This pamphlet is intended to help North Coast farmers to protect their soil against erosion, compaction, acidity and nutrient decline.

PREVENTING SOIL EROSION

- **Avoid cultivating steep slopes.** Cropping is best restricted to the flattest available sites, as the risk of soil erosion increases dramatically when slopes exceed 10% (6°). Slopes greater than 20% (9°) should never be cultivated.

- **Avoid cultivating through natural drainage lines.** This can result in soil erosion and the development of gullies. Natural drainage lines in a cultivation paddock are best kept in a grassed condition for the safe disposal of stormwater run-off.

- **Retain crop stubble** on the soil surface as a mulch to protect the bare soil from erosion after harvest. Fitting a trash chopper or straw spreader to the header at harvesting helps to produce a more evenly spread blanket of crop residue on the soil surface.

- **Double crop** to protect the soil from erosion. This involves growing a summer and a winter crop in each cropping year. By sowing a winter crop such as oats into the stubble of a summer crop such as soybean, growers can ensure there is enough groundcover to protect the soil from erosion throughout the year. The North Coast region is fortunate to have a climate which is suited to double cropping.

- **Direct drill** sowing of crops and reduced tillage helps to maintain soil structure, allowing good soil drainage which subsequently reduces stormwater run-off and soil erosion.

- **Erosion control earthworks** such as graded banks are sometimes needed to prevent soil erosion in cropping paddocks. However, in most situations, soil erosion can be prevented by the practices previously recommended in this pamphlet. The control of stormwater run-off is very important in controlling soil erosion wherever bare soil is exposed and unprotected. Professional advice on the design and layout of graded banks and waterways is available from the soil services section of the Department of Lands.

**The stubble of the previous crop protects the soil from erosion.**

**Drainage lines are best left undisturbed and in a natural, grassed condition.**

**A conventionally cultivated crop with erosion that could have been prevented by direct drill sowing.**
PREVENTING SOIL COMPACTION

Reduce the number of soil workings

Excessive cultivation can damage your soil’s structure and result in soil compaction, surface crusting problems, reduced soil moisture storage, and lower yields.

Soil structure refers to the way soil particles are arranged into individual aggregates (lumps), and to the spaces and holes within and between these aggregates. Well-structured soils contain many pores (holes) and spaces in the soil to allow good drainage and aeration, and easy plant root growth. Organic matter is essential for good soil structure as it helps to bind the soil particles together. To maintain good soil structure, you should adopt practices that maintain the levels of organic matter in the soil, and minimise cultivation which pulverises the soil and destroys its structure.

Weed control

Control weeds with herbicides rather than cultivation. The use of herbicides is usually cheaper than cultivation; and soil structure is not damaged.

Seed bed preparation and sowing

Paddocks cropped for the first time. Before sowing the first crop, you may need to:

- remove any tree stumps or other obstructions
- deep-rip compacted soil
- cultivate once or twice to make an even ground surface in the grazing paddock.

Regularly cropped paddocks. Consider the following tillage practices:

- Direct drill a pioneer crop into sprayed-off pasture.
  — If harvesting the pioneer crop, use a straw chopper fitted to the header to produce an even cover of crop stubble (a trash blanket) over the ground
  — Alternatively, graze the crop.
- Deep rip any areas of compacted wheel ruts resulting from a wet harvest.
- Sow the next crop into the trash blanket of the previous crop, using suitable direct drill planter equipment; or
- Aerial sow the following crop into the field before harvesting the first crop. Soybean growers on the North Coast commonly aerially sow a crop of oats or ryegrass into a field of soybeans before harvest. Pasture mixes can also be sown by this method for a pasture phase at the completion of a crop cycle.

Implements for direct drill cropping. Coulter and tyne combinations have proven to be the most successful implements for direct drilling into pastures and stubble on the North Coast. Tyned and non-inverting implements are preferable to discs and mouldboard ploughs when tillage is unavoidable. Tyned implements open the soil up without pulverising it.

Cultivation. If cultivation cannot be avoided, the soil should preferably be worked at the correct moisture content. Cultivating the soil when it is too wet or too dry will damage the soil structure and produce a compacted soil layer.

Heavy clay soils are best cultivated when the soil is dry — avoid cultivating wet soil. If a handful of clay topsoil from mid-cultivation depth can be rolled between your hands into a rod that is less than 3 mm...
in diameter without crumbling, then the soil is too wet to plough.

Light sandy, silty, or loam soils should be cultivated only when there is enough moisture in the soil for a handful of it to be squeezed into a coherent ball, but not enough moisture for the soil to feel wet.

More information on assessing soil moisture for cultivation is available from your local NSW Department of Primary Industries Soil Advisory Officer or District Agronomist.

**Other practices to reduce soil compaction**

Restrict farm machinery and vehicle wheel tracks to designated laneways. Keep farm vehicles and machinery off wet paddocks, and use lighter machinery wherever possible. Sometimes, however, this may be unavoidable when the soil is wet at harvest time.

If compacted soil layers or hardpans are present in your soil, they will need to be shattered by deep ripping the paddock with a suitable tyned implement.

A half tracked header can be used on wet paddocks to reduce damage.

