

SOILWISE

Pocket guide to looking after soils

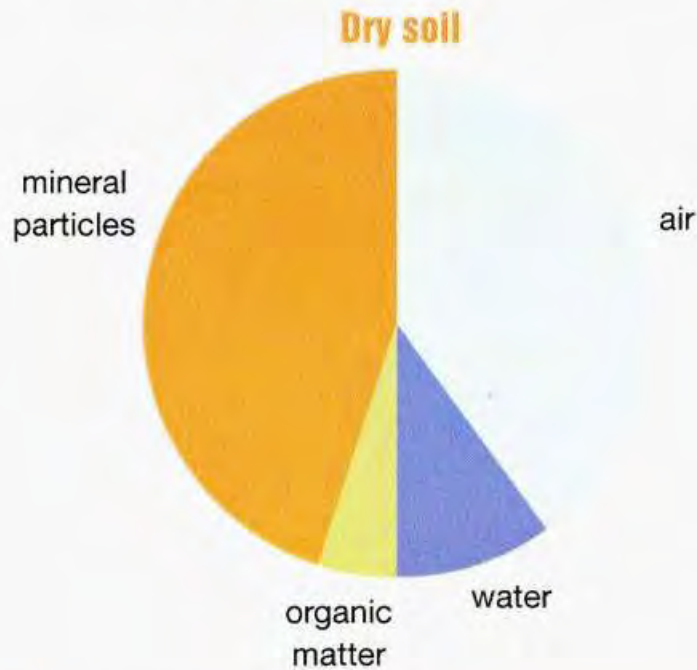


What is soil?

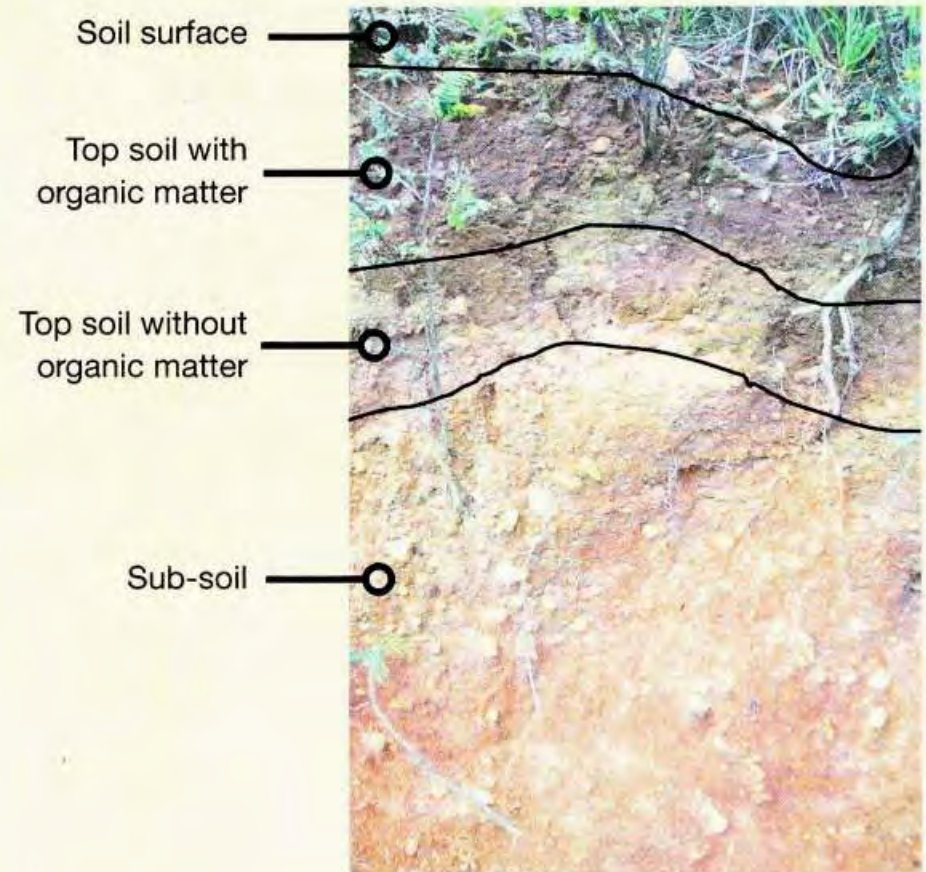
Soil is made up of 5 parts:

- Mineral particles
- Organic matter
- Water
- Air
- Living organisms

The amounts change with different soils.



