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Strawberry fertiliser guide

Lawrence Ullio

Horticulturist

Intensive Industries (Horticulture), Sydney Markets

Strawberries are grown on a wide range of soil types in New South Wales. Fertiliser programs and soil preparation depend largely on the soil's natural fertility, soil organic matter content and previous cropping history of the site.

Soil preparation

Soil preparation should start 4–5 months before planting. For an autumn planting of fresh runners, land preparation, including discing, fumigation and weed control, should be started by early summer.

Strawberries respond well to a good supply of organic matter in the soil. The sowing of green manure crops, several months before planting, can help improve soil organic matter.

Well-composted animal manure such as poultry manure, applied at 8–10 t/ha several weeks before sowing can be used as a base fertiliser for most green manure crops.

Green manure crops like cowpeas, oats and forage sorghum can be grown for 2–4 months and incorporated back into the soil before they mature. Sufficient time must be allowed for the crop to completely break down in the soil before fumigation and bed formation takes place.

Strawberries can grow over a wide range of soil pH, but do best between pH 6.5–7.0. If the soil pH is below pH 6.00 apply either agricultural lime or dolomite at least 6 months before planting. Dolomite is best used if soil magnesium is low.

Fertiliser program

Pre-planting fertilisers

A soil analysis several months before planting can be used to determine the nutrient state of the soil and help to develop a fertiliser program.

Apply base fertiliser before the final cultivation and thoroughly incorporate into the soil before laying down plastic mulch.

Direct contact between newly planted runners and soil fertilisers can damage roots and reduce essential growth before the onset of winter.

A more recent development is the use of slow release fertilisers. These are best applied during bed formation in a band 10–15 cm below the surface. They can also be applied after planting around the base of plants.

Slow release fertilisers have the advantage of supplying nutrients to the plants at a more regular rate over 3–9 months, allowing more even plant growth and reducing the risk of fertiliser burn.

Supplementary fertiliser

Additional fertiliser may not be needed during the growing season if land has been well prepared and a good supply of pre-planting fertiliser added.

However, in soils of low fertility, or after periods of heavy rain, supplementary fertiliser may be needed, especially nitrogen.

The application of fertilisers along walkways close to the beds or placed in planting holes on plastic mulch around established plants is no longer practised. It can lead to poor nutrient uptake, plant damage from fertiliser toxicity and excess nutrient run-off into waterways.

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Table 1. Soluble fertilisers suitable for fertigation in strawberries.

Product	Analysis	Application rate (kg/1000 plants)	Time	Comments
Urea	46% N	0.4–0.5	Early flowering onwards	Improve fruit size. Reduce at fruiting. Stop if fruit is soft.
Ammonium nitrate	34% N	0.5–0.6	As for urea	Improve fruit size. Stop if fruit is soft.
Sulfate of ammonia	21% N + 24% S	0.9–1.0	As for urea	Corrosive to mild steel
Calcium nitrate	15.5% N + 12% Ca	1.0–1.2	Post flowering and fruit development	Improve fruit colour and firmness. Do not mix with magnesium sulfate.
Potassium nitrate	13% N + 38% K	0.7–0.8	Flowering and fruiting	Assist in maintaining fruit quality and flavour.
Potassium sulfate	40% K + 16% S	0.7–0.8	Fruiting	Assist in maintaining fruit quality and flavour.
Mono -ammonium phosphate (MAP)	22% P + 12.5% N	1.0–1.2	Early in season and after cutting back for second crop.	Improve flower and fruit size. Improve root growth. Apply before cutting back if plants are kept for a second year.
Magnesium sulfate (Epsom salts)	10% Mg + 14% S	0.2–0.4	Pre-flowering	Improve fruit colour and firmness. Do not mix with calcium nitrate.

Fertigation

A more effective way to apply fertiliser to established plants is by fertigation. This is a technique of supplying soluble fertilisers to crops through an irrigation system located under the plastic mulch.

Compensated no leak drip irrigation, a more recent development, has allowed more accurate application of both water and plant nutrients to the plant's root zone. This allows for quicker correction of plant nutrient imbalance during both the growing and fruiting stage of the plant.

