RLF TECHNICAL NOTE

TECHNICAL NOTE 3

BENEFITS OF USING LIQUID FERTILISERS IN OVERHEAD IRRIGATION

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NOURISHING PLANTS BY OVERHEAD IRRIGATION

Fertiliser application to soil is generally achieved by spreading or banding granular fertilisers. Plant nutrient demand is also assisted with foliar fertilisers applied by boom spray or aerial spray. As many growers already use overhead irrigation systems such as Centre Pivot Irrigation, injecting nutrients in overhead irrigation adds another option for keeping up with high plant nutrient demand under irrigation.

Foliar tests have been simulated at the rate of 20,000 litres, or 1mm of irrigation/ha. At this rate, when leaf surface is dry, leaf coverage to near drip point is achieved with little ground-hit when canopy cover is complete. Timing of application can be selected to allow for drying conditions (such as mid-morning or early afternoon) that increase the concentration of leaf-applied nutrients for more efficient foliar uptake.

Overhead irrigation, likewise, can be used to apply nutrients to the soil with uniformity and at required increments, so overhead fertigation offers flexibility, reduces loss of nutrients, increases efficiency of uptake, reduces cost of fertiliser application and prevents excess trafficking and soil destruction.

WHY FEEDING NUTRIENTS BY OVERHEAD IRRIGATION IMPROVES CROP NUTRITION?

In Centre Pivot Irrigation, application of water to horticultural crops, field crops or pastures in the range of 600mm to 1000mm per hectare per season is common. At such rates, wash-out of nutrients from leaves is considerable. The nutrients most washed-out from leaves by overhead irrigation include potassium and other cations like magnesium, calcium and metallic trace elements.

- Maas, et al. (Irrig Sci. 1982) showed that frequent sprinkler irrigation with saline water to capsicum increased uptake of sodium, calcium and chloride resulting in leaf injury. The extent of injury (foliar uptake) was linearly related to frequency and duration of sprinkler application, thus water quality at high rates of overhead irrigation can cause nutrient imbalance or toxicity in leaves.

- Baker (2006, New Phytologist) showed that overhead irrigation at high rates causes removal of cations as well as sulphate, phosphate and even waxy layer of leaf epidermis.

If irrigation water contains essential and needed ions such as using a suitable liquid fertiliser in the system, the wash-out of endogenous ions from plant leaves is reduced. Indeed, depending on the composition, frequency and period of overhead fertigation, accumulation in leaves rather than loss of nutrients from leaves can occur. By contrast, using only water for overhead irrigation, nutrients are lost from leaves at the expense of energy that the plant has used to take up these nutrients. It is well known that plants spend energy at least at two locations for every single ion that is accumulated in leaves.

WHY NUTRIENTS ARE LOST FROM LEAVES DURING OVERHEAD IRRIGATION?

Before considering the quantitative aspect of nutrient loss, let us look at how overhead irrigation causes nutrient loss.

Xylem sap that reaches leaves carrying nutrients that are absorbed by the roots, is in equilibrium with the liquid in **Leaf Free Space** from which the leaf cells take up ions actively across their cell membranes (by spending cellular energy or ATP). It is from this Leaf Free Space pool that rain and irrigation also washes-out nutrients.

QUANTITY AND COMPOSITION OF NUTRIENT LOSS FROM LEAVES DURING OVERHEAD IRRIGATION

Nutrient loss from leaves varies, depending on composition of rain or water as well as duration and frequency of leaf wetting.

- Potter (1991, Can. J. For. Res 21: 222-229) estimated that in undamaged leaves, the loss of potassium in Acer rubrum was25% of leaf pool where annual rainfall was 1000mm.
- Horst Marschner (1986 Mineral Nutrition of Higher Plants, Academic Press) cites annual losses for potassium, phosphorus and manganese to be 9, 0.69 and 0.38 kg/h respectively for Spruce (Picea abies of pine family).
- Elin GJengedal (1996, Water, Air and soil Pollution 86: 221-234) concluded that in Southern Norway the loss of potassium from leaves due to acid rain is so high that it could not be compensated by root uptake.
- Mecklenburg (1966, Plant Physiology) showed that apart from loss of cations such as calcium and potassium from leaves, a number of carbohydrates, organic acids and amino acids are also washed out of the **Leaf Free Space**.

COMPARING NUTRIENT LOSS FROM LEAVES AND ROOTS

It should be mentioned here that washing the roots will cause loss of nutrients from Root Free Space similar to leaves. Indeed, nutrients are washed more readily from root than from leaves. The reason being permeable root epidermal structure allowing for loss to occur across all root surface, whilst in leaves the impermeable waxy epidermis prevents loss across all surface area. The loss from leaves occurs through ectodesmata and perhaps areas where epidermis is thinner or damaged.

