

# AGFACTS AGFACTS AGFACTS



## Covercrops for subtropical orchards

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Groundcovers are plants that form a covering mat of living vegetation over the soil. They play an important role in the soil management of orchards striving for sustainable production. This Agfact outlines the benefits of groundcovers, useful species and management techniques.

### BENEFITS OF GROUNDCOVERS

#### Reduce erosion

Erosion of bare soil is an important issue in the high rainfall climate of the North Coast of NSW. In heavy rain soil and fertiliser are lost from the

orchard and may contaminate streams and waterways.

Groundcovers reduce erosion by:

- providing a cover to reduce the impact of rain on the soil and slowing overland flow of water,
- providing a root system that binds soil particles together,
- indirectly improving soil structure and water infiltration and reducing compaction,
- increasing organic matter, which absorbs water.

**Amarillo peanut (left) and smothergrass (right) in a macadamia orchard, managed as a short sward. A permanent low-growing groundcover reduces erosion, benefits the soil and provides a good surface for mechanical harvesters if low-mown in the harvest season.**



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**DISCLAIMER**

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The information contained in this publication is based on knowledge and understanding at the time of writing (February 2003). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of New South Wales Department of Agriculture or the user's independent adviser.

The product trade names in this publication are supplied on the understanding that no preference between equivalent products is intended and that the inclusion of a product name does not imply endorsement by NSW Agriculture over any equivalent product from another manufacturer.

**Build up organic matter**

Groundcovers are a useful way of increasing soil organic matter.

Organic matter is the principal food source for soil organisms. Their activities in digesting and breaking down organic matter helps aggregate soil particles into larger clumps, thereby improving soil structure. A well-structured soil is more resistant to erosion and provides a more favourable environment to plants. This is through improved aeration, root penetration and water infiltration.

Organic matter finally breaks down to humus, a substance that enhances the soil's ability to hold nutrients. As well, it can absorb and hold up to 10 times its own weight in water. This not only improves the soil's water holding capacity, but reduces irrigation requirements.

**Suppress weeds**

When properly established, groundcovers suppress weed growth and eliminate the need for constant herbicide application within the tree row—which is expensive, labour intensive and carries a risk of injury to young trees.

Allelopathy is the term used to describe the effect of one plant's toxins on another plant. Toxic exudates from the roots of some groundcover species can act as weed suppressants. Some members of the sorghum family are good suppressants of a number of annual weeds, both as living plants and mulch. Some species can also suppress undesirable soil organisms such as nematodes. However, it is possible that some groundcovers will suppress growth of some horticultural crops.

**Increase water infiltration**

Groundcovers reduce evaporation from the soil surface and increase infiltration of water through the soil profile. Initially, this can cause increased leaching in heavy rainfall areas where soil has low levels of organic matter. With increased humus content, losses of calcium, magnesium and potassium are reduced through the ability of humus to hold onto nutrients.

Increased water infiltration reduces overland water flow, so there is less opportunity for surface loss of soil-applied fertilisers. Fertiliser nutrients can then be held in place within the groundcover, some being taken up by the roots to become available later as organic matter breaks down. However, leaching of nitrate and sulfate will continue.

**Fix nitrogen**

The nodulated legume is a useful source of soil nitrogen - one of the main reasons legume groundcovers are encouraged in orchards. The actual amount of nitrogen fixed by the rhizobia in the root nodule depends on the host legume species, the strain of rhizobium, and whether the environment of the soil is favourable. Hence, at planting it is important to inoculate with the correct strain of rhizobium. Some legumes, such as cowpeas, fix most nitrogen before flowering. Others such as soybean can fix 90 per cent during fruiting and maturation. This means slashing or turning under at the correct time is important with annual legumes.

The increasing cost of nitrogen fertilisers makes it more economically attractive to obtain nitrogen from legumes. This is offset by the cost of phosphate to grow legumes.

Legumes can add about 3 per cent nitrogen to soil, while grasses produce straw that has a high carbon:nitrogen ratio and is lower in nitrogen. The breakdown of grass and straw requires bacteria to use existing soil nitrogen, thus reducing the nitrogen available in the soil.

However, there could be times when the groundcover does compete for moisture and nutrients with the orchard crop, and this needs correction by additional irrigation and fertiliser and control of vegetation near young trees.