Soils are found in layers



What is in my soil?

1 Half fill a jar with soil



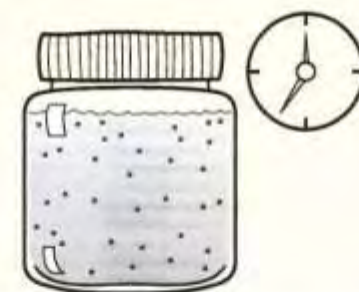
2 Top it up with water



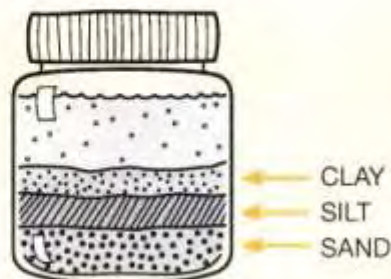
3 Put the lid on and shake well



4 Leave for a few hours



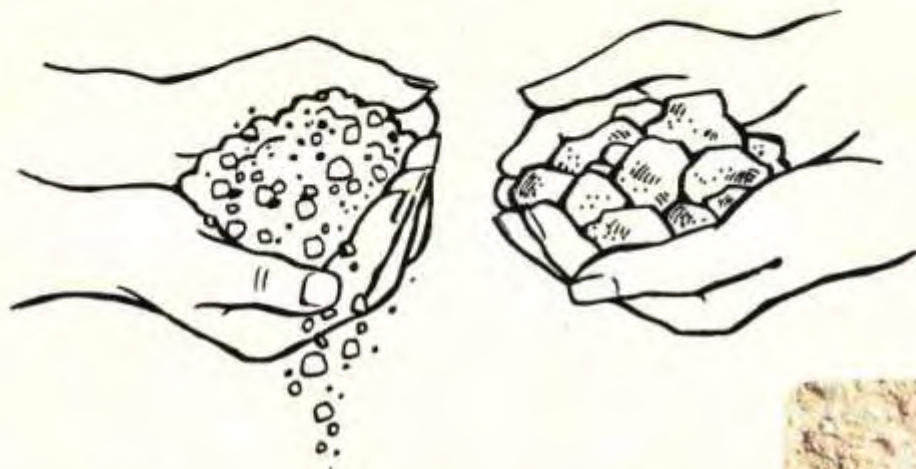
Soil particles settle in the following order: sand, silt and clay. The heaviest particles are sand and the lightest are clay.



If the water does not clear, clay particles are still floating in it. Brown material floating on the top of the water is organic matter.



What is my soil structure like?



Soil structure is the way soil is held together.

Good structure helps plants grow and holds enough water.



Cultivation equipment

Rotary hoe



These are used to incorporate material into the soil and prepare the bed.

Disc plough



These break up soil by inverting it to bury weeds and crop waste. Regular use breaks up the soil particles and makes a compact layer under the surface.

Putting air
in soil

Killing
weeds

Keeping good
soil structure

Preparing
for seeds



Soil texture

Finding out what type of soil you have is very useful.

Follow these steps and check the table on the next page.



- 1** Take a small handful of soil.



- 2** Add enough water to make a ball. If you cannot make a ball, the soil is very sandy.



- 3** Feel the ball with your fingers to find out if it is gritty (sand), silky (silt) or sticky/smooth (clay).



- 4** Roll the ball again and with your thumb gently press it out over your first finger to make a hanging ribbon.



- 5** If you can make a short ribbon your soil texture is loamy – a mixture of sand and clay.



- 6** The longer the ribbon the more clay is in your soil.

