

Liquid Nutrient Management in Broadacre Crops

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Many cereal growers have successfully adopted the liquid fertiliser technology all over the world. Australian nutrition researchers have consistently achieved higher grain yields especially on alkaline calcareous soils of South Australia using fluid planting technology. This research in South Australia and Victoria has demonstrated the benefits of fluid starters over conventional granular nutrients in broadacre crops.

This nutrient management guide for broadacre crops is not location specific and has been structured as a general guide, as one product would not be suitable for all soil types, crops and climatic conditions. For example, certain cropping zones have relatively higher manganese requirements than zinc, whereby others require more zinc than manganese, or no manganese at all. Similarly, nitrogen (N), phosphorous (P) and potassium (K) applications can also vary according to the soil reserves, tillage practices, biological and chemical mineralization rates in the different soil types of Australia. However, an effort has been made to provide a range of options for Liquid Nutrient applications

- As Starter Fluids at planting
- As Foliar sprays throughout the growing season
- As Seed nutrient coatings applied to the seed for early establishment

Starter Fluids and Phosphorous

Phosphorous (P) is one of the major inputs in broadacre production, and has been widely studied under different farming systems of Australia. On an average cereal growers apply 7- 25 (granular) or 3 – 15 (fluid) Kg P/ha depending upon soil P reserve, soil moisture status and target yield. Phosphorous helps in early crop establishment and promotes root growth. Spraygro Liquid Fertilisers manufacture phosphorous starter fluids and foliar spray products suited to a wide range of soil and climatic conditions. Fluid starters play an important role in seed germination and seedling vigour, which sets the plant to achieve their maximum genetic potential. **Maxiphos Injecta 23** (16-23-0), an ammonium polyphosphate (APP) blend has shown good response in South Australia and Victorian grain regions. Unlike granulated MAP and DAP, APP tends to diffuse to a greater distance in soil, and the polyphosphate chain slowly release its phosphorous in the root zone so that calcium phosphate formation can be minimized in alkaline calcareous soils.

MaxiPhos Injecta 23 can be blended with EDTA chelated trace elements to provide trace elements like zinc, manganese and copper with nitrogen and phosphorous. This chelated zinc is fully available zinc with APP to give crops a quick and healthy start. Trace elements such as zinc, manganese and copper have also been incorporated into **Custom Bulk Liquids (CBL's)**, derived either from phosphoric acid, technical grade MAP, acidified ammonium polyphosphate or combinations of - so that a single pass can deliver multi-nutrients at seeding with a true solution. These blends are easy to apply through seeders as they are not formulated past saturation point, so they are not suspension products prone to settling and requiring agitation. For example **Starter NPZMC** (9:15:0, 1.5 Mn, 1.0 Zn, 0.5 Cu, 1.5 S), a **Technical grade MAP-Urea-Phosphoric acid** based starter fortified with sulfate trace elements produces a clear solution that does not block or abrade lines. The trace elements in these products are fully available for uptake and can be adjusted according to the crop requirement for the region. These products can also be tank mixed with 42N, the urea-ammonium nitrate blend to boost N at seeding.

Agronomic benefits of fluid starters include:

- precise placement below the seed in the furrow
- high availability of nutrient pool for root interception
- better lateral diffusion rate in soil than solids
- less requirement for soil moisture to release nutrients
- dust free application of fertilizers without wastage and run-off
- early crop establishment and shading to suppress weed growth
- easy to store, handle and fill in a tank on the property





Some examples of SprayGro Fluid Starters (% nutrient w /v):

Fluid Starters	N	P	K	Su	Ca	Mg	Zn	Mn	Cu	Fe	Mo
Starter P		43.5									
Starter PZ	1.0	35.0		1.0			2.0				
Starter PZM	1.0	30.0		2.0			2.0	2.0			
Starter PZMC	1.0	28.0		2.2			2.0	2.0	0.5		
Starter NP	9.0	15.0									
Starter NPZ1	9.0	15.0		0.5			1.0				
Starter NPZ2	9.0	15.0		1.0			2.0				
Starter NPZ3	9.0	15.0		1.5			3.0				
Starter NPZM	9.0	15.0		1.5			1.5	1.5			
Starter NPZMC	9.0	15.0		1.5			1.0	1.5	0.5		
Starter NPK	9.0	15.0	4.0								
Starter NPKZ	9.0	15.0	4.0	1.0			2.0				
Starter NPKZM	9.0	15.0	4.0	1.5			1.5	1.5			
Starter NPKZMC	9.0	15.0	4.0	1.5			1.3	1.5	0.2		
Starter Complete	9.0	15.0	4.0	1.5			1.0	1.0	0.2	0.5	0.05
Starter Complete HiK	8.0	13.0	7.0	1.4			1.4	1.0	0.2	0.5	0.05
Starter Pulse	9.0	15.0		1.1			1.0	1.0	0.25		0.25
Starter Canola	15.0	11.0		17.0							
Starter Canola HiK	13.0	11.0	6.0	15.0							
Starter Zinc				8.2			16.7				
Starter Trace ZM				6.5			9.0	4.0			
Starter Trace ZMC				7.3			9.0	4.0	1.5		
Starter Trace NP	5.0	10.0		1.6			2.0	1.0	0.20		