Table 1 shows the amount of nitrogen that a range of agriculturally important legumes can fix.

## Improve microenvironment for establishing trees

Tall non-spreading groundcovers provide a suitable microenvironment for establishing subtropical horticultural tree crops, especially where tree rows are widely spaced. Young orchard trees are protected from:

- damaging winds
- temperature extremes in the soil and surrounding air, and
- extreme changes in humidity and soil moisture.

Planting between rows of tall growing species, such as sudax and lupins, helps create the right type of micro-environment for the establishing orchard. If such a groundcover is established for two years it can fill a critical role while tree canopies grow big enough to provide their own micro-environment. Sudax has been used successfully for this purpose in establishing avocado orchards. A leguminous species will also add significant amounts of nitrogen to the soil. These high-bulk covercrops can be mown, and mulch directed along the tree row by side-discharge attachments.

### Reduce mowing

Regular mowing of orchards is expensive. Permanent low growing groundcovers require less mowing. Grazing animals in established orchards is another option, but requires special management and consideration of food safety risks for animal manures.

### Reduce soil compaction

The constant passage of orchard machinery between tree rows causes soil compaction. Penetrometer readings greater than 4 MPa have been recorded in mature macadamia orchards at 30 to 40 cm soil depth. Values greater than 2MPa are known to be detrimental to root growth and function of plants. This can affect tree health after a number of years.

Raindrop impact from intensive rainfall on bare soil along the tree row causes surface sealing. It may also contribute to compaction and other degradation in the long term. Adverse effects include loss of soil structure, restricted root penetration, reduced water penetration and reduced soil aeration essential to root growth and beneficial micro-organisms.

**Table 1. Amount of nitrogen fixed—range under varying conditions**

Species	Nitrogen (kg/ha/yr)
Clovers	20–600
Glycine wightii	250–400
Vetch	50–200
Lupin	130
pigeon pea	40–90
cowpea	70–240
soybean	20–120
peanuts	40–100

Permanent low-maintenance groundcovers reduce the need for machinery in the orchard and alleviate compaction. Groundcovers also help rejuvenate compacted soils. Local trial work found reduced compaction at 0–10cm soil depth after 3 years.

### Provide a suitable harvest surface

In nut crops, a permanent low growing groundcover under trees helps to reduce soil erosion and provides a good surface for mechanical harvesters to recover fallen nuts.

However, care must be taken to ensure groundcover is kept short with a mulcher between harvest rounds to maximise nut recovery.

## COVERCROPS FOR THE PRE-PLANTING PHASE

Green manure crops are grown to provide organic matter, which is incorporated in the soil when the crop is mature. They are an important part of the pre-planting stage of some tropical fruit orchards. High bulk annual legume species include lablab, cowpeas, and lupins. Non-legumes such as oats and sorghum have also been used for this purpose, but unlike legumes they do not provide the bonus of nitrogen fixation. If they are used for at least one year before planting they can build up organic matter levels and improve soil structure and fertility.

### Summer-growing groundcovers

High bulk annual summer-growing groundcover legumes ideal for this purpose include:

- Caloona cowpeas
- lablab

- soybeans
- silverleaf desmodium
- siratro
- mungbeans and pigeon peas, either alone or with hybrid forage sorghum, to provide higher bulk and a better carbon:nitrogen ratio.

### Winter-growing groundcovers

Suitable winter-growing groundcovers include

- lupins
- Namoi woolly-pod vetch
- oats
- ryegrass.

Oats and ryegrass can be used with lupins, or on their own as a suitable first coloniser in very poor soils. Namoi woolly-pod vetch has been used successfully as a covercrop to stabilise slopes, which have been cleared in autumn for banana planting the following spring.

### Preparation

Seedbed preparation varies according to:

- slope of the land and potential for erosion
- physical status of the soil
- mix of groundcovers
- probability of heavy rains
- level of grass regeneration. Pre-emergence herbicides can be used if competition from weeds is expected.

**On level land**, if only one green manure crop—such as a summer legume—is used before planting the orchard in autumn, it might be appropriate to use a full preparation of ploughing, discing, levelling and row mounding, if required (see Agnote DPI 331) before planting.

**On steeper slopes**, when heavy rains are likely, it is wise to use a registered herbicide to kill grass and then direct drill the seed. However, competition from regenerating grass such as kikuyu can reduce the stand of some species unless selective follow-up herbicides are used.