**Increase soil organic matter**

Adequate levels of organic matter need to be maintained in the topsoil to stabilise the soil structure. Soil organic matter helps to bind the soil particles together into aggregates, and is also very important for the retention of soil moisture and nutrients. The following techniques can be used to maintain adequate organic matter levels in the topsoil:

- **Stubble retention.** Crop stubble eventually breaks down to organic matter and nutrients.
- **Pasture phases** are the most effective way of increasing the organic matter levels in a cropped soil. It is recommended that cropping systems on the fragile hill soils of the North Coast include at least a five-year pasture phase which follows a period of no more than three years of double
cropping. On the better soils, the cropping phase can be longer.

- **Green manure crops.** For regular cropping on the rich alluvial soils, growing green manure crops is another way of increasing the organic matter levels in the soil. These crops are usually grown to be slashed and incorporated into the soil to increase the soil’s organic matter content.

- **Direct drill sowing.** Tillage assists the breakdown of organic matter in the soil, so any reduction in tillage will minimise the destruction of the soil’s organic matter.

- **Organic fertilisers,** such as ones based on animal manures, provide another source of organic matter for the soil. The costs of transporting and spreading these fertilisers can sometimes make their use too expensive for areas that are far from suppliers.

**MAINTAINING SOIL FERTILITY**

**Test your soil regularly**

Regular soil testing can help to ensure the correct amount of fertiliser is applied to the soil to satisfy the nutrient requirements of the crop. It also protects the environment by helping to avoid excessive applications of fertilisers. Soil analysis determines the soil’s current levels of nutrients (nutrient status). A full soil test should be done on your soil at least once a year, and preferably before each crop. Leaf analysis can sometimes complement soil analysis by determining the crop’s needs for trace elements.

Fertiliser companies can provide recommendations on fertiliser application rates from soil test results. Also, consult your district agronomist on the nutrient requirements of each crop.

**Soil pH**

Soil pH is important because it affects the availability of the nutrients in the soil to the plants. Most soil nutrients are available to the plants in the pH range of 5–7 (CaCl₂ method). Strongly acid soils (pH less than 5) may require the addition of fine agricultural lime or dolomite to allow better plant uptake of soil nutrients and to avoid aluminium and manganese toxicity. Usually, fine agricultural lime is the preferred liming material. Dolomite is often used when soil test results show that the soil is low in magnesium, as well as being acid. Lime and dolomite are most effective if they are incorporated into the soil. Soybeans have good tolerance to acid soils. However, liming may be necessary for the crops or pastures grown in rotation with soybeans.

Green manure crops, such as sorghum, can be turned into the soil to add organic matter.
Using an annual grass crop (such as winter cereal or ryegrass) or a perennial grass following the soybean crop will capture recycled soil nitrogen and reduce leaching losses of nitrate which contribute to soil acidification.

**Fertiliser applications**

Consult your advisers and fertiliser company on the best way to apply each fertiliser or liming material to the crop. This is because each fertiliser differs in terms of how strongly it is held by the soil and in its potential to damage seedlings if applied incorrectly.

**CROP ROTATIONS**

Crop rotations help to:

- reduce soilborne disease
- improve weed control
- provide more efficient use of the soil nitrogen from legume crops
- increase soil organic matter levels.

Good rotation combinations include summer legumes such as soybeans with winter cereals such as oats and barley, as well as summer cereals such as maize.

Rotations that include both broadleaved crops and cereals or pasture grasses allow the use of a wider herbicide spectrum for better weed control and reduce nitrate losses which lead to soil acidification.

The growing of annual cool-season forage crops and winter grain crops is important for recovering the nitrogen released from the soybean crop residue. These practices help reduce the extent of nitrate losses via leaching and the associated soil acidification.

Pasture phases are an important component in a rotation as they increase the organic matter levels in the soil. On fragile hill soils, a five-year pasture phase is recommended.

**WHAT THE FARMERS SAY**

Geoff Feuerherdt, grain grower, ‘Berriley’, South Tabulam

‘With direct drilling you don’t get the packing and crusting that you can get with conventional cultivation on some soils, and it’s easier to get onto the paddocks for harvesting after wet conditions. The soil structure has definitely been improving since we’ve been direct drilling.

‘We usually soil test a couple of paddocks every year. We do this to help us work out our fertiliser program.

‘We return the crop stubble on our continuously cropped flats to maintain the organic matter in our soils.’

Lime is applied to correct soil acidity.
Stuart Larsson, ‘Mara Seeds’, Culmaran Creek

‘I’ve been direct drilling for some years. We prefer to do it. Ploughing hill country is just not on. The big thing about direct drilling is that you’ve got so much control over soil erosion and weeds. It is also a lot quicker than the conventional approach.

‘We grow soybeans for 3–4 years, and then go back into pasture for 4–5 years.’

FURTHER INFORMATION

Further information is available from your local NSW Department of Primary Industries enquiries officer, district agronomist, or soil advisory officer.

Publications

Soil Sense — Soil Information for North Coast Farmers, 2000, NSW Agriculture.

Soil Sense leaflets (various titles) available from NSW Department of Primary Industries.

Pasture and forage crop sowing and management guide (produced twice a year by NSW Agriculture agronomists for North Coast districts).

Agnotes and Agfacts on specific aspects of cropping are available from NSW Department of Primary Industries offices.

For example:

— Agfact P3.3.3, Maize growing
— Agfact P5.2.6, Soybean growing.

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DISCLAIMERS

The information contained in this publication is based on knowledge and understanding at the time of writing (July 2004). 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 NSW Department of Primary Industries or the user’s independent adviser.

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