Soil texture

Soil texture	Ribbon length	How the soil behaves or feels
Sand (S)	Nil	Not sticky, no shape.
Sandy loam (SL)	15–25 mm	Makes a loose lump, feels sandy.
Loam (L)	About 25 mm	Makes a thick ribbon. It will easily form a ball and has a smooth spongy feel. Greasy to touch if organic matter is present.
Clay loam (CL)	40–50 mm	Very sticky and forms a smooth ball; smooth when shaping.
Light clay (LC)	50–75 mm	Very easy to shape and feels very smooth; you can break apart the ball of soil. You can easily shape the ball of soil into a rod. The rod can be made into a ring without it cracking.
Light medium clay (LMC)	75–85 mm	Forms a well-shaped ball; smooth to touch. It is hard to break apart the ball. You can easily shape the ball of soil into a rod. The rod can be made into a ring without it cracking.
Medium clay (MC)	Greater than 75mm	Forms a smooth well-shaped ball. The ball will not break apart and acts like plasticine; can be made into rods without cracking.
Heavy clay (HC)	Greater than 75mm	Forms a smooth, very well-shaped ball. The ball will not break apart. Easily made into rods. The rod does not break when forming a ring. Acts like stiff plasticine. Very sticky and strongly glues together.

Cultivating soils

Cultivation equipment

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Deep ripper



These are used to break up deep compacted layers.

Chisel plough



These are used to shatter but not turn the soil in the top 30 cm.

Cultivation equipment

Rotary hoe



These are used to incorporate material into the soil and prepare the bed.

Disc plough



These break up soil by inverting it to bury weeds and crop waste. Regular use breaks up the soil particles and makes a compact layer under the surface.

Putting air
in soil

Killing
weeds

Keeping good
soil structure

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for seeds



The cultivation test

If you can do this with your soil it is too wet to work.



✓ Advantages

- Controls weeds, some pests and diseases
- Mixes in organic matter, manures
- Prepares growing beds for seeds or seedlings
- Breaks up crusts and clumpy soils

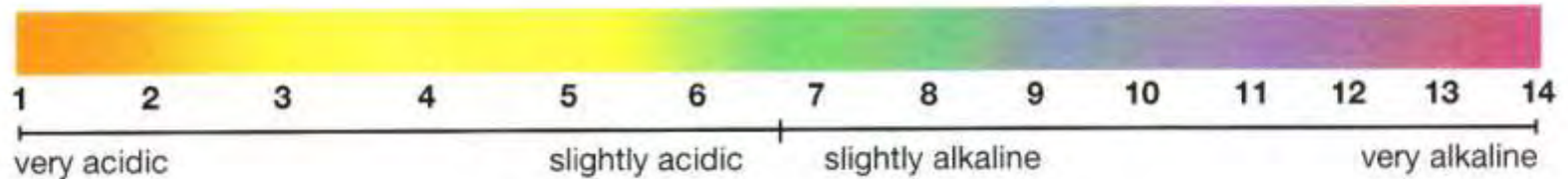
✗ Disadvantages

- Breaks down soil structure
- Compacts the soil under the surface
- Reduces soil organisms

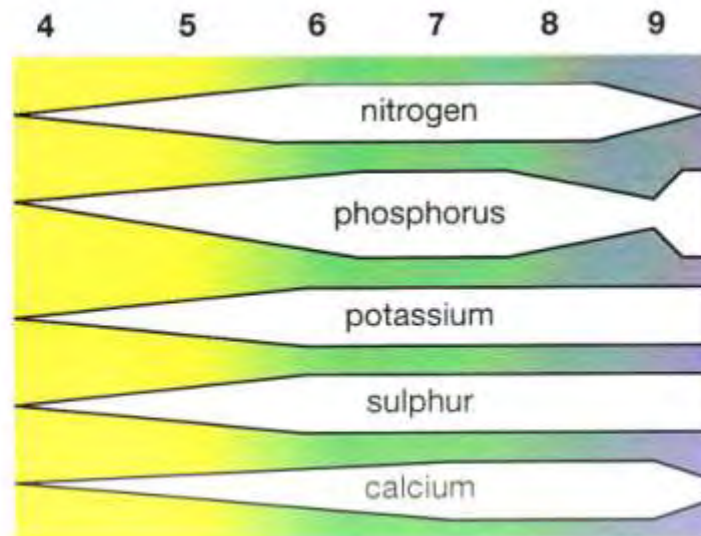
What is soil pH?