### Fertiliser

Where covercrops are planted after a previous crop that has been highly fertilised, additional

fertiliser might not be necessary at planting. Use molybdenised superphosphate for legumes at sowing. Molybdenum is then only necessary once every four years.

### Grass:legume combinations

For high bulk, extra production can be obtained by combining grasses like forage sorghum and oats with legumes like lablab or lupins. The legume produces nitrogen to be used by the grass. Reduce the seeding rates for combinations by about half.

## PERENNIAL AND BIENNIAL GROUNDCOVERS

Perennial groundcovers provide long-term cover and they are particularly useful in established orchards. They need to grow no higher than 30cm and provide continuous year-round ground cover. This protects the soil and contributes to fertility through its breakdown products.

Legumes are favoured as groundcovers because of nitrogen fixation. However, pure stands do not occur in nature because grass invasion uses the nitrogen fixed by the legume. NSW Agriculture trials (1996-2001) found smothergrass (*Dactyloctenium australe*) was the best groundcover in macadamia orchards. It grew well in heavy shade as well as high light. Amarillo peanut (*Arachis pintoii*) was the best legume.

Planting material is commercially available for only a limited number of low-growing perennial species suited to the subtropics.

### Some favoured species

**Amarillo peanut and hybrid peanut.** Amarillo peanut is suited to most orchards. A spring-summer grower, it maintains live groundcover all year. The dense stoloniferous growth forms a thick mat up to 20cm deep, which suppresses weeds, is competitive with grasses, fairly tolerant to shading and hardy in tropical conditions.

In crop species sensitive to competition — such as bananas—Amarillo peanut tends to be too competitive unless suppressed along the row (see Agnote DPI 332).

**Smothergrass** is the most shade-tolerant grass currently available and is the best species for

mature macadamia orchards. It is planted from runners and spreads quickly, choking out other species. It forms a dense mat as a mown sward. Care should be taken to keep it mown short in the harvest season to maximise nut recovery by mechanical harvesters. Avoid competition with young trees by maintaining a bare area around the trees (see Agnote DPI 382).

**Bahia grass** (*Paspalum notatum* cv. Competidor) is a useful shade grass, which tends to be slow to establish and is slow to spread. **Broadleaf paspalum** (*Paspalum wettsteinii*) is a taller growing species suited to shade.

**White clover** (*Trifolium repens*). Several cultivars including Haifa, Grasslands Huia (New Zealand), and Kenya white (*Trifolium semipilosum* cv. Safari) are suitable groundcovers. These form a dense mat of creeping stolons up to 20cm high. They do not tolerate shade and require irrigation in winter-spring to maintain growth. The clovers tend to be short-lived in our subtropical environment and may need periodic oversowing. Kenya clover (cv. Safari) is more tolerant of grass competition.

**Maku lotus** (*Lotus pedunculatus*) forms a dense mat up to 30cm high with shallow-spreading rhizomes below ground. It is spring and summer dominant, tends to be dormant in autumn-winter, tolerates shading more than clovers, is tolerant of acid soils with high aluminium, and appears well suited for the orchard situation (see Agnote DPI 333).

**Lotononis** is a creeping perennial, which forms a dense mat up to 30cm high with dominant growth in spring and summer and tends to remain green through winter. A reasonably good seedbed is required to assist its slow establishment from small seed, but it will tolerate acid soils. As with clovers, a disadvantage could be its spring flowering when it coincides with orchard crop flowering, causing competition for bees. Seed is expensive.

**Joint vetch** (*Aeschynomene falcata* cv. Bargoo) has slender stems from a crown with a strong tap root. It is mainly a summer grower up to 20cm high and competes well with summer grasses.

**Namoi woolly-pod vetch** is an annual, which can re-establish the following year and shows some promise for use in established banana

plantations. Its seasonal habit of summer dormancy reduces competition with bananas when water is limited.

Because good moisture and milder temperatures favour establishment of most of the legumes listed, they should be planted in autumn on the North Coast of NSW. However, Amarillo peanut and the grasses are planted with adequate moisture in late spring-summer. Ryegrass or oats can be planted with the autumn-planted species to give early cover.

