# Blueberry nitrogen nutrition Part 1: The right nitrogen source

Dr Sophie Parks, NSW DPI

- Blueberry plants like nitrogen in the form of ammonium
- Blueberry plants do not take up more ammonium than they need
- Excess ammonium in the rootzone can become nitrogen pollution in soil run-off

The current NSW Department of Primary Industries (DPI) recommendation for nitrogen fertiliser application is a rate of no more than 100-121 kg of nitrogen (N) per hectare per year on blueberry crops.

This annual rate split into weekly applications, is recommended for a mature planting of fertigated blueberries grown in soil, using a plant density of approximately 3500 plants per hectare. Fertigation is the delivery of fertiliser in solution to the crop via irrigation, and in well-designed systems can direct nutrients into the root zone to meet the demands of plant growth.

The 4Rs approach for plant nutrition is encouraged to improve the nitrogen-use efficiency of this recommended rate. These provide guidance on how to meet the nutrient needs of a plant based on plant requirements and include:

1. *The right source* – the fertiliser type the plant requires
2. *The right rate* – how much the plant requires
3. *The right time* – when the plant requires it
4. *The right place* – where the plant requires it

In this fact sheet we are focusing on the first R, *the right source* of N for blueberries.

**Dr Sophie Parks**

## Blueberry plants have an appetite for ammonium as a nitrogen source

Plants can take up N in the form of nitrate and ammonium. These forms of nitrogen are charged chemical compounds represented by the symbols NO3- and NH4+ respectively.

Most plants prefer nitrate since ammonium cannot be easily stored in plant tissue, however some such as blueberry like ammonium included in their nitrogen fertiliser regime.

Overseas research has shown that blueberry crops perform better when an ammonium source of N fertiliser is used. Similarly, our research in northern NSW showed a small trend of increased plant growth in response to a higher proportion of N being supplied as ammonium, despite all plants receiving the same total amount of N (Figure 1).

A small trend of increased total N concentration in leaves was also observed (Figure 2).

The positive response of blueberry to an ammonium source applied as a foliar spray is obvious in the greener leaves pictured in Figure 3 compared to the red leaves of plants sprayed with water.

However, nitrate cannot be ignored as an N source for blueberry, as uptake of nitrate via roots and shoots has been demonstrated in previous studies.

Research by the NSW DPI Clean Coastal Catchments project is continuing to improve our understanding of blueberry responses to both ammonium and nitrate in evergreen growing systems.

**HOW TO INTERPRET BOX PLOTS:** To create this graph, data are sorted from lowest to highest and separated into four quartiles. In each box, the cross represents the average or mean increase in stem width within each treatment (low, medium or high), in this case for 11 plants. The box contains the middle two quartiles of the observations with the box ends representing the upper and lower quartile measurements for increase in stem width. The ends of the 'whiskers' indicate the highest and lowest measurements, and the horizontal line in the box is the median (middle) measurement for increase in stem width.