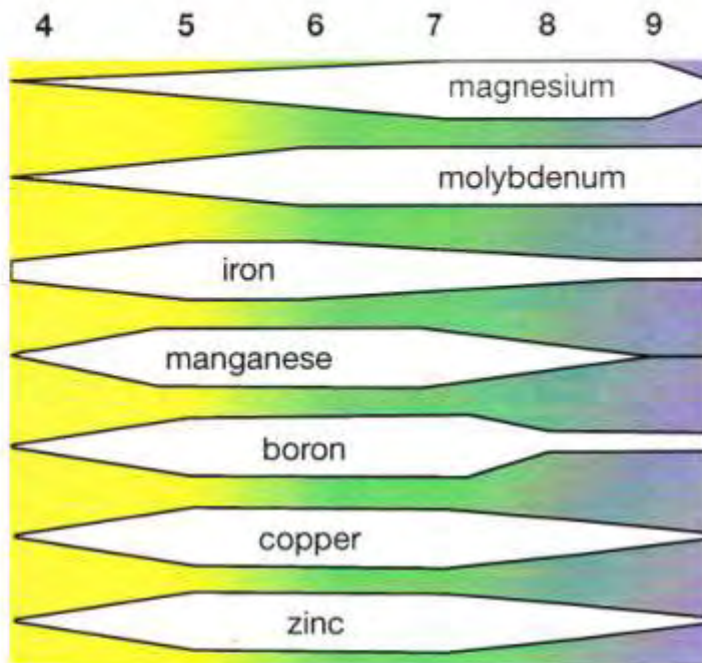
Soil pH is a measure of the acidity or alkalinity of soil.

The pH scale is divided into 14 points, 7 is neutral, above 7 is alkaline, below 7 is acid.



The availability of plant nutrients is affected by pH. Most nutrients are available to plants in the pH range 6.0 – 7.0





Best pH for....

Tomatoes, cherry tomatoes	5-7
Beans, peas, snow peas	6-7
Cabbage type crops, broccoli, chinese cabbage	5-7
Leafy herbs	5.5-6.5

Measuring soil pH



For best results take a number of samples from different places in your soil and mix together. The soil should be taken from 5-10 cm down.



1 Mix $\frac{1}{2}$ teaspoon of soil with 2 drops of indicator to make a paste.



2 Dust with white barium sulphate powder.



3 Compare the colour of the powder with the colour chart.



How to change the pH of your soil

Raising pH (make it more alkaline)

To raise the soil pH you need to apply **lime**. You can use **agricultural lime** (calcium carbonate) or **dolomite** (calcium and magnesium carbonate). The rate that you use depends on the soil type. The following rates (g/m²) will raise the pH of the top 10cm of soil by 1 pH unit.

Soil texture	pH 4.5-5.5 grams/m ²	pH 5.5-6.5 grams/m ²
Sand, loamy sand	110	85
Sandy loam	195	130
Loam	240	195
Silty loam	320	280
Clay loam	410	320
Organic soil	790	680

Mix this amount into the soil before planting the crop. The soil pH will only change slowly.

Lowering pH (make it more acid)

If your soil is very alkaline (above 7.5) it is very costly to lower it. For soils that are neutral or slightly alkaline (7.5 or below) add sulphur at

- 25g/ m² for sandy soils,
- 50 g/ m² for loams and
- 100 g/m² for clay soils.

This application should reduce soil pH to 6-6.5.

How to test the amount of Nitrogen (N) in the soil

You should test for the amount of Nitrogen already in the soil before you plant or sow a new crop. There could be enough N left over from the previous crop to let the new crop grow for a while. Nitrogen is in the soil in a form called nitrate (NO_3^-). The plant takes up NO_3^- through the roots as it grows.

Quick Test for Soil nitrate

The Quick Test is reliable and inexpensive soil test that can be done on-farm to check soil nitrate (NO_3^-) nitrogen levels.

You will need to use **Meckoquant® Nitrate Test Strips**, made by MERCK. You can get these by calling MERCK on 1800 335 571 and ask to order Nitrate test strips 1.10020.



