and, if done right, naturally occurring compounds from the biofumigant plants can suppress soilborne pests, diseases and weeds. The table only summarises the biofumigant cover crops at the species level. Varieties vary considerably. For performance of biofumigant varieties see the **Guide to Brassica Biofumigant Cover Crops: Managing soilborne diseases in vegetable production systems.**

⋆ indicates no biofumigant activity.

## 2. GROWTH TOLERANCES

Choosing cover crops well suited to the conditions is important, but remember to get the most out of your cover crops your need to treat them like a crop by sowing at the right time, avoiding main pest and disease periods, and giving them adequate nutrition and water.

The table summarises the relative tolerances of the cover crops to heat, drought, waterlogging and frost. Use these ratings to identify cover crops which will cope with the growing conditions expected in your region.

## 3. SOIL CONDITIONS

Use the soil conditions to make sure the cover crop is suited to your soil's pH. The minimum soil temperature for germination is provided and for best results the temperature should be rising for early sowing of warm season cover crops.

## 4. SOWING

Practical information on sowing cover crops is summarised.

Possible sowing rates (kg/ha) are provided as a guide. The lower rate would be suitable for drilled cover crops at the optimum sowing time. Use higher rates when broadcasting, sowing late in the season, or for improved weed suppression.

Seed size and sowing depth information is provided to help match with sowing machinery.

If the legume is not regularly grown, then adding the right rhizobium inoculant is very important.

The specific rhizobium inoculant for each legume is provided. For the best result, coat seed and sow on same day.

## 5. ESTABLISHMENT

The establishment time provides a ranking of the relative speed to achieve ground cover. This will be important for outcompeting weeds and providing protection against wind and water erosion. Sowing rates and soil temperatures will have a big influence on establishment time.

Root depth is important in stabilising subsoil structure, e.g. after deep ripping, scavenging for nutrients below crop roots, and for drought tolerance. Three classes for root depth are used: Shallow – majority of roots 0-50 cm; Medium – majority of roots 0-100cm; and Deep – roots can grow deeper than 100cm.

# COVER CROPS FOR VEGETABLE GROWERS

Cover Crop Quick Reference table for picking a cover crop.

Pick your season, your main purpose (1), and expected growth (2) and soil conditions (3). The suggested sowing practices are provided in 4, with 5 providing an indication of establishment.

More information on how to use the Quick Reference table is on the back. For other cover crop resources **visit www.soilwealth.com.au**

