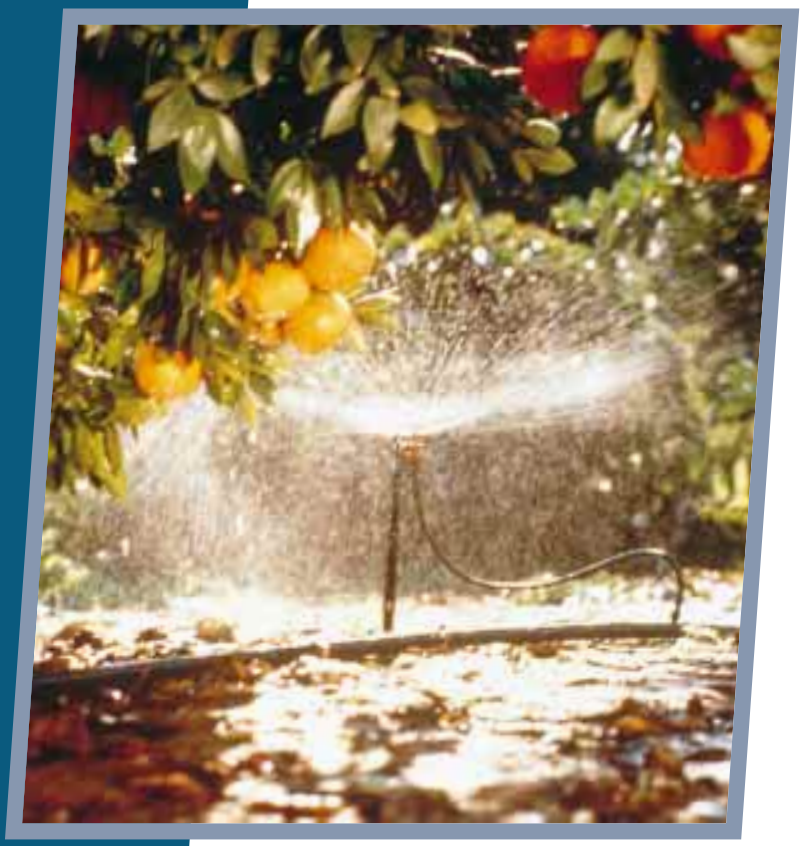
LEAFLET NO.5

The Causes of Soil Acidity



The application of nitrogenous fertiliser with micro irrigation is a common cause of localised soil acidity in horticulture.

SOIL ACIDITY IS A NATURAL PROCESS

Soils acidify naturally as they weather over millions of years. The acidity of any soil varies according to the type of rock it comes from, the length of time it has weathered and the local climate. As a result some soils can be naturally very acidic (low pH) while others are much more alkaline (high pH).

THE RATE OF SOIL ACIDIFICATION INCREASES WITH AGRICULTURAL ACTIVITIES

While many NSW soils are naturally acid most agricultural production systems increase the rate of soil acidification. The reasons for this increased rate can be explained by examining the main causes of soil acidity.

FOUR MAIN CAUSES OF SOIL ACIDIFICATION

The four main causes of soil acidity are:

- removal of product from the farm or paddock
- leaching of nitrogen below the plant root zone
- inappropriate use of nitrogenous fertilisers
- build up in organic matter

Removal of product. Obviously the main aim of any agricultural production system is to produce saleable products. However most agricultural products are slightly alkaline so their removal from a paddock or farm leaves the soil slightly more acidic. The degree of acidification will depend on how alkaline the product is and how many kilograms of product are removed.

Where little actual product is removed from the farm, such as in wool production, the system remains largely in balance. The most acidifying forms of agricultural production are operations such as lucerne hay cutting. For instance the removal of one tonne of lucerne hay requires 70 kg of lime to neutralise the resulting acidity.

Leaching of nitrogen. Leaching of nitrogen in the nitrate form is a very important factor in soil acidity. Nitrate is a major nutrient for plant growth. It is supplied either from nitrogenous fertilisers or atmospheric nitrogen fixed by legumes. When there is more nitrate than the plant can use, the nitrate is at risk of draining - leaching - below the plants roots and into the ground water system. This leaves the soil more acidic.

Leaching of nitrate can happen through inappropriate use of nitrogen fertilisers and is more common in intensive production like horticulture - or because the plants are not at a suitable stage of growth to use the available nitrogen.

Pastures based on annual species, the use of long fallow in crop rotations and heavy applications of nitrogen fertilisers are examples of practices that may increase the risk of nitrate leaching.

Use of nitrogenous fertilisers. The amount of acid added to the soil by nitrogenous fertilisers varies according to the type of fertiliser. The most

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Cutting and removing large quantities of hay — especially lucerne — will increase soil acidity, unless balanced by lime use.

acidifying are ammonium sulfate and monoammonium phosphate (MAP), followed by diammonium phosphate (DAP). Less acidifying are urea, ammonium nitrate and anhydrous ammonia. Fertilisers such as sodium and calcium nitrate are not acidifying.

Superphosphate has no direct affect on soil pH. However, its application stimulates growth of legumes and clovers which fix nitrogen. This increases the amount of nitrate nitrogen in the soil increasing the potential for leaching and consequent soil acidification.

Build-up of organic matter. Over the last 50 years the regular use of fertiliser and improved pastures, particularly subterranean clover, has increased the amount of organic matter in the soil. While organic matter has many beneficial effects including improving soil structure, the increasing amount of organic matter may make the soil more acid.

However, organic matter will not build up indefinitely, and when an equilibrium is reached the acidification process stops.

NB. It is important to differentiate between a natural build up in organic matter and the build up that occurs by adding organic material from another site. Where organic matter build up occurs due to transported material the increased organic matter generally increases pH (less acid).

DIFFERENCES IN FARMING SYSTEMS

Soil acidification rates vary according to the agricultural production system in use.

Cropping. Product removal and nitrate leaching are usually the most significant factors in a cropping system. Build up of soil organic matter and the use of nitrogenous fertilisers are mostly secondary factors. The relative importance of nitrate leaching will depend on the specific pasture / crop rotation. Use of nitrogenous fertilisers and timing of application will be more important in intensive cropping systems with higher inputs of N fertiliser.

Grazing. Nitrate leaching and build up of soil organic matter are the major causes. Product removal in total is usually low and the use of nitrogen fertilisers not applicable. It should be noted that the leaching of nitrate is potentially much less under a perennial pasture than one based on annual species.

Horticulture. Much of the acidity in horticulture is localised around micro irrigation outlets. This is where nitrogen is applied via the watering system. Excess use of nitrogen fertiliser, consequent nitrate leaching and product removal are all major contributors to acidity in horticultural production.

Irrespective of the production system the challenge is to manage the causes of acidity to either slow the acidification rate or neutralise the extra acid through the use of a liming material.

This pamphlet is one of a series on Acid Soil Management prepared for the New South Wales Acid Soil Action Program. It was written by Bill Schumann, Acid Soil Specialist Queanbeyan.

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