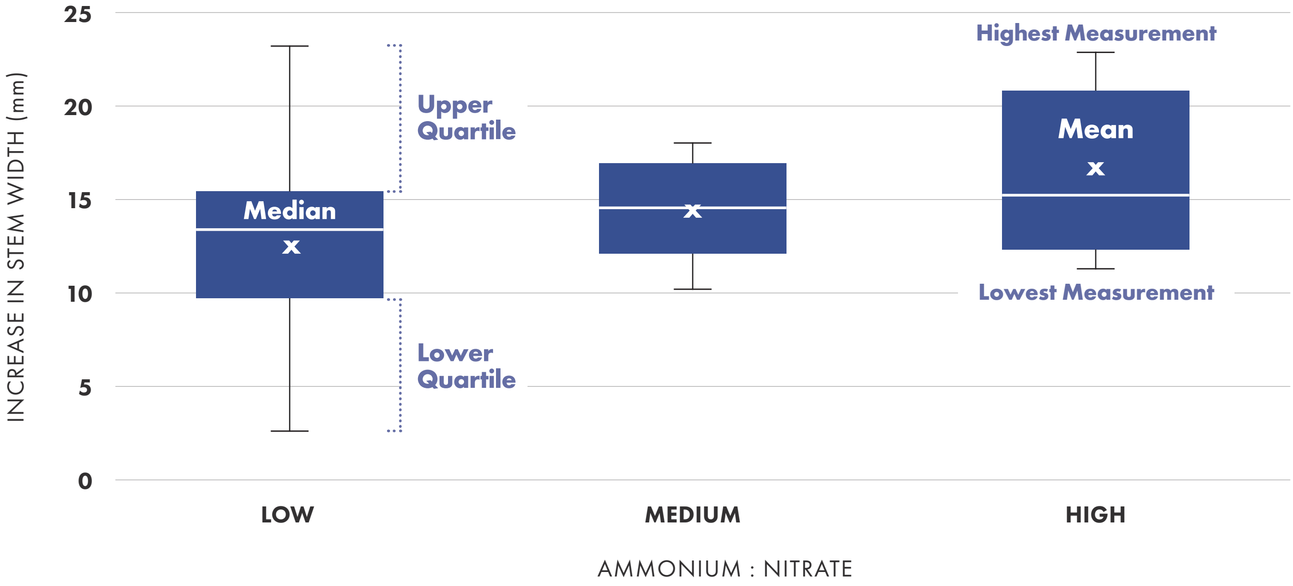


**Figure 1.** Increase in stem width of blueberry plants grown in substrate and fertigated for eight months. All plants received the same rate of total nitrogen but the ratio of ammonium to nitrate in the fertigation was either low, medium or high. Each treatment data set is depicted as a box plot.

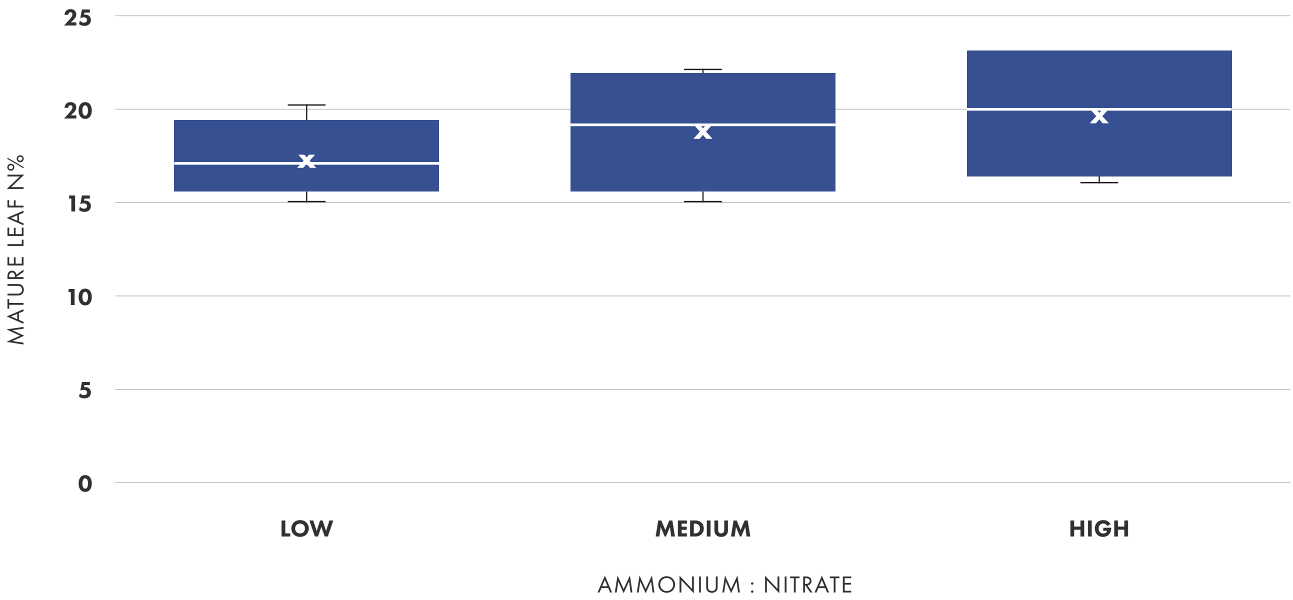


**Figure 2.** Increase in nitrogen concentration in mature leaves of blueberry plants grown in substrate and fertigated. All plants received the same rate of total nitrogen but the ratio of ammonium to nitrate in the fertigation was either low, medium or high. Leaves were sampled from plants in each treatment on 4 occasions over a period of 5 months.

