TERMINATION

Have a plan for terminating your cover crop before you sow!

A combination of chemical and mechanical methods are needed to get good cover crop kill. See **Cover Crop Termination Scenarios** box for examples.

Make sure your cover crop is terminated before seed set to prevent it becoming a weed. Watch out for cover crops like buckwheat which can set seed very early, or mixes where different species mature at different times.

The timing of termination allows you to control the amount of biomass and its composition to match your cover crop aims. Be clear on your cover crops main purpose and how it fits into your farm.

The table provides an expected range of biomass (t/ha) and C:N ratio, a key measure of the cover crops chemical composition. See **Cover Crop Chemistry – Carbon to Nitrogen ratio** box for details.

Early termination will produce a cover crop at the lower end of the biomass and C:N ratio ranges. The cover crop will be easier to incorporate and will breakdown and release nitrogen quicker than a late terminated cover crop.

Late termination will produce the most biomass with a higher C:N ratio. The cover crop will be slower to breakdown and provide more erosion protection and weed suppression after termination. However, incorporation will require more cultivation, and nitrogen tie-up is more likely.

COVER CROP TERMINATION SCENARIOS

Scenario #1 – Any Cover crop + Cultivation: Glyphosate (optional) + tillage. Glyphosate applied prior to cultivation will reduce the need for multiple passes and help ensure an effective kill in cool moist conditions.

Scenario #2 – Cereal-only Cover crop + Strip Tillage: Glyphosate + Roller Crimper + Paraquat (optional). Apply glyphosate prior to rolling at high active ingredient and water rates to achieve coverage, but not to the point of runoff. Avoid stressed and/or dusty conditions. If 100% kill is not achieved, burn off rolled cover crop with Paraquat; strip-till in the direction of rolling to produce a good seed bed with the inter-row protected by the cover crop residues.

Scenario #3 - Mixed species Cover crop + Strip Tillage: Glyphosate and/or Glufosinate (in higher humidity climates) + Roller crimper + Sprayseed + Oxyflurofen (Double Knock). The initial herbicide terminates the upper canopy, usually cereals or grasses. Rolling knocks this layer down and exposes the ground cover which is then killed with Sprayseed and Double Knock.

MOWING OR MULCHING

Mulching mowers can cut lower then slasher mowers and are more effective in terminating cover crops. Mulching mowers also cut the biomass up finer which promotes breakdown and reduces the residues catching on drilling or transplanting equipment.

ROLLING AND CRIMPING

Rollers and roller crimpers are useful for creating coarse mulch on the surface which breaks down slowly. This is ideal for protecting the soil from erosion, weed suppression, and keeping the soil cooler.

Generally, cover crop kill rates are similar for drum rollers and roller crimpers –timing is more important in getting good kill rates. Relying just on roller crimpers for termination will produce variable results based on the type of cover crop, timing, and weather conditions. For the most reliable cover crop kill, roller crimping can be combined with a herbicide.

CULTIVATION

Relying solely on cultivation to terminate your cover crop will often require more aggressive rotary hoeing and more passes to achieve a good cover crop kill. This is not good for your soils health and can undo many of the benefits of growing the cover crop. Combining cultivation with another termination method will allow softer cultivation methods, such as discing or strip tillage.

COVER CROP TERMINATION GUIDE

FOR AUSTRALIAN VEGETABLE GROWERS

CHEMICAL TERMINATION

Herbicides combined with mechanical measures are the most reliable termination combo.

Large biomass cover crops are a challenge for herbicides, which have typically been developed to kill plants in their early development stage.

Glyphosate is the most reliable of herbicides for killing large biomass cover crops. Glyphosate is effective against both grasses and broadleaves and, as it is translocated, is usually effective on larger plants.

SpraySeed (diquat + paraquat), Gramaxone (paraquat), Reglone (diquat), Basta (glufosinate) and Alliance (amitrole-t) are some non-selective alternatives to glyphosate. However, they are contact herbicides and most effective on small plants. Large biomass cover crops generally will not be controlled by a single application of these herbicides alone. Coverage and environmental conditions are important factors in determining the effectiveness of these herbicides.

Mixed species cover crops can be difficult to terminate. The range of species and the multilayered structure of the cover crop can reduce herbicide effectiveness.

As with all herbicides, adjust active ingredient rate and water volumes for cover crop size. Consider droplet size, tank-mix partners, and surfactants to maximise performance. The information provided is a GUIDE ONLY! Always read and follow herbicide label instructions.

MECHANICAL TERMINATION

Timing of mechanical termination is critical to get a good cover crop kill – the right growth stage and weather conditions must be used.

Mechanical methods are most effective on cover crops at the late flowering - milk development growth stage. The plants are nearing the end of their growth cycle and would have hayed off naturally in the coming weeks. Mechanical termination effectively speeds this up, with the least chance of cover crop regrowth.