1 Collect a cup of top soil from 10 different places



2 Put in a bucket and mix well.

3 Put 2 lines on a small clear container 3cm from the bottom and 4 cm from the bottom. Fill the container up to the bottom mark with water.



5 Put the container somewhere where it will not be disturbed and wait until the soil has settled to the bottom and the water on top has cleared.







7 Line up the test strip with the colour chart on the container and compare the colour.

4 Gently add small amounts of soil until the solution level comes up to the top mark. Put the cap on and shake for 10 minutes.



6 Once the sample has settled and a fairly-clear solution is present, dip a Nitrate Test Strip into the solution. Wet both test pads on the strip. Shake off the drips and wait 60 seconds.



	Less than 100 mg/l	You need to use a moderate rate of fertiliser
	100-200 mg/l	Use a low rate of fertiliser
	200-500 mg/l	Do not need to fertilise
	Greater than 500 mg/l	Too much fertiliser already exists and could burn the crop

How to test soil EC



1 Collect a cup of top soil from 5 different places

3 Put 2 lines on a small clear container 3cm from the bottom and 4 cm from the bottom. Fill the container up to the bottom mark with water.



5 Put the cap on and shake for 10 minutes. Leave to settle.



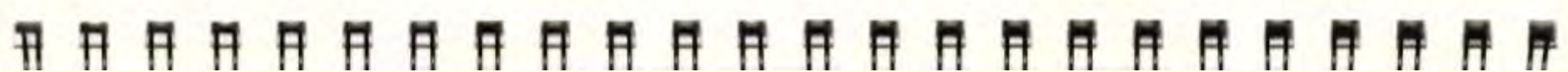
2 Put in a bucket and mix well.



4 Gently add small amounts of soil until the solution level comes up to the top mark.



6 Once the sample has settled and a fairly-clear solution is present, dip an EC meter gently into the solution, but do not disturb the soil. Read off the meter. Check the EC is below the number in the table.



An **EC** of less than 750 μ S/cm (0.75 dS/m) is best.

	EC (dS/m) that begins to decrease crop yield
Peas, Beans	1.0
Lettuce	1.3
Capsicum	1.5
Tomato	2.3
Melons	2.2
Onions, shallots	1.2
Broccoli	2.8
Cabbage	1.8
Cucumber	2.5

1 μ S/cm = 0.001mS/cm = 0.001dS/m

1dS/m= 1 mS/cm=1000 μ S/cm



The root zone is the depth that most of the roots get to.

Checking soil water

Plants need water to grow and they obtain water through the roots.

It is important to give plants just the right amount of water.

Soil type + the crop age + rain and heat = the right amount of water.

How to tell when to water

Using a dig stick

- 1 Look for surface soil dryness and test for deeper soil wetness using a dig stick. This is a pointed steel stick about 1 metre in length.
- 2 Push it slowly into the soil. It should be hard to do this at first, then becomes very easy. The point at which it becomes easy to push in is where the soil becomes wet. So you can measure how deep the dry soil goes.
- 3 Put your finger on the stick to mark the depth and take the stick out. You can see how deep down the wet soil is.
- 4 If this is beyond the root zone of the crop you should water, if not then you can wait a while longer and test again in a few hours.



Push the dig stick in slowly to find the water depth.



Making and using compost

There is no 'one way' to compost. There are many variations in the material available and the equipment available so you have to experiment a little with your own composting.

But here are some basic steps:



- 1 Set aside an area and build some walls to contain the heap 2.5m by 1m is a good size.
- 2 Collect the organic matter you will use.
- 3 Place these in layers mixing the nitrogen rich materials with the carbon rich materials.
- 4 Once all the material is in place, water it so that it is damp but not wet.
- 5 Have a removable cover to protect the heap from excessive rain and drying out.
- 6 Turn the heap every 2 weeks.
- 7 Do not add any more material to this heap, create a new heap for new material.

Useful materials for a compost heap are:

Materials high in carbon

Crop waste – leaves and stems
Straw
Sawdust
Paper
Wood ash

Materials high in nitrogen

Vegetable and fruit waste (from the kitchen or field)
Grass clippings
Flowers
Fresh weeds
Tea leaves
Manures
Blood and bone
Seaweed

The ideal mix is 25 parts of carbon rich material to 1 part of nitrogen rich material by weight.