**Figure 3. Effect of ammonium on canopy greening. The plant on the left was sprayed weekly for several weeks with a solution containing ammonium, while the plant on the right was sprayed with water.** Photo credit: Dr Sophie Parks, NSW DPI

## Appropriate sources of ammonium fertiliser for blueberry

Urea is commonly used as a source of nitrogen for fertigated crops and evidence suggests that plant roots can take up urea directly from the root zone solution. Otherwise, urea quickly forms ammonium when broken down or 'hydrolysed' in the soil making it an ideal N source for blueberry.

Urea can also be applied as a foliar spray on the blueberry canopy to alleviate symptoms in nitrogen-deficient plants and current research aims to understand how this practice contributes to nitrogen nutrition generally. However, when applying foliar urea, ensure to select a low biuret grade as biuret is potentially phytotoxic and can cause leaf burn.

Other ammonium fertilisers can be used in fertigation when the crop has demand for sulfur (S) or phosphorus (P). These include ammonium sulfate (sulfate of ammonia) for supplying S and mono ammonium phosphate (MAP) for supplying P. Keep in mind that the proportion of S and P in these fertilisers exceeds that of N, yet the demand by the plant for N will always exceed that for S and P. Therefore, another source of N will be required alongside these fertilisers for optimal plant growth.

Caution is required in the application of these fertilisers since they contribute to soil acidification and ammonium sulfate is the most acidifying of these. Although blueberry plants prefer an acid soil range of pH 4.2-5.5 (as measured in a water and soil solution) based on overseas data, it is recommended that ammonium sulfate be avoided unless soil pH is above 5.0. Regular pH testing is suggested to monitor this important factor.

## Overfertilisation: when ammonium can become nitrate

The key to optimal nutrition is to supply small amounts of fertiliser often when the plant demands it. Imagine if you presented your dog or cat with a month's supply of dinners in the one sitting. Although some pets may try, they would not be able to eat everything, and much of the food would be wasted!

Similarly, research has shown that when provided in excess, a blueberry plant will not take up more ammonium through its roots than it needs.

The danger of doing this is that the remaining ammonium in the root zone can be acted upon by bacteria, undergoing nitrification, a process that "results in the formation of nitrate.

The nitrate formed is unlikely to be taken up by blueberry roots and can easily move down the soil profile with the next rainfall event or irrigation application, contributing to nitrogen pollution in water ways.

Nitrification is also associated with rapid acidification of the soil or substrate, a problem that can reduce the availability in soils of some essential nutrients required by plants.

## Blueberry in potted substrate

For blueberry grown in substrate, nutrient solutions are delivered in fertigation to provide complete nutrition, with little nutrition being provided by the substrate, unlike a soil system. However, we only have a limited understanding of how blueberry plants perform within this type of system. Research is underway which aims to provide appropriate nutrient formulations and production guidelines to optimise nitrogen nutrition, minimise nitrification in the root zone, and enable the reuse of nutrients in leachates from these systems.We are also investigating plant demand for nitrogen and other nutrients on a seasonal basis in the evergreen blueberry crop, to address the right rate and the right time aspects of the 4Rs. Further nutrition guideline fact sheets looking at nutrition rates and timing will be released through the Clean Coastal Catchments project in 2021-2022.

*The Clean Coastal Catchments project is funded under the NSW Government's Marine Estate Management Strategy. The ten-year Strategy was developed by the NSW Marine Estate Management Authority to coordinate the management of the marine estate.*

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