Warm dry conditions will increase the effectiveness of mechanical methods. Expect mechanical termination to be least effective over winter.

The effectiveness of mechanical termination varies between cover crops – check the table for guidance.

BIOFUMIGATION TERMINATION

Timing is critical to maximise the biofumigation action – see **Guide to Brassica Biofumigation Cover Crops** for details.

1. Terminate by mulching at **25% flowering** to maximise glucosinolates.
2. Mulch as finely as possible to activate.
3. Incorporate mulched biomass **as soon as possible**.
4. Irrigate or lightly roll to seal in biofumigation gases.

COVER CROP CHEMISTRY – CARBON TO NITROGEN RATIO

The Carbon to Nitrogen (C:N) ratio is a major factor controlling how long a cover crop takes to breakdown, influencing nitrogen release/tie up and how long biomass residues stay around.

The ideal biomass C:N ratio for soil microbes is 24:1. This provides a balanced diet for the happy microbes with the 24 parts of carbon providing the energy for the microbes, while the one part of nitrogen allows the microbes to build the required proteins and enzymes. When the C:N ratio is above 24:1, biomass breakdown decreases, and the microbes may need to draw nitrogen from the soil.

As C:N ratios rise above 50:1 the carbon can become more complex and even slower to breakdown. The slow decomposition of cover crops can be beneficial if the goal is to protect the soil from erosion or for weed suppression. If high C:N ratio cover crop biomass is left on the surface and not incorporated, then nitrogen draw down is less of an issue.

For some vegetable crops, the quick decomposition of cover crop residues is required. In this case a lower C:N ratio cover crop is best. This can be achieved by either choosing a low C:N ratio cover crop or by early termination – see the Table for guidance.

SUMMARY - see reverse for details

- Have a plan for terminating your cover crop before you sow!
- Be clear on your cover crops main purpose and how it fits into your farm. This will determine the right cover crop and right termination time and method.
- If not managed right, cover crop biomass residues can cause problems – see the **Potential Cover Crop Biomass Residue Issues** box.
- Make sure your cover crop is terminated before seed set to prevent it becoming a weed.
- By picking the termination time, you can change the amount of cover crop biomass and C:N ratio and control the rate of breakdown – see the **Cover Crop Chemistry** box.
- A range of biomass (t/ha) and C:N ratios are provided for each cover crop in the Table. Early termination will produce a cover crop at the lower end of the biomass and C:N ratio ranges, while late termination will produce the most biomass with a higher C:N ratio - see the **Table for guidance**.
- Two termination methods need to be combined to get a consistent cover crop kill.
- Herbicides combined with mechanical methods is the most reliable termination combo.
- Relying on just mechanical termination requires careful attention to timing to achieve good kill rates and can only be used on limited cover crops.
- Biofumigation termination requires special attention – see **Biofumigation Termination** box.
- Aggressive and more passes are required if relying solely on cultivation to achieve a good cover crop kill. Aggressive cultivation can undo the soil health benefits of growing the cover crop.

POTENTIAL COVER CROP BIOMASS RESIDUE ISSUES

Having a cover crop termination plan will help avoid these issues:

- Vegetable crop sowing/transplant issues due to much cover crop biomass residues.
- Nutrient draw down resulting in nitrogen deficiencies in the vegetable crop.
- Cover crop residues in spring keeping soil cool and slowing early growth
- Cover crop residues breaking down too quickly and not protecting the soil from erosion.
- Cover crop residue contaminating vegetable crops such as baby leaf.
- Disease carry-over on biomass residue – e.g. Sclerotinia surviving on decaying cover crop residues.
- Cover crop residues providing food and shelter for crop pests such as snails and slugs.

