INVESTING IN FERTILISER STORAGE INFRASTRUCTURE

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Introduction

The soils in which we farm in Australia are some of the oldest geologically in the world, and their natural fertility is no longer sufficient to sustain crop production. Crop rotation can go some way to supporting biological nutrient cycling, especially where legumes are grown. However, in all geographic regions, soils have declining levels of a range of nutrients and manufactured fertilisers are used to ensure optimum yield outcomes. Given fertilisers make up a significant proportion of the variable costs of growing a crop, decisions about nutrient strategies have always been complex. However, in recent years both price and supply of fertilisers have been heavily influenced by domestic and international market forces and the pressure is on growers to take greater control of their fertiliser decisions.

On-farm storage of fertiliser in the Southern and Western Regions is well established and follows a pattern of starter fertilisers being received on-farm from harvest to seeding and urea then being delivered for in-season topdressing of winter crops. Come the end of the season, it is typical for structures to be empty of fertiliser and available for storage of other commodities such as grain. For any fertiliser held over the summer, weather conditions are generally hot and dry, reducing the risk of product degradation.

In the Northern Region the ability to grow both summer and winter crops (because of the subtropical environment) means fertiliser requirements can be year long. While this might be an advantage to a business trying to calculate the return on such a significant investment, the high humidity and summer rainfall also present a challenge for maintaining product integrity in storage. A large proportion of grain and cotton growers have historically utilised Big N (anhydrous ammonia) to supply their nitrogen requirements and the delivery of it direct on-farm in gas tankers negated the need for storage. However, since December 2022, the manufacture and supply of Big N by Incitec Pivot has ceased and growers are looking to invest in equipment and infrastructure to handle alternative nitrogen products, whether liquid or solid.

Being somewhat immune to price volatility and supply issues makes a strong case for on-farm fertiliser storage, however investing in sheds or silos can also be incredibly costly if they are not planned specifically for the environment in which the farm operates and the products needing to be stored. Put simply, the costs and logistics of getting it wrong can be significant.

The concept of this publication was raised by members of the Northern Panel based on their own experiences and feedback from other growers through the National Grower Network (NGN). We hope the information provides clarity and guidance for businesses considering investing in on-farm fertiliser storage facilities.

Vicki Green
GRDC Grower Relations Manager – North

Background

The world population is expected to reach 9.8 billion by 2050 and is currently growing at a rate of approximately one per cent annually (United Nations, 2022). It was estimated in 2008 that 48 per cent of the world population was dependent on food production derived from synthetic fertilisers (Erisman et al., 2008). This highlights how dependent we are on fertiliser to feed the future world population.

On a world scale, Australia is considered a small player in the fertiliser market consuming approximately just under two per cent of the world's total fertiliser use (Fertilizer Australia). However, if we didn't have access to fertilisers, the cost to the Australian agricultural sector, through reduced production, would equate to many millions of dollars (Ryan, 2010).

Fertiliser storage and handling becomes an imperative part of the supply chain to ensure growers can access fertiliser for crops in a timely manner. This publication will explore a range of on-farm fertiliser storage options and considerations growers should evaluate prior to investing in storage facilities.

Why is there a need for fertiliser storage solutions?

In Australia, 92 per cent of fertiliser is sold as bulk fertiliser (Fertilizer Australia, *Sustainability and Stewardship 2020*) with the majority of the product being imported from overseas (Fertilizer Australia). Consequently, distributors need to carefully plan purchases to ensure enough product is delivered on time. The demand is seasonal and the window for use revolves around pre-planting, planting and post-emergent applications. To manage seasonal demand and ensure product is available during peak periods, distributors utilise storage facilities close to port or smaller distributors have storage facilities in regional centres.

In December 2022 Incitec Pivot's Brisbane-based Gibson Island ammonia plant ceased production of the anhydrous ammonia product Big N. Big N was widely used in the Northern region particularly in the pre-plant summer cropping market and required no on-farm storage. Incitec Pivot held approximately 60 to 70 per cent of the market share for anhydrous ammonia, therefore, many growers previously relying on Big N will have to consider alternative nitrogen fertiliser sources such as urea or liquid fertilisers. Due to the high nitrogen content of Big N compared to alternative products, on-farm storage requirements for replacement products will need to be assessed, as tonnages required to deliver the same amount of nitrogen will be much higher.