The Species Sowing Guide on pages 6 and 7 forms a comprehensive summary of groundcovers for subtropical orchards.

## MAINTENANCE

Part of the strategy in using low-growing groundcovers is to reduce orchard mowing and herbicide application. Once established, they can be slashed as required to reduce accumulated bulk and to help cultural operations in the orchard.

It is desirable to avoid slashing in late summer (except in bearing macadamias) in order to:

- encourage re-seeding
- ensure sufficient groundcover
- protect the soil in the wet season
- reduce weed growth in winter/early spring.

The groundcovers outlined in this Agfact have been selected because they do not have a vigorous climbing habit. Spreading on the ground can be effectively controlled with strategic applications of glyphosate or paraquat spray around the trees—if registered for use in that tree or vine crop—to make harvesting easier or control growth near the tree trunk. Care should be taken to avoid spray contact with the tree.

## USING GROUNDCOVERS FOR MULCHING AND MOUNDING

Mulching is an important part of good orchard management and long-term groundcovers can provide bulk in summer for mulching along tree rows in young orchards. Legumes provide material with high nutrient value and a balanced carbon:nitrogen ratio, which could be used alone or boosted by other mulch materials with

## SPECIES SOWING GUIDE

The following groundcovers are useful for orchards and plantations on the North Coast of NSW. They include high bulk species suited to the pre-plant or early establishment phase, and

lower growing perennials to provide permanent legume cover. Seed of these species is available commercially, unless otherwise indicated.

### Groundcovers for spring/summer (October to January) planting

what to sow	rate kg/ha	approximate seed cost 2003 \$	fertiliser	remarks
<b>High bulk species annual legumes</b>				
Lablab	30-40	65-130	500kg/ha Mo super at sowing	Ideal before planting orchard. Disadvantage is tendency to climb over young trees when planted in orchards.
Caloona cowpeas	60	130	-	Ideal non-climbing summer legume
Soybean	60	65	500kg/ha Mo super at sowing	Can be harvested for grain. Diseases can be a problem when wet.
Glycine	8	110	500kg/ha Mo super at sowing	Perennial, adapted to frost-free red soils. Climbing plant also.
Siratro	5	110	500kg/ha Mo super at sowing	Less bulk, but more persistent than glycine. Climbing plant also.
Amer. Jointvetch cv Glenn	5	40	500g/ha Mo super at sowing	Erect summer grower to 2m tall. Suit interrows in establishing orchard.
<b>grasses</b>				
Setaria (various varieties)	3-4	50-65	200kg/ha MAP at sowing	Perennial. Makes ideal mulch when slashed. Topdress with 100 kg/ha urea. Forms tussocks. Difficult to mow.
Hybrid forage sorghums	20	90	200kg/ha MAP at sowing	Early sowing preferred. Regrows after mowing. 50-100 kg/ha urea topdress after second mow.
Millett - Japanese	20	40	200kg/ha MAP at sowing	Sown earlier in spring than sorghums.
Broadleaf paspalum	5	40	200kg/ha MAP at sowing	Perennial shade tolerant. Year round grower. Summer dominant.
<b>Lower growing species biennial/perennial legumes</b>				
Amarillo peanut	20-25	400-500	500kg/ha MO super at sowing	Persistent perennial. Compatible with grasses. Shade-tolerant. Competes with bananas if grown near stems.
Shaw vigna	5	250	500kg/ha MO super at sowing	Compatible with grasses, slow to establish. Allow to reseed.
Bargoo jointvetch	3-4	120-150	300kg/ha MO super at sowing	Competitive summer grower suited to poor acid soils. Seed scarce.
Wynn cassia	5	90	500kg/ha MO super at sowing	Seed available Queensland. Dormant in winter. Allow to seed in autumn to regenerate in the following spring.
<b>grasses</b>				
Bahia grass cv Competidor	5	60	200kg/ha MAP super at sowing	Perennial. Persistent. Fairly shade-tolerant species. Slow to establish and spread.