Fertilisers should be dissolved in good quality water. Avoid using water with high carbonate levels (hard water), since soluble fertilisers high in phosphate, sulfate or calcium can cause precipitation and block drippers.

A crop specific soluble fertiliser mix is best applied after plants are established and at intervals of 2 to 3 weeks. The fertigation mix may need to change depending on the crop need and seasonal conditions.

It is best to irrigate before and after injecting the disolved fertiliser to assist the movement of nutrients down into the roots zone. Apply at least 0.5–1 L per plant depending on soil type.

Some of the more common soluble fertilisers used in strawberries are in Table 1. Some can be applied alone or in combination.

Other soluble fertilisers include zinc sulfate, iron chelate, boric acid, manganese sulfate and sodium molybdate. These trace elements are best applied after soil or leaf analysis indicates a need for them or when plants show field symptoms of deficiency.

Foliar sprays

Foliar fertiliser sprays can be used on established plants to correct deficiencies identified by leaf analysis or from field symptoms.

If deficiency persists a soil application of the nutrient may prove to be more effective.

There are several commercial blends of complete foliar fertilisers suitable for strawberries. They contain a wide range of essential nutrients that are readily absorbed through the leaves.

Plants under stress, for example during early fruit set and fruit development, can benefit from a foliar fertiliser spray program. Most foliar fertiliser sprays can be used in combination with pesticide however, check the labels of both products before mixing.

Plant analysis

Leaf analysis can be used to identify nutrient deficiencies or toxicities in a crop and help develop or modify fertiliser programs. This service is available from commercial laboratories.

Sample plants when they are actively growing. For a complete analysis collect 30 to 40 of the youngest mature leaves from a number of plants of the same cultivar, place in a paper bag and immediately send the laboratory for testing.

The reliability of leaf analysis results depends on careful attention to sampling.

Results can be interpreted using leaf analysis standards on Table 2.

Early field symptoms can be an early indication of possible nutrient disorders and if confirmed with a leaf testing fertiliser program may need adjusting. Table 3.

Table 2. Leaf analysis standards for strawberries.

Nutrient	Deficient	Adequate	Toxic
Nitrogen (N%)		2.5–3.5	
NO_3–N		<800	
Phosphorus (P%)	<0.1	0.3–0.5	
Potassium (K%)	<1.0	1.5–2.50	
Sulfate (S%)		0.1–0.2	
Calcium (Ca%)	<0.3	1.0–2.0	
Magnesium (Mg%)	<0.2	0.4–0.6	
Sodium (Na%)		<0.3	>0.3
Chlorine (Cl%)		0.1–0.5	>0.5
Copper (Cu mg/kg)	<3	5–10	
Zinc (Zn mg/kg)	<20	30–50	
Manganese (Mn mg/kg)	<30	50–350	
Iron (Fe mg/kg)	<50	70–200	
Boron (B mg/kg)	<25	30–50	
Molybdenum (Mo mg/ /kg)	<0.50	>0.5	

Nutrient deficiency symptoms

Plant nutrient deficiencies or toxicity during the establishment and growing season can have a major affect on fruit yield and quality. Some of the more common plant symptoms of plant nutrient disorders are the following.

Nitrogen is an important nutrient in strawberry growing. During periods of rapid growth, leaves of nitrogen-deficient plants remain small and may turn from green to light green or yellow. Figure 1.

Figure 1. Nitrogen deficiency

In older leaves the leaf stalk reddens and the leaf blades become brilliant red.

Fruit size is reduced, and the calyx around the fruit becomes reddish. Figure 2.

Figure 2. Nitrogen deficiency. Red calyx.

Control

Apply most nitrogen before planting as a soil base application and during the growing season as either foliar fertiliser or by fertigation. Table 1. Applying nitrogen between rows is not effective, wasteful and can easily leach in to dams and waterways.

Phosphorus

The first sign of phosphorus deficiency is a deep green appearance of plants and a reduction in leaf size. As the deficiency becomes more severe the upper surface of leaves develops a dark metallic sheen, while the underside becomes reddish purple. Figure 3.