| SPECIES | 1. WHAT BENEFITS? | | | | | 2. GROWTH TOLERANCES | | | | 3. SOIL CONDITIONS | | 4. SOWING | | | | 5. ESTABLISHMENT | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PROTECT SOIL & ADD BIOMASS (t/ha) | SUPPRESS WEEDS | ADD NITROGEN | RECOVER NUTRIENTS | BIOFUMI-GANT | HEAT | DROUGHT | WATER-LOGGING | FROST | pH (water) | LOWEST GERMINATION TEMP (ºC) | RATE (kg/ha) | SEED SIZE | DEPTH (cm) | RHIZOBIUM INOCULANT | TIME | ROOTING DEPTH |
| **CEREALS & GRASSES** | | | | | | | | | | | | | | | | | |
| **COOL SEASON** | | | | | | | | | | | | | | | | | |
| Cereal rye (*Secale cereale*) | 3 - 10 | ★★★★ | ★ | ★★★★★ | ★ | ★★ | ★★★ | ★★★ | ★★★ | 4.9 - 7.9 | 3 | 60 - 120 | M | 1 - 3 | NA | quick | deep |
| Oat (*Avena sativa*) | 2 - 10 | ★★ | ★ | ★★★★ | ★ | ★★ | ★★★ | ★★★ | ★★★ | 4.5 - 7.5 | 8 | 80 - 110 | M | 3 - 6 | NA | quick | deep |
| Black/Saia oat (*A. strigosa*) | 4 - 10 | ★★ | ★ | ★★★★ | ★ | ★★ | ★★★ | ★★★ | ★★ | 4.5 - 7.5 | 8 | 50 - 70 | S - M | 3 - 6 | NA | quick | deep |
| Annual ryegrass (*Lolium multiflorum/rigidum*) | 2 - 9 | ★★★★ | ★ | ★★★★ | ★ | ★ | ★★ | ★★★ | ★★★ | 5.5 - 7.5 | 13 | 15 - 20 | S | 1 - 2 | NA | slow | medium |
| Barley (*Hordeum vulgare*) | 2 - 10 | ★★★ | ★ | ★★★★ | ★ | ★ | ★★ | ★★ | ★★★ | 6.0 - 7.9 | 8 | 50 - 100 | M | 3 - 5 | NA | quick | deep |
| Wheat (*Triticum aestivum*) | 3 - 8 | ★★ | ★ | ★★★★ | ★ | ★ | ★★ | ★ | ★★★ | 5.5 - 7.9 | 5 | 60 - 120 | M | 2 - 4 | NA | medium | deep |
| **WARM SEASON** | | | | | | | | | | | | | | | | | |
| Sorghum (*Sorghum bicolor*) | 4 - 14 | ★★★★ | ★ | ★★★★★ | ★★★ | ★★★★ | ★★★ | ★★ | ★ | >4.8 | 16 | 15 - 30 | M | 3 - 5 | NA | medium | deep |
| Sorghum x Sudan grass (*S. bicolor x S. sudanense*) | 4 - 10 | ★★★★ | ★ | ★★★★★ | ★★ | ★★★★★ | ★★★★★ | ★★★ | ★ | >4.8 | 18 | 20 - 30 | M | 2 - 4 | NA | medium | deep |
| Sudan grass (*Sorghum sudanense*) | 4 - 10 | ★★★★ | ★ | ★★★★★ | ★ | ★★★★ | ★★★★ | ★★ | ★ | >4.8 | 18 | 15 - 30 | M | 1 - 2 | NA | medium | deep |
| Millet - French or Proso (*Panicum miliaceum*) | 2 - 8 | ★★★ | ★ | ★★★★ | ★ | ★★★★★ | ★★★ | ★ | ★ | 4.5 - 9.0 | 14 | 8 - 15 | S | 1 - 2 | NA | medium | medium |
| Millet - Japanese (*Echinochloa esculenta*) | 2 - 6 | ★★★ | ★ | ★★★★ | ★ | ★★★★ | ★★ | ★★ | ★ | 4.6 - 7.4 | 15 | 10 - 30 | S | 1 - 3 | NA | medium | medium |
| Teff (*Eragrostis tef*) | 3 - 8 | ★★ | ★ | ★★★ | ★ | ★★ | ★★★★ | ★★★★★ | ★ | >4.8 | 18 | 6 - 12 | VS | 0.3 - 1 | NA | medium | shallow |
| **LEGUMES** | | | | | | | | | | | | | | | | | |
| **COOL SEASON** | | | | | | | | | | | | | | | | | |
| Faba bean (*Vicia faba*) | 6 - 8 | ★★ | ★★★★★ | ★★ | ★ | ★★ | ★★ | ★★★ | ★★★ | 6.0 - 7.2 | 4 | 100 - 200 | L | 5 - 8 | F | slow | shallow |
