Workflow: Production – Basic Farming Practices

Toolkit 3.5
Plant Nutrition

target audience

Farm managers and supervisors.

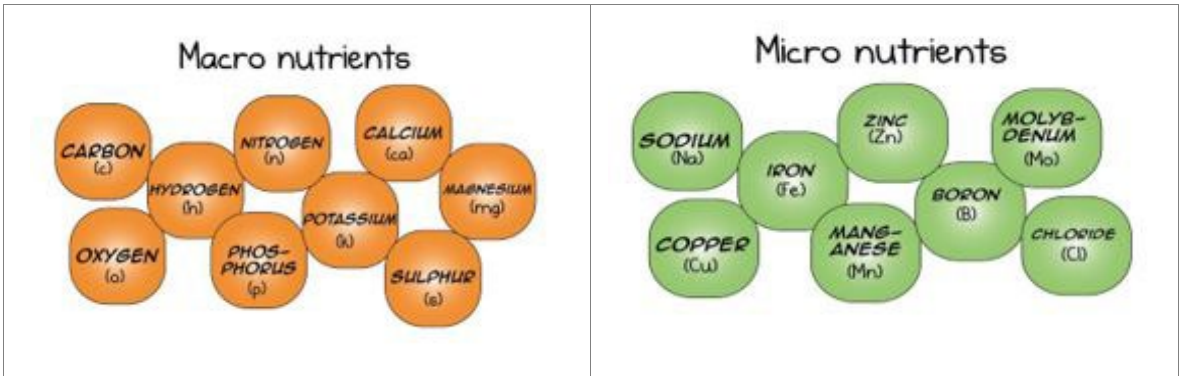
what it is

All plants need sunlight, water, air (oxygen and carbon dioxide), and nutrients (also called mineral nutrient elements or essential nutrient elements) to grow and produce food, and to successfully complete their lifecycles. Different kinds of plants need these elements in different quantities, and different kinds of plants also need different nutrient kinds and quantities.

why it is important

Plants get nutrients from the soil and the irrigation water, and fertilisers must supply what these two cannot supply enough of naturally. If a citrus tree is provided with the correct essential nutrient elements in the correct chemical formula and quantities at the right time, it allows the plant to grow well and maximise yield and fruit quality. To accomplish this, we need to know which nutrients the plant requires, in what amounts, at what times during its annual cycle, and how these nutrients ought to be administered.

Soil is composed of minerals, including the essential nutrient elements that are required for plant growth. Each essential nutrient element has a special role or roles in the physiology of plants. These nutrients are called essential elements, because without them plants cannot complete their lifecycle from seed through the vegetative and reproductive stages to the seed stage. The essential elements are grouped into macro- and micro-nutrient elements.



Citrus trees require relatively large quantities of macro-nutrient elements	*Citrus trees require relatively smaller quantities of micro-nutrient elements*

success factors

- The Principle of the Most Limiting Element – The ability of the plant to grow and produce food is determined by the level of the most limiting nutrient element. There is an optimum level for every nutrient element. The portion of each optimum level that is available to the plant determines the plant's ability to complete the processes related to that element. The element of which the lowest portion is available is the most limiting element, because the plant's ability to grow will be limited to this portion, or percentage.
- If you bring nitrogen (N) to optimum levels in the plant, this will not allow the plant to produce optimally if another element is not optimal. For instance, if the plant only has available 30% of the potassium (K) it requires, its ability to produce is limited to 30%, that being the most limiting element in this example. Although molybdenum is required in tiny quantities compared to nitrogen, if the plant only has 40% of the molybdenum it requires, that will still limit the plant's ability to produce to only 40% of its capacity.
- Soil Sampling and Analysis – In citrus production, soil samples are taken and analysed to help determine and improve the nutrient status of the tree and to ascertain chemical and physical properties of the soil. Analytical results of these chemical and physical properties are utilised during land preparation to correct conditions that are not ideal for the production of citrus. Soil imbalances such as low pH, low calcium levels, low or high magnesium levels, etc., are best corrected during soil preparation.
- Once an orchard has been planted, soil analyses are used to monitor nutrient content and other properties of the soil. This helps to judge the availability of certain nutrients to the plant, so that supply of nutrients can be optimised.
- Leaf Sampling – The results of leaf analyses are used to establish the nutrient status of the citrus tree. Fruit analyses are not used for this purpose in citrus production. Fruit sampling and analyses are used only for maturity indexing during harvesting, which means determining whether fruit is ready to be harvested or not. Fruit is physically observed for nutrient deficiency symptoms, but not analysed.
- To comply with the first principle of sampling, and to minimise the effects of other factors on the nutritional status of the trees, soil and leaf samples are taken at and from the same set of trees every year. Two to four rows that represent the orchard in all respects are selected for sampling, and are referred to as the index blocks or rows. The rows are marked, and samples for that orchard are always taken from these trees.
- The Nutritional Programme – Develop a fertilisation programme every year for the nutrients that must be applied regularly.
- The programme is based on the tree age and the yield of the trees during the previous season and other historic data, from which the amount of nutrients that the tree would have used to produce the fruit can be calculated. Soil and leaf analyses are used to further guide the development of the fertilisation program, and to detect deficiencies of specific nutrients, which in turn allows for further refinement of the fertilisation program to prevent further deficiencies.
- A fertilisation program can never be developed purely in response to nutrient deficiencies that have been detected. By the time nutrient deficiency symptoms appear, the deficiency has already impacted on the growth and production of the tree. It is essential to have a proactive approach to plant nutrition.
- To take proper preventative action, tools are needed to diagnose the nutritional status of the trees. In citrus production, leaf analysis, and to a lesser extent, soil analysis are the diagnostic tools that are used to monitor the nutritional status of the trees. Crop information is added to

