

N-P-K and Mineral Nutrition of Macadamia During Summer

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Macadamia trees evolved living under the canopy of the once extensive sub-tropical rainforests that were in SE Qld and Nth NSW. Because of competition in this habitat, the Macadamia has adapted the ability to extract soil minerals such as Nitrogen (N), Phosphorous (P) and Calcium (Ca) for survival, even when these minerals are in low supply in the soil.

In nature, these minerals are supplied by organic material falling to the ground from the canopy above, eventually creating a natural organic “mulch” which, in conjunction with the soil, supplied the minerals that Macadamia required. This low-concentration mineral supply came slowly, but constantly, to the tree’s root system. Water and nutrients were more available during summer.

Today, we want our trees to do more than survive – we require them to produce commercially viable quantities of suitable grade nuts. So, they obviously require more inputs than trees living in nature, simply because they are producing more. They already have more light than in the rainforest, and we supply organic and/or synthetic fertilisers.

We have moved Macadamia out of rainforest to areas where climate and soils are not so hospitable.

Growers must compensate for the changes we require from the trees, by managing soils, nutrition, and water supply.

Summer is the time when nuts are already set and kernels growing, eventually accumulating the oil that largely determines value of the harvested kernels. Kernels contain sugars that result from the photosynthetic process, and oil is produced from sugars in the kernel. Any impediment to the production of sugars will impact on kernel size, quality, and oil content.

Water supply – sufficient rainfall and/or irrigation needs to happen during summer for 2 reasons:

1. To prevent moisture stress, so water can move through the tree from roots to leaves, both cooling and bringing nutrients required by both roots and leaves. If leaves get too hot, stomata will close, and photosynthesis will cease. Cessation of photosynthesis will mean suspension of sugar production.
2. Insufficient water supply reduces transport of minerals required from the soil to the roots growing nuts and leaves. Lack of essential minerals will impede photosynthesis.

Minerals required particularly during this period:

Nitrogen – N, is required for production of proteins (enzymes) and photosynthesis. Nitrogen is in demand during spring and early summer, to facilitate nut yield and oil accumulation.

Care must be taken not to over-supply N in late summer to regulate late-summer leaf flush. A flush may demand carbohydrates and nutrients to maintain leaf growth, rather than nut development.

Macadamia can absorb N as both Ammonium and Nitrate. If the soil is acidic, it is less likely to further lower pH by applying Nitrate-N, rather than Ammonium.

Phosphorous - P, is required for energy production, and so essential for oil production. P is also important in cell division. Macadamia is specialised in its ability to tolerate low P levels typical of most Australian soils. P is largely immobile in soil and is taken up when roots grow into soil that contains it. P applied in late summer will support the root flush that normally happens at that time, further promoting uptake of P already in the soil.

Some soils have clays that tightly bind P, to get the best results from applied P in such soil, it is necessary to apply Phosphorous sparingly but frequently, as excess P can result in deficiency of Iron and Zinc.

Potassium – K, required for water balance by regulation of the opening and closing of stomata, and so the movement of nutrients and carbohydrates within the tree. It also involved in enzyme function, effecting protein, starch, and energy production. So K requirement is high during summer for kernel growth and oil accumulation.

K can be applied in different forms. Potassium Sulphate (SOP), Potassium Chloride (MOP) and Potassium Nitrate (NOP) are the most common forms. Both SOP and MOP supply K plus minerals required in much smaller amounts. In dry periods, and periods of reduced irrigation water availability and quality, these excess minerals can accumulate in the soil.

In acidic or saline soils, or where irrigation water in summer is restricted and/or saline, Potassium Nitrate can be a safer K and N source.

Macadamias also require Calcium, (Ca) and Magnesium (Mg) and at least 7 other trace elements.

Calcium - Ca is important for the structure of cell walls, and is important for development of root tips, young leaves, and new shoots. It is also required for activating some enzymes and other purposes. Ca is found attached to soil clays and so absorbed by the root tips.

Ca is often applied either as a slow-release soil conditioner (Lime or Dolomite) or as a slow-release Calcium and Sulphur source (Gypsum). It is also available in various soluble forms, commonly Calcium Chloride or Calcium Nitrate.

Magnesium - Mg is vitally important, part of chlorophyll, the pigment in the plant where photosynthesis happens. Magnesium can also be applied as slow-release fertiliser, in Dolomite and Magnesium Oxide, or as soluble Magnesium Sulphate, Magnesium Nitrate. Dolomite or Magnesium oxide should not be used if soil pH is high or Neutral. Magnesium, like Calcium, should be always available, and can be supplied in small amounts throughout the year, summer included.

The correct balance of Ca and Mg is important to the uptake of both minerals, so soil testing is required to decide how much to apply.

Of the other microelements, the absorption of Iron (Fe), Manganese (Mn), Zinc (Zn), Copper (Cu), is also related to the levels of Calcium and Magnesium in the soil.

Boron - B is also vital for reproduction, and levels should have been sufficient prior to flowering.

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