Making the decision to invest in on-farm fertiliser storage facilities is driven by several factors, but mainly supply and price. On-farm storage allows growers to secure products and potentially purchase them at a lower price throughout the season. Additionally, it enables growers to maximise the productivity and efficiency of labour resources during the busy planting period.

More recently in the Northern region there has been a reduction in the number of distributor storage facilities in regional areas and a shift to retail outlets that store smaller quantities of fertiliser. This has been driven largely by bigger farming operations and the availability of larger trucks, which can cart grain to port and backload with fertiliser.

Benefits of on-farm fertiliser storage:

- guaranteed product supply;
- potential to capitalise on early order discounts;
- increased productivity and ease of logistics at planting;
- allows growers to collect most of their product prior to planting or top-dressing; and
- provides flexibility for more timely fallow application of nitrogen.

Factors to consider

Factors to take into consideration prior to investing in on-farm fertiliser storage:

- economic benefits of storage facilities;
- distance to port;
- freight availability, pricing and backload opportunities;
- supply/product availability;
- timing of orders, delivery and use on-farm;
- pricing trends at port;
- storage capacity required;
- length of time the storage is required to store fertiliser;
- lead time for sheds, silos or tanks to be installed;
- fertiliser characteristics (for example, MAP versus urea, liquid vs granular); and
- ability for the storage to be multipurpose (for example, storage of grain, machinery).

Economic benefits of storage facilities

On-farm storage facilities open the door to many opportunities that may be of economic benefit. Some shed and silo storage options offer the flexibility to store other commodities such as grain. This can improve harvest logistics and allow trading of different quality grades throughout the season or as the market recovers.

On-farm storage gives growers the ability to save money by purchasing and storing fertiliser earlier than normal if prices rise or if supply is likely to become an issue. The flow-on effect of being able to store fertiliser ensures planting logistics are not interrupted if trying to source fertiliser at this busy time. The savings made by being able to capitalise on price and supply fluctuations, may pay for the storage facilities within a few years.

Distance to port or distributor

Historically, distance to port has played a large role in determining the need for fertiliser storage on farms. Typically, growers further from port or a distributor require a larger capacity to store fertiliser than those closer. This enables growers to secure and store a large portion of their fertiliser requirements on-farm prior to the planting, which makes planning easier.

Recently, there has been a shift to increase farm fertiliser storage irrespective of distance to port that has been driven largely by supply and price. This offers the flexibility for growers to purchase and store fertiliser prior to planting, which can be beneficial if supply issues are forecast or prices are likely to increase.

Supply/product availability

Our reliance on importation of fertiliser comes with some logistical issues, such as lead time associated with shipping. This can result in oversupply or undersupply if forecasts were greatly different than demand for products. Importers generally place orders three months ahead however, if there are disruptions to the supply chain during peak use periods, the lead time can be pushed out resulting in supply issues. Given growers are largely dependent on importation of fertiliser products, this can leave businesses exposed.

Timing of orders and delivery

Traditionally growers have ordered products when required, making it difficult for importers and distributors to plan purchases. However, with the recent increases in prices, more growers are placing orders earlier than needed to ensure supply is guaranteed. This allows importers and distributors to plan purchases, which in turn helps to ensure product is available for pick up prior to planting.

Pricing trends at port

In 2021 domestic manufacture was only 24 per cent of total fertiliser used in Australia. Consequently, growers are price takers when it comes to fertiliser. The global and local fertiliser market is affected by several factors and therefore prices are constantly subject to change. Some of the main factors influencing price include:

- the world demand and supply for fertiliser;
- the cost of fertiliser production;
- timing of purchase and stocks;
- final volumes of imported products and raw materials;
- offshore prices when shipments are secured;
- the Australian dollar / US dollar exchange rate for each shipment;
- sea freight costs; and
- fossil fuel prices, particularly natural gas.

Product characteristics

It is important to consider the on-farm storage capacity required for both solid and liquid products. Determining if products can be stored long term or short term will help decide what infrastructure is required. Also consider lead times for sheds to be built or tanks and silos to be delivered, particularly if storage is required quickly.