Figure 3. Phosphorus deficiency.

The fruit and flowers tend to be smaller than normal and the roots are less abundant, stunted and darker.

Control

Most phosphorus should be applied before planting and placed within the root zone. Applying superphosphate after laying plastic mulch in either the planting holes or in the walkways is not effective. Soluble phosphorus fertiliser can be apllied by fertigation.

Potassium

The symtoms of potassium deficiency can be easily confused with those of magnesium deficiency, or with leaf scorch caused by salinity, wind, sun or dry conditions.

Mature leaves show a browning and drying of the upper leaf surface, progressing from the margin to the centre of the leaf between the veins. At the same time the mid-rib section of the leaf becomes dry and darker. These symptoms first appear on lower leaves. Figure 4.

Fruit quality also is affected by low potassium levels. The fruit can fail to develop full colour, be pulpy in texture and lack flavour.

Figure 4. Potassium deficiency with increasing severity with age.

Control

Apply potassium before planting and during early fruit development. A higher rate of potassium should be used in sandy soils and in high rainfall areas. Apply soluble potassium by fertigation after planting. Table 1.

Magnesium

Marginal leaf scorch begins as yellowing and browning of the upper leaf margin, progressing towards the centre of the leaf between the veins. Figure 5.

The basal part of the leaf and the short petiole remain green and turgid, unlike in potassium deficiency. Fruit from magnesium deficient plants appears normal, except that they are a lighter colour and softer in texture.

Figure 5. Magnesium deficiency. Marginal scorch (left) and normal leaf (right).

Control

Apply dolomite several months before planting if soil test results indicate low levels of magnesium and low pH. Apply magnesium sulfate (epsom salts) by fertigation at first signs of deficiency and repeat if needed. Table 1.

A foliar spray of magnesium sulfate can also be used to give immediate relief, but it should be tested on a few plants first. Discontinue at the first sign of phytotoxicity.

The heavy use of potassium fertilisers can reduce the uptake of magnesium by plants.

Calcium

During rapid leaf growth ‘tip burn’ symptoms may appear on immature leaves.The tips of these leaves fail to expand fully and become black. Figure 6.

Figure 6. Calcium deficiency. Leaf tip burn.

Fruit develop a dense cover of seeds, either in patches or over the entire fruit, and develop a hard texture and acid taste (Figure 7). The roots become short, stubby and dark.

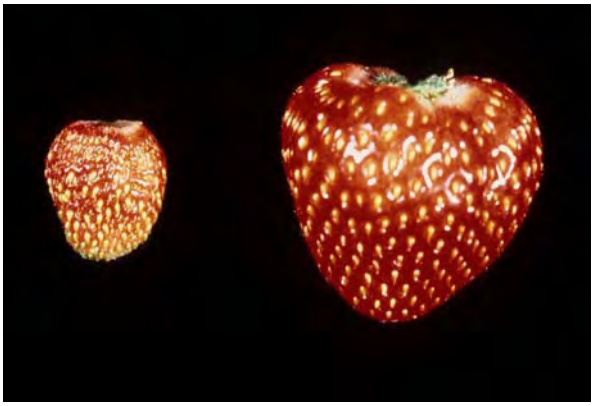

Figure 7. Calcium deficiency. Small fruit with dense cover of seeds (left). Normal fruit (right).

Control

Adjust the soil pH. Apply calcium in the form of agricultural lime or dolomite before planting. Apply calcium nitrate by fertigation or as foliar spray at first sign of deficiency. Table 1.

Table 3. Visual symptoms of nutritional disorders of strawberries.

Symptoms	Possible causes
Leaf symptoms	
Uniform yellowing	nitrogen or sulfur deficiency or poor soil drainage
Yellowing with veins remaining green	zinc, manganese or iron deficiency
Dark green foliage	phosphorus deficiency
Leaf scorch	potassium or magnesium deficiency or salt toxicity
Growing points damaged with restricted growth	calcium or boron deficiency
Fruit symptoms	
Poor pollination (bumpy fruit)	boron deficiency, frost damage or high temperature during flowering
Hard seed	calcium deficiency
Soft, poor colour and flavour	potassium deficiency

Zinc

Zinc deficiency is uncommon in New South Wales. It is easily distinguished by the green ‘halo’ that develops along the serrated margins of young, immature leaf blades.