<b>What to sow</b>	<b>rate kg/ha</b>	<b>approximate seed cost 2003 \$</b>	<b>fertiliser</b>	<b>remarks</b>
Smothergrass	turf/runners	-	200kg/ha MAP at sowing	Persistent, shade-tolerant spreading perennial. May be competitive with young trees. Grown from runners.
Shadegro®	5	500	200kg/ha MAP at sowing	Perennial shade-tolerant. Less spreading than smothergrass and not as persistent. Seed
expensive. Microlaena cv wakefield	5	not available	200kg/ha MAP at sowing	Perennial shade-tolerant soft native. Less spreading than smothergrass.
<b>other species</b>				
Dichondra repens	5	275	200kg/ha MAP at sowing	Very low growing. Slow to establish. Moderate shade tolerance. Insufficient cover for steeper slopes.

## Groundcovers for autumn/winter (March to June planting)

### High-bulk species

#### legumes

Sweet lupin or NZ blue lupin	60-90	50-80	500kg/ha Mo super at sowing	Slash/turn under at the end of flowering.
Namoi woolly-pod vetch	40-50	120-150	500kg/ha Mo super at sowing	Establishes quickly in autumn. Provides good cover to 50cm high. Dies off in summer.

#### grasses

Oats	90-130	130-180	300kg/ha MAP Topdress with 100kg/ha urea	Establishes quickly. Use lower rates when sowing with a perennial legume. Regrows after mowing. Topdress with urea after for bulk.
mowing Rye - annual	30	100	300kg/ha MAP Topdress with 100kg/ha urea	Establishes quickly. Use lower rates when sowing with a perennial legume. Regrows after mowing. Topdress with urea after for bulk.
mowing Rye - perennial	30	200	300kg/ha MAP Topdress with 100kg/ha urea	Establishes quickly. Use lower rates when sowing with a perennial legume. Regrows after mowing. Topdress with urea after mowing for bulk.

#### low-growing perennial legumes

White clover Haifa	4	50-100	500kg/ha Mo super at sowing	Can also be sown spring. May need periodic oversowing. Companion grasses must be kept short.
White clover Kenya	4	200	500kg/ha Mo super at sowing	Declines in winter. Slow to establish. Manage carefully in the first year.
Maku lotus	4-5	120-150	500kg/ha Mo super at sowing	Slow to establish. Stays green in winter.
Lotononis	1	N/A	500kg/ha Mo super at sowing	Suits sandy soil

Mo super: molybdenised superphosphate  
MAP: monoammonium phosphate

#### NOTE:

Generally, sowing rates are higher than those normally recommended for pasture.  
Before buying seed, check its quality and that it is certified.  
Inoculate all legume seed with the correct inoculum.  
Consult your local seed merchant for the best varieties for your area.

groundcover and place cuttings along the tree row.

Low-profile mounding of tree rows, stabilised with low-growing groundcovers, is an important management tool to assist drainage, divert excess water to the interrow and reduce erosion in orchards.

## DISEASES AND PESTS

While groundcovers offer obvious advantages for improving soil or microenvironment in the orchard, there are some groundcover species that can harbour pests and diseases detrimental to orchard crops.

Orchard crops such as citrus, grapes and bananas are sensitive to nematodes and should not be planted to a groundcover that encourages nematodes. For example, cowpeas, lablab and lupin are susceptible to some root knot, root lesion, and burrowing nematodes. Amarillo peanut does not harbour nematodes.

Diseases such as rusts and leaf spots can be a problem in groundcovers, so it is important to determine the susceptibility of orchard species to such diseases before selecting a groundcover.

Pests such as grasshoppers, heliothis, caterpillar, and monolepta beetle can be attracted to, or harboured in, some groundcovers. Vermin problems can be associated with rank growth over long periods.

### ALWAYS READ THE LABEL

Users of agricultural or veterinary chemical products *must always* read the label and any permit, before using the product, and strictly comply with the directions on the label and the conditions of any permit. Users are not absolved from compliance with the directions on the label or the conditions of the permit by reason of any statement made or not made in this publication.

## FURTHER INFORMATION

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For more information, contact your NSW Agriculture District Horticulturist or Department of Land and Water Conservation officer.

See also:

Agfact H1.3.8 *Mulching tree and vine fruits on the north coast.*

Agnote DPI-332 *Amarillo peanut – a perennial orchard groundcover.*

Agnote DPI-333 *Maku lotus – a legume groundcover for subtropical orchards.*

Agnote DPI-331 *Reducing soil erosion and other soil degradation in macadamia orchards.*

Agnote DPI-382 *Sweet smothergrass – a perennial groundcover for subtropical orchards.*