In mineral uptake studies by roots, plant nutritionists give frequent washes for a few minutes to whole or excised roots using water or pH 4 solution to wash out the Free Space pool and measure ions that are inside the root cells or protoplast.

RLF PRODUCTS SUITABLE FOR INJECTION IN PIVOT IRRIGATION SYSTEMS

The following RLF products are the choice for injection in overhead irrigation systems for foliar and root uptake :

POWERN26

Is a concentrated nitrogen solution (26% W/V nitrogen and 2.3% W/V of sulphur) with the following specification :

- Mildly acidic (pH =6) suited for foliar and soil application.
- Contains a balanced ratio of nitrogen and sulphur as per crop requirement and removal.
- Has 10% of its total nitrogen as ammonium ion (NH_4+) and the rest as urea that converts to ammonia in leaf cells. Ammonium ions can be incorporated into proteins rapidly, and unlike nitrate do not require energy to be reduced for incorporation into protein.
- Is leaf-safe compared to UAN or ammonium nitrate since urea per unit nitrogen has half the osmotic pressure or water stress of the ammonium nitrate.
- Contains an inhibitor to minimise steel corrosion.
- Is suitable for crops and pastures.
- Can be applied at 20 to 50 litres per hectare.

POWERN39

A Urea - Ammonium nitrate product (39% W/V nitrogen and 0.5% maximum Biuret), with the following specification :

- Distributes available nitrogen evenly as compared to granular fertiliser.
- Is less volatile than urea, so when it reaches the soil, loss of nitrogen is less than urea if follow up rain does not occur.
- Is taken up quickly by the leaf.
- Contains available nitrogen for immediate uptake by roots.
- Suitable for crops and pastures.
- Suitable for dribble-banding.
- Can be applied at 10 to 50 litres per hectare.

POWERN42

A Urea - Ammonium nitrate with 42% w/v nitrogen suitable for foliar and fertigation with similar specification to **PowerN39**.

POWER PK (0-10-35)

An exceptional product having concentrated phosphorus and potassium (W/V 10% phosphorus and 35% potassium). It has a neutral pH suited for use as foliar or fertigation on its own or when mixed with **Power N range** of products to get maximum benefit in maintaining NPKS balance of the crop.

PLASMA POWER

Highly concentrated phosphorus and trace element product having in W/V 17.2% phosphorus, 6.2% sulphur, 1.5% magnesium, 7.1% zinc, 7% manganese and 1.5% copper. This product can be mixed with **Power N range** when the boosting of phosphorus and trace elements are required.

PLASMA FUSION

Is a chelated Broad-spectrum product highly suitable for foliar sprays. It contains 12 essential elements with high level of zinc and EDTA. It is suitable for cereals, pastures and legumes to be mixed with **Power N** or **Power PK** for a balanced nutrient range. As %w/v contains 9.15% nitrogen, 10.9% phosphorus, 2.56% potassium, 3.12% sulphur, 1.95% magnesium, 4.1% zinc, 1.06% manganese, 0.265 copper, 0.24% iron, 0.58% boron, 0.007% cobalt, 0.032% molybdenum.

RAPID MAX

Has five essential elements as %W/V are of phosphorus 20.37%, magnesium 1.52%, sulphur 3%, zinc 10.03% and copper 4.02%. This product can be used on its own or in tank mix to boost level of phosphorus, zinc and copper where manganese is not needed.

POWER NP

Contains 6 essential elements in %w/v being nitrogen 5%, phosphorus 20.15%, sulphur 2.04%, zinc 3%, manganese 3% and copper 0.55%.

POTASSIUM PLUS

Contains 41.7% W/V potassium, having citric acid and high potassium content is a key-product to use since loss of potassium under overhead irrigation is first-rate among all other nutrient losses.

CONCLUSION

The following key points are important :

- Applying RLF liquid products in overhead irrigation allows uptake by leaves and reduction in endogenous nutrient loss from leaves resulting in net accumulation of essential nutrients in leaves.
- Losing the nutrients that the plant accumulates in leaves, by spending energy at the root and leaf level is too precious to happen during overhead irrigation. The higher the rate of irrigation, the greater is this loss of nutrient and waste of energy. The challenge is to use liquid fertilisers in overhead irrigation to reduce this loss.
- Foliar uptake can be enhanced under certain conditions such as frequent application when leaf surface gets dry, or is dry.
- Overhead fertigation offers benefits such as flexibility in split application, saving of labour, reducing fuel cost and preserving soil structure by less trafficking.
- The specialised range of RLF products mentioned above have various characteristics and compositions that suits Centre Pivot or Overhead Irrigation Systems either singly or in combined form as required to suit the operator demand.
- RLF products that stand out in efficiency and value, even in comparison with granular fertilisers, are Power PK, Power N range, Potassium Plus, and Plasma Power.

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