Leaving the Garden of Eden:

Soil nutrition linked to yields, frost, diseases

Sometimes we need to wake up and smell the coffee. Successful organic farming is based on building a humus-rich soil with adequate, balanced nutrition. Failure to attend to this leads to declining yields and more vulnerability to frosts and diseases. This article is for those farmers and managers who have observed this first-hand.

By ADAM WILLSON*

Whether you believe Adam bit the apple or we have evolved from hunter-gatherers, the facts remain the same. We have moved away from the best alluvial soils and are now farming more and more marginal land.

Most edible plant species originated from alluvial basins. Traditionally, these soils were very high in stable soil humus, nutrients and mineral balance (the Nile and Tigress catchments are good examples).

Periodic topdressings of floods with colloidal organic matter and minerals resulted in plants rich in nutrition and flavour. I have seen barley crops growing in Tibet that have been fertilised with colloidal minerals from glacial water (the same way for the past 4000 years).

Today many organic farming operations grow crops and pastures on marginal lands. Why, then, do we still see zero-input farming on depleted soils? How can plants and pastures reach their genetic potential without adequate, balanced nutrition?

How can food crops produce the compounds essential for flavour and plant defence if the minerals are not found in the soil? We are living on the oldest continent with a plethora of geologically infertile soils. This has never been the Europe of 200 years ago.

YOUR ACHILLES HEEL

In Homer's Greek mythology classic *Iliad*, Archilles was granted protection by the gods. All his mother had to do was immerse him in the river Styx, but the ankle his mother held did not get immersed. Archilles grew up to become the Greeks' best warrior fighting the Trojans but was eventually killed when Paris' poison arrow hit his unprotected heel.

Every soil (particularly, marginal soils) has an Archilles heel. This characteristic of the soil limits production or leads to crop failure. Two examples come to mind.

Throughout Australia, many soils are devoid of the trace element molybdenum, essential for converting the plant nitrate into protein and fixing nitrogen in legumes. Failure to attend to this can lead to nitrate poisoning in foods, increased insect attack or poor fixation of nitrogen in legumes.

In Western NSW, many soils are wind-blown, high in potassium and low in calcium. In the 1920s, research indicated the Ca:K ratio of the soil directly affected protein and carbohydrate production. For most Australian farmers, potassium is the limiting nutrient. For Western NSW wind-blown soils, calcium is the limiting nutrient.

When soil imbalances are corrected, the plant begins to produce huge amounts of healthy, white feeder roots. This results in increasing yields and pronounced flavours in the food.

ROOT OF FROST DAMAGE

In most crops, frost damage starts long before visible signs occur. Frost damage first occurs when the plant sap cools and begins to crystallise. This commonly occurs in lighter soils (as they dry faster), recently cultivated soil and low-lying areas.

Once this rapid cooling begins, flow of water in the plant stops and cell walls begin to burst from the expanding freezing sap. The temperature at which crystals form inside the plant depends on the type and amount of solids dissolved (solutes) in the sap water.

These solutes in turn are affected by every manager's soil

Leaf exudates coat this early-season nectarine in a first-year organic program. Workers complained their fingers went sticky and black while thinning the crop. This crop produced beautiful, sweet, even fruit.

and plant nutrition program. In order to increase the amount and concentration of solutes, a farmer needs to address the following:

The crop must be grown in humus-rich soil. Humus reduces the daily (diurnal) temperature fluctuations in the soil. As nutrient uptake depends on soil temperature, humus increases the ability of the plant to uptake nutrients.

Every plant releases organic compounds (root exudates) through its roots into the surrounding root zone (rhizosphere). These root exudates help release nutrients and feed the surrounding soil microbes. The more attention a manager puts into adequate and balanced nutrition, the more root exudates will be produced.

As a result of these interactions, plants can absorb many nutrients, amino acids and vitamins from the soil. This adds to the ability of a plant leaf to increase its solute concentration and minimise the effects of frost.

Certain organic foliars dramatically increase leaf solutes when applied with the right wetting agent. They can get into the plant within just four hours and can last for up to 23 days.

PRODUCING RIGHT LEAF SPIT

Apart from the physical barrier of waxy leaf coatings, plants have developed two main ways to defend themselves:

The first is production of specialised disease-inhibiting organic compounds called secondary metabolites. The three main secondary metabolites include terpines, nitrogenous and phenol chemicals, each chemical group playing a certain function. The key to a plant producing secondary metabolites is enzyme production. In order to produce enzymes, certain trace elements must be made available to the plant.

The second major defence mechanism is through production of leaf exudates (leaf spit). Here, plants produce leaf exudates that coat the leaf surface with organic compounds that attract surrounding beneficial microbes. In effect, it provides a protective layer of beneficial microbes around each leaf. There is no need to constantly use compost teas if crop nutrition is correct.

Farmers can minimise leaf diseases in various practical ways:

- Focus on building soil humus levels.
- Ensure adequate, balanced soil nutrition.
- Always chelate calcium to make it bio-available.
- Remember trace elements are essential for enzyme activity.
- Apply organic foliars at the right stage of plant growth.

SUMMARY

Farmers can no longer ignore the practical and financial benefits of paying more attention to balanced, adequate nutrition. Simple changes to crop nutrition have increased vegetable and grain returns by 20%-50%.

Difficult leaf diseases such as Septoria in celery can be eliminated by supplying the right nutrients at the right stage of growth. Complete nutrition is critical to successful organic farming, particularly on marginal lands. It is the future to feeding the world. ■

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