Foliar phosphorous

Traditionally responses to foliar phosphorous in broadacre agriculture have been poor, largely due to

- the wrong form of P being used
- not enough P being applied to the leaf
- application of P being made too late in the growing season to maintain yield potential

To explain, the P used in the SprayGro Top Up range of foliar products contains phosphorous as monovalent phosphate ions derived from monoammonium phosphate and phosphoric acid, the most suitable sources of available P for foliar applications. The foliar application rates range between 7.5-10 L/ha in minimum 100-150 Lt water in most broadacre crops due to the fact that leaf cuticles possess intense negative charge which can interfere with phosphate (negative charge) penetration into the leaves. In order to produce more negative phosphate charge over the leaf surface to facilitate phosphate absorption, high spray application rates are required. This approach is different from potassium, ammonium, calcium and metallic trace elements penetration since these nutrients have positive charge ions which are attracted by the negative charge of the cuticle membrane to get into the leaves. For effective anion absorption there must be a gradient of charge difference between the leaf surface and the cuticle.

Phosphorous restores the vital energy production processes by synthesizing new proteins and nucleic acids to increase root and shoot growth. It also helps in cell membrane synthesis, oil production and amino acid synthesis. Phosphorous hastens maturity and help in the development of fruit colour. Early applications of phosphorous, in the beginning of the crop cycle helps in root development, shoot growth and productivity.

Nitrogen

42N, a urea ammonium nitrate solution (UAN 42:0:0) is a widely used N fertilizer in cereals. It is highly stable, mobile and concentrated liquid fertilizer containing readily available ammonium, nitrate, and urea

Liquid Nutrient Management in Broadacre cont.

nitrogen. The amount of N applied is a major determinant in grain yield in cereals. Generally applied at 10-30Kg N/ha at seeding, then top dressed N as foliar and/or broadcast applications at key stages of growth. The rate of application also depends upon the N mineralization in the paddock. Nitrogen is the key element required for the growth and development of plants. It helps in overall growth of the crop, protein biosynthesis, chlorophyll synthesis, and encourages tillering and leaf area development.

- 42N contains one quarter each of ammonium and nitrate nitrogen and one half is urea nitrogen to cater to the immediate and long term N nutrition of various crops.
- The ammonium nitrate component in 42N is rapidly available as soon as it reaches the root zone.
- The nitrate nitrogen fraction is fully available for immediate uptake and metabolism. This fraction is prone to leaching after heavy irrigation and/or rainfall.
- The urea portion moves freely with the soil water until it is hydrolysed by soil bacteria to ammonium nitrogen.
- 42N is a clear liquid fertilizer, easy to handle and store.
- This product can either be foliar applied or at seeding to supply nitrogen at critical stages of growth, especially during the winter months to improve growth, protein and grain yield.
- The product is buffered to provide optimum nitrogen availability in most soil types.

Surface dribble-band applications of 42N tend to be somewhat more efficient than broadcast urea, particularly when conditions encourage volatilization losses. Urea is most commonly used fertilizer as nitrogen source; however, its conversion to the ammonium and nitrate forms is restricted under low soil temperature conditions. Crops fertilized with urea alone under winter conditions fail to show any immediate N response due to poor nitrification process.

Foliar applications of 42N at later stages of growth improve protein content in grain. Many ag-chemicals can be applied with 42N, however check with physical compatibility prior to mixing. 42N can be conveniently tank mixed with trace elements, calcium, sulphur, phosphorous and potassium fertilizers at the recommended rates when diluted with water.