| Vetch, Woollypod "hairy" (*V. villosa*) | 4 - 7 | ★★ | ★★★★ | ★★ | ★ | ★ | ★★ | ★★ | ★★★★ | 5.0 - 7.5 | 9 | 25 - 40 | M | 2 - 4 | E | slow | medium |
| Vetch, common (*V. sativa*) | 2 - 5 | ★★ | ★★★ | ★★ | ★ | ★ | ★★ | ★★ | ★★★★ | 5.0 - 7.5 | 6 | 50 - 60 | M | 1 | E | medium | medium |
| Field pea (*Pisum sativum*) | 3 - 8 | ★★ | ★★★★ | ★★ | ★ | ★★ | ★★ | ★★ | ★★★ | 6.0 - 7.0 | 6 | 80 - 120 | M | 3 - 7 | E or F | medium | shallow |
| Clover, white (*Trifolium repens*) - perennial | 2 - 6 | ★★ | ★★★★ | ★★ | ★ | ★★★ | ★★ | ★★★★ | ★★ | 6.0 - 7.0 | 5 | 4 - 12 | S | 1 | B | medium | shallow |
| Clover, berseem (*T. alexandrinum*) | 3 - 7 | ★★★ | ★★★★ | ★★ | ★ | ★★★ | ★★ | ★★ | ★ | 7.0 - 7.5 | 6 | 10 - 20 | S | 1 | B | medium | shallow |
| Clover, balansa (*T. michelianum*) | 3 - 6 | ★★ | ★★★★ | ★★ | ★ | ★ | ★★★ | ★★★ | ★★★ | 5.0 - 7.0 | 6 | 4 - 8 | S | 1 | C | medium | medium |
| Clover, crimson (*T. incarnatum*) | 3 - 6 | ★★ | ★★★ | ★★★ | ★ | ★ | ★ | ★ | ★★★ | 5.5 - 7.0 | 6 | 10 - 20 | S | 1 | C | medium | deep |
| Clover, red (*T. pratense*) | 2 - 5 | ★★ | ★★★ | ★★★ | ★ | ★★ | ★★ | ★★ | ★★ | 5.5 - 7.0 | 5 | 5 - 10 | S | 1 | B | medium | deep |
| Lentil (*Lens culinaris*) | 2 - 5 | ★ | ★★★ | ★★ | ★ | ★★★ | ★★★ | ★ | ★★★ | 6.0 - 7.5 | 5 | 50 - 60 | M | 5 - 10 | F | slow | shallow |
| Lupin (*Lupinus* spp.) | 2 - 8 | ★ | ★★★ | ★★★ | ★ | ★★ | ★★★ | ★★ | ★★★ | 4.5 - 7.0 | 5 | 70 - 100 | M | 3 - 5 | G or S | slow | medium |
| Medic (*Medicago* spp.) | 1 - 4 | ★ | ★★ | ★★ | ★ | ★★★★ | ★★★ | ★★ | ★★★ | 6.0 - 7.5 | 10 | 10 - 20 | S | 1 | AL or AM | slow | shallow |
| Serradella (*Ornithopus* spp.) | 3 - 8 | ★ | ★★★★ | ★★ | ★ | ★★★ | ★★ | ★★ | ★★ | 4.5 - 7.0 | 5 | 2 - 5 | S | | S or G | slow | medium |
| Biserrula (*Biserrula pelecinus*) | 3 - 8 | ★★★ | ★★★★ | ★★★ | ★ | ★★ | ★★★★ | ★ | ★★★ | 4.0 - 7.5 | 5 | 10 - 20 | M | 3 - 5 | WSM1497 | medium | deep |
| **WARM SEASON** | | | | | | | | | | | | | | | | | |
| Lablab (*Lablab purpureus*) | 4 - 12 | ★★★ | ★★★★★ | ★★★ | ★ | ★★★★★ | ★★★★★ | ★ | ★ | 5.0 - 7.5 | 18 | 20 - 40 | L | 4 - 6 | J | medium | deep |
| Soybean (*Glycine max*) | 2 - 8 | ★ | ★★★★ | ★★ | ★ | ★★★ | ★★★ | ★★★ | ★ | 5.5 - 7.5 | 15 | 40 - 60 | M | 2 - 5 | H | medium | medium |
| Cowpea (*Vigna unguiculata*) | 2 - 6 | ★★★ | ★★★ | ★★ | ★ | ★★★★★ | ★★★★ | ★ | ★ | 4.5 - 6.5 | 18 | 35 - 90 | M | 3 - 6 | I | medium | deep |
| Mung bean (*V. radiata*) | 1 - 6 | ★★ | ★★★ | ★★ | ★ | ★★★★★ | ★★★★★ | ★★ | ★ | 5.5 - 7.5 | 18 | 20 - 30 | M | 2 - 4 | I | medium | medium |
| Sunn hemp (*Crotalaria juncea*) | 4 - 8 | ★★★★ | ★★★★ | ★★★ | ★ | ★★★★★ | ★★★★ | ★ | ★ | 6.0 - 7.5 | 14 | 10 - 20 | M | .5 - 3 | I | medium | medium |
| Lucerne (*Medicago sativa*) - perennial | 4 - 10 | ★★ | ★★★★★ | ★★★ | ★ | ★★★★★ | ★★★★★ | ★★★ | ★★★ | 6.5 - 8.0 | 4 | 15 - 25 | S | 1 | AL | slow | deep |