Using fertilisers

Plants need a good balanced diet to grow well. They need:



Carbon, Hydrogen and Oxygen – these come from the air



Nitrogen Phosphorus and Potassium – the main nutrients from the soil



Sulphur Molybdenum Calcium Magnesium Iron Manganese Boron Copper and Zinc – the minor nutrients from the soil

All of the elements are found in plants in different amounts.

Plants need a lot more of the main nutrients than they do the minor nutrients.

You might need to apply 250 kg of superphosphate each year to supply enough P but only 50g once every 5 years of Molybdenum (Mo).

You need to fertilise to replace what the crop has used and what has leached away.

Some fertilisers replace all the necessary elements and others just supply a few or one. Some fertilisers are only minor element fertilisers. All brands and types of fertilisers have labels which show what they contain.



Replacing Nitrogen

Different crops need different amounts of nitrogen.
Nitrogen can be replaced using the following fertilisers



Note that:

- 300kg of Ammonium nitrate provides 100kg of Nitrogen per hectare
- 710 kg of Calcium nitrate provides 100kg of Nitrogen per hectare
- 770kg of Potassium nitrate provides 100kg of Nitrogen per hectare
- 220kg of Urea provides 100kg of Nitrogen per hectare
- 830 kg of Nitrophoska Blue special provides 100kg of Nitrogen per hectare

To make sure you apply dry fertiliser at the correct rate, follow these steps:

- 1** Make up a shallow flat box, like a tray 1 metre square. That is 1m by 1m with a 5cm or so edge around it.
- 2** Spread the fertiliser as you normally. When you are finished just this bed stop and pick up the tray and weigh the fertiliser in the tray. You can do this using commonplace kitchen scales.
- 3** Compare this amount with the recommended rate. If the recommended rate is in kg/ha divide the recommended rate by 10. This will give the rate in g/m squared.
- 4** If you have applied the fertiliser at the correct rate the amount you weighed would equal the recommended rate.



Fertiliser labels

The % of:
 N- Nitrogen
 P- Phosphorus
 K- Potassium
 That the fertiliser contains

Breakdown of the contents of the fertiliser

Directions on how to apply the fertiliser



Name of the fertiliser

Crop it is used on

Directions on how much to apply

SOIL TEMPERATURE	DOSE PER TONNE
10°C	200kg
15°C	150kg
20°C	100kg
25°C	50kg

AZALEA & CAMELLIA Suggested Application Rates		
INCORPORATED IN SOIL		
SOIL TYPE	100mm	200mm
Very Acidic	1.0kg	1.5kg
Acidic	0.5kg	1.0kg
ON SURFACE SOIL		
SOIL TYPE	100mm	200mm
100mm	2g	4g
120mm	3g	6g
140mm	4g	8g
160mm	5g	10g
180mm	6g	12g
200mm	7g	14g
220mm	8g	16g
240mm	9g	18g

Directions on how to apply the fertiliser

Apply to the soil surface and work into the soil to a depth of 100mm.

Do not apply to the soil surface if the soil is too dry or too wet.

Do not apply to the soil surface if the soil is too hot or too cold.

Do not apply to the soil surface if the soil is too acidic or too alkaline.

Do not apply to the soil surface if the soil is too salty.

Do not apply to the soil surface if the soil is too low in organic matter.

Do not apply to the soil surface if the soil is too low in phosphorus.

Do not apply to the soil surface if the soil is too low in potassium.

Do not apply to the soil surface if the soil is too low in calcium.

Do not apply to the soil surface if the soil is too low in magnesium.

Do not apply to the soil surface if the soil is too low in sulfur.

Do not apply to the soil surface if the soil is too low in zinc.

Do not apply to the soil surface if the soil is too low in boron.

Do not apply to the soil surface if the soil is too low in copper.

Do not apply to the soil surface if the soil is too low in manganese.

Do not apply to the soil surface if the soil is too low in iron.

Do not apply to the soil surface if the soil is too low in nickel.

Do not apply to the soil surface if the soil is too low in cobalt.

Do not apply to the soil surface if the soil is too low in selenium.