Potassium

Potassium in cereals promotes starch biosynthesis leading to higher grain weights. Potassium restores the vital crop water balance, regulates stomatal opening to improve photosynthesis which is the key biomass production process in plants. Potassium is also a component of some enzymes that actively participate in photosynthetic reactions leading to biomass production. Potassium must be applied early in the season for root uptake or through the foliage only at later stages of growth, as roots generally do not pick up potassium after flowering/anthesis in cereals. Traditionally, potassium is often ignored in the crop production system; as a result many growers are now experiencing potassium deficiency in their paddocks. Potassium has now been widely recognised as the least available nutrient in soil due to erosion, its excessive mining by roots and non-replenishment back into the soil. As a result the buffer potassium component of soil is not enough to release potassium in top soil for plant absorption in most cropping regions of Australia.

The deficiency symptoms of potassium include

- Marginal and leaf tip necrosis due to the enhanced synthesis of polyamines
- Poor quality grain and grain size (screenings)
- Late season blotchy chlorosis
- Poorly developed root system
- Plants wilt easily with imposition of marginal water stress

K Blast 36 (0-0-36, 8.8S) is easy to use form of Potash, is a unique blend of liquid potassium thiosulphate, potassium citrate and potassium carbonate for use on all types of broadacre crops across different soil types. It can be co-applied with NP starters in any ratio, depending upon the soil potassium status. The thiosulfate sulphur has the tendency to acidify the root zone due to the formation of sulphuric acid which can unlock some trace elements, though only for a short duration as soils have good buffering capacity. Prolonged use of K Blast 36 would help building up the buffer potassium pool in eroded soils. It can also be foliar applied through the leaves at later stages of crop growth, if required. K Blast 36 must be added slowly in the tank as it froths up when combining with acidified APP and urea-phosphoric acid based starters.

Other Elements of Interest

Calcium and magnesium deficiencies in cereals are becoming quite evident in certain cropping regions. Post-tillering spray applications of calcium and magnesium can improve the production potential of cereal crops. Calcium helps in providing strength to the culm while magnesium helps in chlorophyll production and retention in leaves, especially the flag leaf to improve biomass accumulation and its translocation to grains.

The Trace Elements

Many cereal growing areas are deficient in zinc and manganese, and a few in copper. These micro nutrients play a vital role in yield formation by regulating crop metabolism and effective utilization of macro nutrients.

Zinc promotes the biosynthesis of natural plant hormones, called auxin. As the auxin concentration increases during germination, it induces ethylene production that helps the seedling to emerge from the ground. Ethylene is a gaseous hormone that is directly responsible for seed germination and seedling emergence from the ground. Auxin helps in elongation growth of the seedling once it has emerged from the soil. Thus availability of zinc is the most important biochemical requirement for crop emergence and establishment. Movement of zinc towards the root is highly dependent upon the soil moisture, and this may be the reason why, particularly in arid and semi-arid areas, zinc deficiency is more frequently seen. Crops deficient in nitrogen do not show the redistribution of zinc from the older leaves, indicating that the deficiency symptoms of zinc are more pronounced in nitrogen deficient plants.

Manganese is essential for the efficient absorption of phosphorous and magnesium. Manganese helps in metabolism and utilization of nitrogen applied as starter dose. It also stimulates certain enzymes and coenzymes required for the process of photosynthesis. Plants with deficient manganese are stunted with chlorotic and mottled leaves, pale and look sick especially in alkaline soils. Manganese deficiency is aggravated by prolonged cold weather especially in plants growing on heavily leached acid sands and very alkaline soils.

Copper, traditionally, was not considered essential in Australian grain regions but over the last few years copper deficiency has been seen in wheat and barley. Copper is essential for flowering/heading phase of development and plants deficient in copper do not set full grain and the awns assume a bronze colour instead of green. Early application of copper can prevent its deficiency and promote grain filling in cereals due to efficient translocation of biomass from the stem. Application of nitrogen (to boost grain protein) at grain fill can further aggravate copper deficiency in copper deficient plants.

Foliar Sprays

To foliar spray is the most practical method of supplying trace elements to deficient crops because it eliminates nutrient interactions which occur in the soil solution and avoids the losses which problem soils and unfavourable soil pH has upon the plant availability of trace elements. However, the success of a foliar program depends upon the type of product used, the combination of nutrients applied, stage and health of plant growth, how and when they are applied, and the particle size of the product sprayed onto the plant.