COVER CROP TERMINATION GUIDE FOR AUSTRALIAN VEGETABLE GROWERS

SPECIES	MECHANICAL TERMINATION OPTIONS (Combinations of mechanical and herbicides achieve optimum results)			COVER CROP	
CEREALS & GRASSES	**MULCHING/MOWING**	**ROLLING/ROLLER CRIMPER**	**CULTIVATION**	**BIOMASS DW (t/ha)**	**C:N**
COOL SEASON					
Cereal rye (*Secale cereale*)	★★★	★★★★	★★★★	3 - 10	35 - 80
Oat (*Avena sativa*)	★	★★	★★★	2 - 10	30 - 50
Black/Saia oat (*A. strigosa*)	★	★★	★★★	4 - 10	25 - 55
Ryegrass (*Lolium multiflorum/rigidum*)	★	★	★★	2 - 9	20 - 40
Barley (*Hordeum vulgare*)	★★	★★★	★★★	2 - 10	30 - 55
Wheat (*Triticum aestivum*)	★★★	★★★	★★★	3 - 8	35 - 100
WARM SEASON					
Sorghum (*Sorghum bicolor*)	★	★★	★★★	4 - 14	50 - 100
Sorghum x Sudan grass (S. *bicolour x S. Sudanese*)	★	★★	★★★	4 - 10	35 - 60
Sudan grass (*Sorghum sudanense*)	★	★★	★★★	4 - 10	45 - 55
Millet - French or Proso (*Panicum miliaceum*)	★	★★	★★★	2 - 8	25 - 50
Millet - Japanese (*Echinochloa esculenta*)	★★★★	★★★★	★★★★	2 - 6	25 - 50
Teff (*Eragrostis tef*)	★	★★	★★★	3 - 8	25 - 50
LEGUMES					
COOL SEASON					
Faba Bean (*Vicia faba*)	★★★	★★	★★★	6 - 8	20 - 24
Vetch, Woollypod "hairy" (V. villosa)	★★★	★★★	★★★★	4 - 7	10 - 20
Vetch, common (*V. sativa*)	★★★	★★	★★	2 - 5	10 - 20
Field Pea (*Pisum sativum*)	★★★	★	★★★	3 - 8	14 - 22
Clover, white (*Trifolium repens*) - perennial	★	★	★★	2 - 6	13 - 23
Clover, berseem (*T. alexandrinum*)	★	★	★★	3 - 7	16 - 23
Clover, balansa (*T. michelianum*)	★	★	★★	3 - 6	13 - 20
Clover, crimson (*T. incarnatum*)	★★★	★	★★	3 - 6	14 - 24
Clover, red (*T. pratense*)	★	★	★★	2 - 5	12 - 23
Lentil (*Lens culinaris*)	★★	★★	★★★	2 - 5	19 - 30
Lupin (*Lupinus* spp.)	★★	★★	★★★	2 - 8	15 - 40
Medic (*Medicago* spp.)	★	★	★★★	1 - 4	15 - 20
Serradella (*Ornithopus* spp.)	★	★	★★★	3 - 8	15 - 22
Biserrula (*Biserrula pelecinus*)	★	★	★★★	3 - 8	15 - 25
WARM SEASON					
LabLab (*Lablab purpureus*)	★★★★	★★	★★★★	4 - 12	15 - 35
Soybean (*Glycine max*)	★★★★	★★★★	★★★★	2 - 8	15 - 35
Cowpea (*Vigna unguiculata*)	★★★★	★★	★★★★	2 - 6	16 - 22
Mung bean (*V. radiata*)	★★	★★	★★★	1 - 6	10 - 15
Sunn hemp (*Crotalaria juncea*)	★★	★★★	★★★	4 - 8	23 - 40
Lucerne (*Medicago sativa*) - perennial	★	★	★★	4 - 10	12 - 22
Sulla (*Hedysarum coronarium*) - perennial	★	★	★★★	3 - 10	11 - 20
BROADLEAF					
COOL SEASON					
Fodder mustard (*Brassica napus*)	★★★★	★★★★★	★★★★★	8 - 16	20 - 40
Indian mustard (*Brassica juncea*)	★★★★	★★★★★	★★★★★	4 - 15	15 - 45
Oil seed radish (*Raphanus sativus var. oleiformis*)	★★★★	★★★★★	★★★★★	5 - 12	14 - 46
Turnip (*Brassica rapa*)	★★★★	★★★★★	★★★★★	2 - 6	11 - 25
White mustard (*Sinapis alba*)	★★★★	★★★★★	★★★★★	4 - 12	11 - 23
Rocket (*Eruca sativa*)	★★★★	★★★★★	★★★★★	2 - 8	13 - 16
Chicory (*Cichorium intybus*)	★	★	★★★	3 -6	15 - 20
Linseed or Flax (*Linum usitatissimum*)	★★	★★	★★★	2 - 5	30 - 50
Phacelia (*Phacelia tanacetifolia*)	★★	★★	★★★	3 - 6	10 - 20
WARM SEASON					
Buckwheat (*Fagopyrum esculentum*)	★★★★	★★★★	★★★	2 - 6	10 - 25
Tillage Radish (*Raphanus sativus*)	★★★★	★★★★	★★★★★	6 - 12	10 - 26
Ethiopian mustard (*Brassica carinata*)	★★★★	★★★★	★★★★★	6 - 14	15 - 40
Safflower (*Carthamus tinctorius*)	★★	★	★★	3 - 8	21 - 50
Sunflower (*Heliantus annuus*)	★★	★	★★	3 - 8	29 - 40
Marigold (*Tagetes* spp.)	?	?	?	1 - 3	20 - 30

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