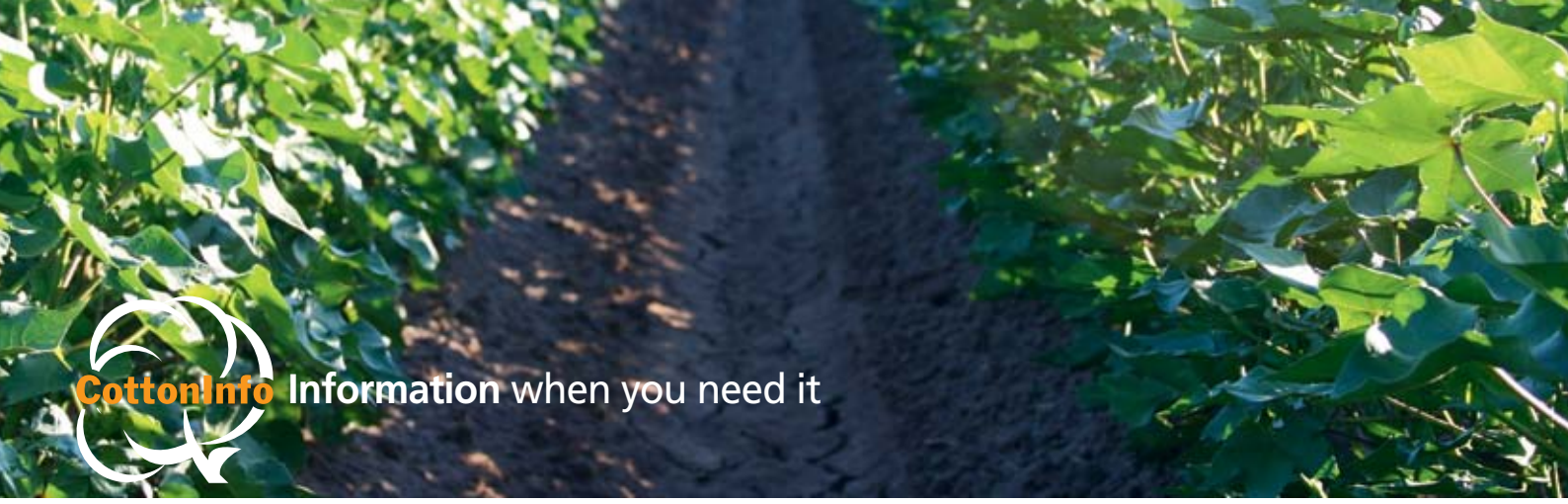

December 2014

Nutrient sampling

guidelines for cotton

- **Sampling methodologies and locations affect Interpretation of soil and plant analysis**
- **Correct storage of samples before analysis is important**
- **Weather is an important factor in petiole and leaf tissue sampling**
- **Petiole test calibrations for nitrate and potassium**
- **Micro nutrients most accurately assessed with leaf blade samples**

Monitoring of soil and plant nutrient status is highly recommended on a field by field basis to manage soil fertility and to avoid nutritional stress of cotton crops. It also helps identify soil properties that could limit production. However, interpretation of soil or plant tissue analyses is often difficult due to confusion about sampling methodologies or locations as well as testing laboratories, which leads to variable results.

The following information has been compiled in an effort to provide some standards across the cotton industry and assist with improving sampling techniques to minimise this variability.

SOIL ANALYSES

Monitoring changes in soil fertility over time is just as valuable as using soil test results to indicate fertiliser requirements. Soil testing for the macronutrients:

Hand cores are suitable for up to sampling up to 30 cm deep while vehicle mounted coring tubes are used when greater sample numbers and sampling depth is required.

nitrogen (N), phosphorus (P), potassium (K) and sulphur (S) can assist in determining fertiliser strategies as the relationships between soil test nutrient concentration and plant response is more clearly defined for these nutrients. It is recommended that, in both cases, soil is collected from the same sites over years to identify changes/trends. Sites can be identified with global positioning systems (GPS).

Timing

Soil sampling is best done May to August in fallow soil or at least a couple of weeks before fertiliser application in back-to-back crops.