Sulphate Solutions – SPRAYGRO BLUESTRIPE RANGE

Soil application of Zn, Mn, Cu and Fe in the form of sulfates deliver hydrated ionized trace element for its immediate utilization by the plant. Being water soluble, the sulfate form is most preferred and it also provides sulphur. The liquid sulfate formulations are the cheapest source of trace elements, have better availability than oxides and carbonate compounds due to higher solubility in water and smaller particle size. However, soil application of straight sulfate trace elements is prone to soil fixation, formation of insoluble phosphates and carbonates especially in alkaline calcareous soils. These reactions can be avoided if sulfate products are applied with acidified APP and/or phosphoric acid starters that acidify the solution and keep trace elements available for absorption. Apart from the products listed below, SprayGro also manufactures Custom Bulk sulphate liquids (minimum 1000L) to suit the trace element requirement of the paddock, if not met with the standard available fertilizer combinations listed below.

Bluestripe Sulphates	Nutrient Analysis w/v %											
	N	P	S	Ca	Mg	Zn	Mn	Cu	Fe	Bo	Mo	Co
Copper Sulphate			3.4					6.7				
Four 7 Trace	7.0		7.0			7.0		0.5				
Iron Sulphate			3.8						6.6			
Manganese Sulphate			10.0				17.3					
Manganese Copper Sulphate			9.0				14.5	1.0				
Manganese Zinc Sulphate			7.3			6.8	6.8					
Moly Mix			1.2								6.0	2.0
Moly Six										0.4	6.0	
Triple Sulphate 1.2			8.0			3.0	12.0	1.2				
Triple Sulphate 1.5			8.2			5.0	10.0	1.5				
Triple Sulphate 2.0			7.0			4.0	8.0	2.0				
Zinc Sulphate			8.2			16.7						

Lignosulphonate Chelates – SPRAYGRO SMARTRACE RANGE

Lignosulphonate is the chelating agent used in Smartrace products. Lignosulfonates are natural by-products of the wood and paper industry and comprises of the modified lignin molecule that contains various binding sites for the metallic micronutrients. However, this binding is comparatively weaker than synthetic chelates such as EDTA. It is for this reason Smartrace chelates perform better if applied as foliar sprays regardless of soil pH levels. Smartrace products are safe to use as sprays before and after tillering in cereals. Products such as Smartrace Triple, Smartrace Zinc, and Smartrace Zinc/Manganese can also be used as seed dressings to boost germination and root growth. All Smartrace products are sticky and adhere to the seed coat.

Benefits of Smartrace Chelated Trace Elements

- Lignosulfonate chelates have excellent sticking and wetting ability.
- The trace elements are released at a controlled rate to avoid unequal charge distribution thus reducing scorching from sudden nutrient overload.
- Efficient entry and movement within the plant, hence lesser amounts needed
- Kinder to most spray equipment, and do not clog and wear out nozzles.
- improved availability of nutrients over a wide range of pH, thus reducing fertilizer wastage
- Rapidly rain fast in 2-3 hours.
- Free-flowing liquid solutions physically compatible with various agrichemicals.

Popular Broadacre Smartrace Chelated Trace Elements

SMARTRACE® Lignosulphonate Chelated Trace Elements	Nutrient Analysis w/v %						
	N	S	Mg	Zn	Mn	Cu	Fe
Smartrace Copper		2.5				5.0	
Smartrace Iron		2.9					5.0
Smartrace Magnesium	5.6		5.0				
Smartrace Manganese		5.8			10.0		
Smartrace Manganese/Copper		5.0			8.0	1.5	
Smartrace Triple		3.8		3.0	4.0	1.0	
Smartrace Spraytrace 4		5.4	2.0	2.0	2.0		2.0
Smartrace Zinc		4.9		10.0			
Smartrace Zinc Copper		5.0		6.0		4.0	
Smartrace Zinc/Manganese		5.4		5.0	5.0		

SMARTRACE™
CHELATED ELEMENTS



SMARTRACE™
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Smartrace Triple Seed Coat trial, Karkoo 2005 Smartrace Trace Element Seed Dressings

Seed dressings have a distinct advantage in applying the known concentration of trace elements to boost germination and seedling growth. Smartrace seed coats:

- Stick to the seed surface and upon seed hydration penetrates the seed coat to deliver ionic form of nutrients into the seed for better utilization.
- Do not accumulate on the seed surface to cause dust.
- Being chelated product, does not get fixed in the soil and nourish seedlings more efficiently than sulfates and non-reactive oxides.
- Are physically compatible with most seed treatment products.