| Sulla (*Hedysarum coronarium*) - perennial | 3 - 10 | ★ | ★★★★ | ★★★ | ★ | ★★ | ★★★ | ★★ | ★★ | 6.5 - 8.5 | 15 | 6 - 12 | S | 1 - 2 | WSM1592 | slow | deep |
| **BROADLEAF (NON-LEGUME)** | | | | | | | | | | | | | | | | | |
| **COOL SEASON** | | | | | | | | | | | | | | | | | |
| Fodder mustard (*Brassica napus*) | 8 - 16 | ★★★ | ★ | ★★★★ | ★★★ | ★★★ | ★★ | ★★★ | ★★★ | 6.0 - 7.5 | 6 | 6 - 12 | S | 1 - 2 | NA | medium | medium |
| Indian mustard (*Brassica juncea*) | 4 - 15 | ★★★★ | ★ | ★★★★ | ★★★★★ | ★★★ | ★★ | ★★ | ★★★ | 6.0 - 7.5 | 5 | 6 - 14 | S | 1 - 2 | NA | medium | medium |
| Oilseed radish (*Raphanus sativus var. oleiformis*) | 5 - 12 | ★★★ | ★ | ★★★★★ | ★★★★ | ★★★ | ★★ | ★★ | ★★★ | 6.0 - 7.5 | 7 | 9 - 15 | M | 1 - 2 | NA | medium | deep |
| Turnip (*Brassica rapa*) | 2 - 6 | ★★★ | ★ | ★★★ | ★★★ | ★★★ | ★★ | ★★ | ★★ | 6.0 - 7.5 | 5 | 5 - 8 | S | 1 - 2 | NA | medium | deep |
| White mustard (*Sinapis alba*) | 4 - 12 | ★★ | ★ | ★★★★ | ★★★ | ★★★ | ★★ | ★★ | ★★ | 6.0 - 7.5 | 4 | 10 - 20 | S | 1 - 2 | NA | medium | medium |
| Rocket (*Eruca sativa*) | 2 - 8 | ★★★★ | ★ | ★★★ | ★★★ | ★★★ | ★★★ | ★★ | ★★★ | 6.0 - 7.5 | 6 | 8 - 16 | S | 1 - 2 | NA | medium | medium |
| Chicory (*Cichorium intybus*) - perennial | 3 - 6 | ★★ | ★ | ★★★★ | ★ | ★★★ | ★★★ | ★ | ★★★★ | 5.5 - 7.0 | 12 | 4 - 7 | S | 1 - 3 | NA | medium | deep |
| Linseed (*Linoideae* & *Hugonioideae*) | 2 - 5 | ★ | ★ | ★★ | ★ | ★★ | ★★★ | ★★ | ★★★ | 6.0 - 7.5 | 9 | 30 - 50 | S | 1 - 3 | NA | slow | medium |
| Phacelia (*Phacelia tanacetifolia*) | 3 - 6 | ★★★ | ★ | ★★★ | ★ | ★★ | ★★★ | ★ | ★★★ | 6.5 - 8.5 | 10 | 8 - 10 | S | 1 | NA | slow | medium |
| **WARM SEASON** | | | | | | | | | | | | | | | | | |
| Buckwheat (*Fagopyrum esculentum*) | 2 - 6 | ★★★★ | ★ | ★★★★ | ★ | ★★★ | ★ | ★ | ★★ | 5.0 - 7.0 | 10 | 30 - 70 | M | 1 - 2 | NA | quick | shallow |
| Tillage Radish (*Raphanus sativus*) | 6 - 12 | ★★★★ | ★ | ★★★★★ | ★★★ | ★★★★ | ★★ | ★★ | ★★★ | 6.0 - 7.5 | 7 | 3 - 10 | M | 1 - 3 | NA | medium | deep |
| Ethiopian mustard (*Brassica carinata*) | 6 - 14 | ★★★ | ★ | ★★★★ | ★★★★★ | ★★★★ | ★★★ | ★★ | ★★ | 5.5 - 7.5 | 7 | 5 - 15 | S | 1 - 2 | NA | medium | medium |
| Safflower (*Carthamus tinctorius*) | 3 - 8 | ★ | ★ | ★★★★★ | ★ | ★★★★★ | ★★★★ | ★ | ★★ | 6.0 - 8.0 | 5 | 15 - 25 | M | 2 - 3 | NA | slow | deep |
| Sunflower (*Heliantus annuus*) | 3 - 8 | ★ | ★ | ★★★ | ★ | ★★★★ | ★★★ | ★ | ★★ | 5.5 - 8.0 | 10 | 5 - 10 | L | 2 - 5 | NA | medium | medium |
| Marigold (*Tagetes* spp.) | 1 - 3 | ★★★ | ★ | ★★ | ★ | ★★★★ | ★★ | ★ | ★ | 6.0 - 7.5 | 18 | 1 - 2 | M | 2 | NA | medium | shallow |

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