As the leaves continue to grow the blades become narrow at the base and eventually become elongated with severe deficiency. Yellowing and green-veining occurs. Figure 8.

Figure 8. Zinc deficiency.

The fruit size may appear normal, although the number of fruit is reduced.

Control

Add zinc sulfate or chelate to the fertliser program and apply at planting to soils known to be low in zinc.

The application of zinc as a foliar spray or by fertigation can give immediate relief. However, the use of zinc sulfate as a foliar spray may damage young leaves, flowers and fruit. Discontinue treatment at the first sign of phytotoxicity.

Manganese

The first sign of manganese deficiency is pale greening to yellowing of young leaves.

Figure 9. Manganese deficiency.

As the deficiency progresses, the main veins remain dark green, while the interveinal areas become yellow, followed by scorching and upward turning of the leaf blade margins.

Scorch areas advance towards the centre of the leaf in a series of broad rays extending across the veins. The fruit size can be reduced. Figure 9.

Control

Apply manganese sulfate or chelate by fertigation. Foliar spray of maganese sulfate can give some relief. Avoid spraying at flowering and at heavy fruit set. Discontinue at the first sign of phytotoxicity.

Iron

Yellowing and green veining are the first signs of iron deficiency. As the deficiency becomes more severe, yellowing increases to a point of bleaching and the leaf blades turn brown. Figure 10. Fruit size and quality are not greatly affected.

Figure 10. Iron deficiency.

Control

Alkaline or poorly drained soils can induce iron deficiency. Check soil pH levels. If the pH level is high, cease liming and use acid-forming fertilisers such as sulfate of ammonia.

Apply iron sulfate by fertigation when symptoms first appear. Foliar sprays with iron sulfate or chelate can also be used.

Boron

Younger leaves show puckering and tip-burn, followed by marginal yellowing and crinkling with reduced growth at the growing point. Figure 11.

Moderate deficiency of boron reduces the flower size and decreases pollen production, resulting in small, 'bumpy' fruit of poor quality. Root growth can be stunted.

Control

Apply a foliar spray of boron or add borax to the soil before planting. Boron is toxic to plants and should not be used excessively.

Figure 11. Boron deficiency.

Non-nutrient plant disorders

Strawberry plants can often show field symptoms that are incorrectly attributed to an imbalance of plant nutrients. Often the cause of these symptoms is due to climate, growing conditions, insect pest damage or diseases. Some of these include the following.

Distorted or misshaped fruit

Some of the possible causes are insect damage such as from thrips or Rutherglen bug, poor pollination and frost damage at flowering.

Occasionally early fruit can show strawberry phyllody symptoms (small leaves sprouting around seeds on fruit). Figure 12.

Symptoms can be similar to calcium or boron deficiency.

Figure 12. Strawberry phyllody.

Marginal leaf burn

Possible causes are soil diseases such as verticillium wilt or crown rot, salt damage from the use of saline water or excess fertiliser. Figure 13.

Symptoms can be similar to potassium or manganese deficiency.

Figure 13. Fertiliser burn. Marginal leaf burn caused by excess fertiliser applied to young plants.

Yellowing of leaves

Possible cause is herbicide damage.

Symptoms can be similar to iron, zinc or manganese deficiency

Bronzing of leaf surface

Possible cause is two-spotted mite (red spider) or wind damage.

Symptoms can be similar to potassium or phosphate deficiency.

Albino Fruit

Possible cause is high nitrogen levels and overcast weather during fruit ripening. Figure 14.

Figure 14. Albino fruit.

Symptoms can be similar to potassium deficiency.

Poor pollination

Possible causes are wet or frosty conditions during flowering, lack of bee activity and poor flower movement. Figure 15.

Figure 15. Poor fruit pollination.

Symptoms can be similar to calcium or boron deficiency on immature fruit.

Acknowledgements

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