This fact sheet has been adapted for CottonInfo from a former Cotton Catchment Communities CRC publication. It was originally authored by CSIRO, NSW DPI, Incitec Pivot and CRDC.

Depth
Sampling 0-30cm is ideal for all nutrients, particularly N, P and K and salinity and sodicity indicators.

Sample subsoil (30-100cm) for sodicity, salinity, nitrate and chloride approximately every 5 years.

Where to sample
Ideally sample in the same place over subsequent years. Sample close to the plant line or the middle of the bed. However, it is important to avoid sampling fertiliser bands especially where phosphorus, zinc or potassium have been applied.

To sample where immobile nutrients have been banded:
- Sample after full disturbance operations (laser levelling) and a period of wetting and drying to allow soil nutrients to reach equilibrium.
- Sample top 30cm in transverse section across the whole bed and mix thoroughly. Mixing and sub sampling is critical.
- Take a core sample through the centre of the fertiliser band. Dilute this with samples from outside the fertiliser band. The number of cores outside the band will be the row width by 0.262.

Number/distribution of cores
This depends on field uniformity. The more variable the field the more samples are required. Field information such as yield maps, biomass images, soil chemistry and electromagnetic induction (EM) surveys used in geographic information systems (GIS) can help identify in-field variation.

Depending on the variability revealed sampling may be:
- Location that represents the average of the field
- Location that represent the highest or lowest yielding areas
- Area that has the greatest or least yield stability from year to year
- Particular soil characteristics.

Sampling tool
Corer of 50mm steel tubing with reduced diameter at the bottom and drilled holes at the top for a handle allows for quick sampling to 30cm. Mechanised sampling equipment is required for deeper sampling.

Sample handling and storage
Most of the soil processes that affect nutrient availability are in some way related to soil water content and temperature. To ensure that a soil sample truly reflects the soil nutrient concentration in the field at the time of sampling, these processes need to be controlled by modifying moisture or temperature conditions. After collection, samples should be either cooled (below 4°C) or dried (48 hours @ 50°C) to stop these processes that could change the nutrient status of the soil sample.

Cooling samples to 4°C and ensuring they are at the laboratory within 48 hours of collection is unlikely to significantly alter recommendations that may arise from the sample. If samples require storage for extended periods then oven drying or freezing are the most appropriate methods of storage.

Limitations
Soil analysis only gives a general indication of the status of micronutrients such as copper, zinc, iron, manganese and boron. Often, there is no strong relationship between a soil test result and an application rate for micronutrients. At best, the lower the concentration of the micronutrient below a critical value the more likely you are to see a response to the application of fertiliser.

Micronutrients are more accurately assessed by analysis of leaf blades, as the concentrations are many times higher in plant tissue than soil and thus, easier to detect. Concentrations within the leaf blade therefore indicate the availability of the plant to take up nutrients.

PETIOLE ANALYSES

In Australia, petiole tests have been calibrated for nitrate and potassium but are not recommended for other nutrients. Of the other nutrients, petioles normally contain about half of the concentrations found in the leaf blade, but this varies, making them less reliable as a sampling tool.

Petioles are ideal for monitoring nitrate-N and potassium concentrations up to flowering. Petiole nitrate-N level declines with time (Figure 1). By flowering, petiole nitrate-N levels are usually declining and it is easy to distinguish between crops having sufficient or insufficient N. Beyond flowering leaf tissue tests are a better method of monitoring crop nutrition.