the data gathered from analyses, and a refined diagnostics system is developed in this manner.

- The fertilisation programme should be seen as part of your integrated production management system, including an integrated pest and disease management approach. One element influences the others, e.g., certain pests can limit the plant's ability to take up nutrients, and so adding more nutrients does not address the root cause of the deficiency.
- Nutrient Applications – Fertilisers are supplied to citrus trees either as soil or foliar applications.
- The application can be either manual, mechanical or by means of fertigation. Mechanical application is uncommon in citrus, so either manual application of granules to the surface of the soil or in diluted form by means of fertigation is mostly used.
- The correct application, i.e. based on sound analysis of what and how much, as well the correct timing during the season, is a critical success factor.

execution steps

1. **Observation** – Leaf Symptoms.
2. **Soil Analysis** – Annually between February and May (pre-harvest and depending on your cultivars).
3. **Leaf Analysis** – Annually between February and May (pre-harvest and depending on your cultivars).
4. **Analysis and Planning** – Calculating nutrient requirements and their respective volumes.
5. **Timing** – Two types of scheduling:
   - Planned as part of your seasonal schedule, e.g., nitrogen application after harvest around July.
   - Reactive fertilising when you observe a deficiency, e.g., foliar application of magnesium nitrate as recommended by a soil and leaf analysis.
6. **Correct Application** – Amounts, dilutions, and physical application methods.
7. **Post Application Procedures** – To ensure the appropriate irrigation practices to prevent leaching of the nutrients, especially your nitrates. Ideally, you would test the soil with probes about a month after fertilising.

assessment questions

Please Note: There is no minimum / maximum amount of questions you can add

1.	Do you do annual leaf and soil analysis?
2.	Do you have trained employees who are able to identify symptoms of deficiencies based on leaf observation?
3.	Can you or your managers/supervisors calculate what nutrients are required and in what quantities?
4.	Do you have a nutritional plan?

5.	Do you have the budget to fund your nutritional plan?
6.	Do you have a schedule that matches your nutritional plan, and can you react should you observe that additional nutrition is required, e.g., foliar application of magnesium nitrate?
7.	Are you calibrating your nutritional supplements and fertilisers accurately?
8.	Are you administering your nutrition according to defined standards (process and methodology)?
9.	Are you able to fertigate?
10.	Do you keep detailed records of your nutritional programme and the results?

resources

1.	CRI Production Guidelines Volume II: Chapter 1 – Fertilisation
2.	Citrus Academy production learning material – Plant Nutrition and Soil Management
3.	Citrus Academy skills sheet – Soil sampling
4.	Citrus Academy skills sheet – Leaf sampling
5.	Citrus Academy information sheet – Nutrient norms for leaf analysis
6.	Citrus Academy electronic posters – Nutrient deficiency leaf symptoms
7.	Citrus Academy information sheet – Fertilisation programme and scheduling example
8.	Citrus Academy information sheet – List of commercially available fertilisers