Do not apply to the soil surface if the soil is too low in molybdenum.

Do not apply to the soil surface if the soil is too low in vanadium.

Do not apply to the soil surface if the soil is too low in silicon.

Do not apply to the soil surface if the soil is too low in chlorine.

Do not apply to the soil surface if the soil is too low in bromine.

Do not apply to the soil surface if the soil is too low in iodine.

Do not apply to the soil surface if the soil is too low in strontium.

Do not apply to the soil surface if the soil is too low in yttrium.

Do not apply to the soil surface if the soil is too low in zirconium.

Do not apply to the soil surface if the soil is too low in niobium.

Do not apply to the soil surface if the soil is too low in hafnium.

Do not apply to the soil surface if the soil is too low in tantalum.

Do not apply to the soil surface if the soil is too low in tungsten.

Do not apply to the soil surface if the soil is too low in rhenium.

Do not apply to the soil surface if the soil is too low in ruthenium.

Do not apply to the soil surface if the soil is too low in rhodium.

Do not apply to the soil surface if the soil is too low in palladium.

Do not apply to the soil surface if the soil is too low in silver.

Do not apply to the soil surface if the soil is too low in cadmium.

Do not apply to the soil surface if the soil is too low in mercury.

Do not apply to the soil surface if the soil is too low in thallium.

Do not apply to the soil surface if the soil is too low in lead.

Do not apply to the soil surface if the soil is too low in bismuth.

Do not apply to the soil surface if the soil is too low in polonium.

Do not apply to the soil surface if the soil is too low in astatine.

Do not apply to the soil surface if the soil is too low in radon.

Do not apply to the soil surface if the soil is too low in francium.

Do not apply to the soil surface if the soil is too low in radium.

Do not apply to the soil surface if the soil is too low in actinium.

Do not apply to the soil surface if the soil is too low in thorium.

Do not apply to the soil surface if the soil is too low in protactinium.

Do not apply to the soil surface if the soil is too low in uranium.

Do not apply to the soil surface if the soil is too low in neptunium.

Do not apply to the soil surface if the soil is too low in plutonium.

Do not apply to the soil surface if the soil is too low in americium.

Do not apply to the soil surface if the soil is too low in curium.

Do not apply to the soil surface if the soil is too low in berkelium.

Do not apply to the soil surface if the soil is too low in californium.

Do not apply to the soil surface if the soil is too low in einsteinium.

Do not apply to the soil surface if the soil is too low in fermium.

Do not apply to the soil surface if the soil is too low in mendelevium.

Do not apply to the soil surface if the soil is too low in nobelium.

Do not apply to the soil surface if the soil is too low in lawrencium.

Do not apply to the soil surface if the soil is too low in roentgenium.

Do not apply to the soil surface if the soil is too low in darmstadtium.

Do not apply to the soil surface if the soil is too low in tennessine.

Do not apply to the soil surface if the soil is too low in oganesson.

How much fertiliser do you need to apply?

Different crops have different fertiliser needs. A soil or leaf tissue test before fertilising is always a good idea. Check the amount of Nitrogen already in the soil. Only apply what is needed.

Crop	Estimated Nitrogen needs N kg/ha	Estimated Phosphorus needs P kg/ha	Estimated Potassium needs K kg/ha
Peas, snow peas	25-30	45	20
Lettuce	50	75	45
Tomatoes, cherry tomatoes	100	30-110	40-130
Asian leafy vegetables*	75	75	75
Raddish, White raddish*	50	50	50
Parsley	60	85	50
Celery	100	30	40
Broccoli	80-120	80-110	30-120
Cabbage	60-85	60-80	30-90
Cucumber	30-40	50-75	60-90
Capsicum	60	50	45

**Also apply poultry manure at 15 cu m per hectare 4 weeks before the crop*

Using Poultry Manure

You can use poultry manure to improve soil structure and supply nutrients.

8 cu m per hectare gives you about **80 kg/ha of N, 50 kg/ha P and 25 kg/ha K.**

This is more than half of the nitrogen for many crops, just need to add a little more N and K at intervals throughout the growing season. This can be done through the drippers or as side dressing. Using more than this will cause soil saltiness.

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