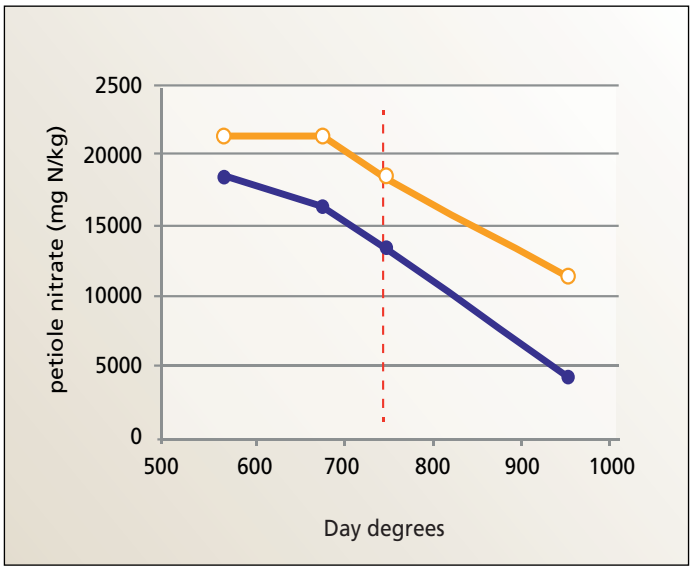

Figure 1: petiole nitrate decline over the season

For nitrate monitoring, three samplings, approximately 10 days apart, give a good indication of the rate of change in nitrate-N in the petioles. Sampling is best done at approximately 600, 750 and 900 day degrees from sowing. When collecting petioles, leaf blades must be removed immediately in the field to prevent the transfer of nutrient from the petiole to the leaf blade. For interpretation of petiole analyses refer to NutriLOGIC, see: www.cottassist.com.au

LEAF ANALYSES

The leaf blade can be used to monitor all nutrients including micronutrients. Sampling twice (at flowering and cut out) produces the most useful information. Leaf tissue tests can be used to identify nutrient imbalances, deficiencies and toxicities and can do so more precisely than soil testing and assist in optimising fertiliser programs.

Limitations

Weather can be an important factor in petiole and leaf tissue testing. Waterlogging, cold weather, low radiation through cloudy conditions all affect nutrient levels. Petioles should be collected up to mid morning; water stress can influence the results. Petiole nitrate is dynamic and the optimum amount will vary according to the plants stage of development. Therefore consult NutriLOGIC which incorporates day degree information to determine where nutrient concentrations are above or below the sufficiency range.

Plant tissue storage and handling

To avoid contamination of samples during collection it is recommended that hands be thoroughly washed with soap and dried or gloves are worn. Common contaminates include salt from sweat and zinc contained in many sunscreen products. Ensure that collection and transport containers have not been contaminated.

Collect approximately 50 petioles (more if they are thin and short) or 50 leaf blades from the 5th topmost leaf. Individual laboratory services may specify the number of petioles/leaf blades they want collected. Petiole and leaf blade samples should be stored in an absorbent bag and kept cool.

Samples need to arrive at the laboratory ASAP and in good condition. Samples not likely to reach the laboratory the day after they were collected should be dried prior to transport. This is best done at low

temperature (less than 70°C) in a convection oven or quickly air dried. Microwave ovens are not suitable.

Laboratory selection

Much of the lack of confidence in soil and tissue nutrient analyses is due to the variability in results from laboratories. The choice of laboratory for soil and plant tissue testing is very important. Some points to consider when selecting a laboratory are:

- The laboratory should use standardised accepted laboratory methods. This increases the accuracy of interpretation as it is more likely that critical concentrations and calibrations will have been generated locally to reflect Australian conditions/ situations. The specific laboratory methods for nutrient soil analysis suggested for the Australian cotton industry are listed in NUTRIpak (Downloadable from the CottonInfo website).
- It is recommended that the laboratory selected be involved in an accredited laboratory proficiency program and that you request that the laboratory disclose its laboratory proficiency rating.
- Laboratories striving for best practice will generally have an externally audited quality assurance program for each analysis.

In summary, the laboratory selected should provide (in order of preference): Australian standard methods, involvement in proficiency program performance (with results available); external audited quality assurance; quality result reporting structure; guidelines for sampling; and sample handling.

With increasing yield potential, aging soils, decreasing water availability, the profitability squeeze and continual environmental scrutiny, optimising nutrition programs is important. Effective, well planned soil and plant analysis have a vital role in each of these areas that determine the long term viability of the cotton industry.

For more information, visit the CottonInfo and myBMP websites:
www.cottoninfo.net.au
www.mybmp.com.au