Solid fertiliser characteristics

Understanding of the physical properties of fertiliser is important for handling, storage and application purposes. The main characteristics to consider are:

- particle size and shape;
- particle strength and hardness;
- hygroscopicity;
- compatibility;
- bulk density;
- corrosivity; and
- fungicide amendments.

Particle size and shape

The form of a product is determined by its manufacturing processes - the same product can take on different forms, for example:

- granule – urea, MAP and DAP;
- compacted granule – sulfate of potash;
- prilled – lime, NPK or NPS blends;
- crystalline – sulfate of ammonia;
- crushed rock – gypsum, lime; and
- powder – sulfate of potash.

Smaller and fine particles do not flow as easily and are more likely to attract moisture, which can cause issues during storage, handling and application. Particle size is an important consideration that companies use to determine which products will form stable blends. Uniform particle size in blends will minimise the likelihood of segregation in which small particles and fines settle to the bottom during transportation.

Prilled products have a smooth and glassy surface whereas the surface of granular and crystalline products varies. Both tend to be spherical in shape with crystalline products being more angular. Spherical particles flow more easily compared to angular shaped products and are less likely to become damaged during storage and handling processes, producing fewer fine granules or dust.

Particle strength and hardness

The strength of a granule or prill generally determines its ability to withstand handling, storage and application processes. Robustness is determined by its crush strength, resistance to abrasion and impact. Crush strength is measured by a crush test where a weight is applied to a granule to measure the point where it crushes. Crush strengths for most fertilisers range from 1 to 10kg/granule. The higher the value, the more robust the granule (Fertilizer Australia).

Abrasion can cause fine particles and dust to form when particles rub against one another during handling processes. The use of augers to transfer products often results in product degradation and is generally not recommended to move fertiliser.

Fertiliser is subjected to impact during loading and unloading of ships, when bagged product is dropped and during application processes. As a result, some of the product breaks up when in contact with a hard surface. Generally, granular products tend to have a higher resistance to impact than prilled materials.

Hygroscopicity

A hygroscopic substance is one that draws water from its surroundings. Most fertilisers are hygroscopic however some absorb moisture more readily than others. Hygroscopicity of fertiliser is dependent on several factors including the chemical constituents, relative humidity of the air, temperature, as well as the size and condition of the particles. Critical relative humidity (CRH) is the humidity at which fertiliser begins to rapidly absorb moisture from the air at a specific temperature. The CRH varies for most fertilisers, ranging from 96 to 46 per cent, and tending to decline at higher temperatures (Fertcare). The higher the CRH value, the less risk of moisture absorption.

In particular, when urea reaches its CRH at about 72 per cent, it begins to absorb water rapidly, as it naturally wants to turn into a solution (per comms Brad Smith CSBP May 22), and therefore urea can be difficult to store. In contrast, when MAP reaches its CRH at about 90 per cent and begins to absorb water it has to reach approximately 95 per cent CRH before granule integrity becomes seriously affected (per comms Brad Smith CSBP, May 22). Consequently, MAP stores better than urea.

A guide to product CRH as straight salts and mixtures can be seen in Table 1 (page 8). It should be noted that these values are for pure salts and therefore the values for commercial products may differ depending on any impurities present.

Table 1: Critical relative humidity (CRH) of pure salts and mixtures at 30°C.

CALCIUM NITRATE	AMMONIUM NITRATE	SODIUM NITRATE	UREA	AMMONIUM CHLORIDE	AMMONIUM SULFATE	DIAMMONIUM PHOSPHATE	POTASSIUM CHLORIDE	POTASSIUM NITRATE	MONOAMMONIUM PHOSPHATE	MONOCALCIUM PHOSPHATE	POTASSIUM SULFATE
46.7											
23.5	59.4										
37.7	46.3	72.4									
–	18.1	45.6	72.5								
–	51.4	51.9**	57.9	77.2							
–	62.3	–**	56.4	71.3	79.2						
–	59.0*	–	62.0*	–	72.0*	82.5					
<22.0	67.9**	66.9**	60.3	73.5	71.3**	70.0*	84.0				
31.4	59.9	64.5	65.2	67.9	69.2	–	78.6	90.5			
52.8**	58.0	63.8	65.2	–	75.8	78.0*	72.8**	59.8	91.6		
46.2	52.8	68.1	65.1	73.9	87.7	78.0*	–**	87.8	88.8	93.6	
76.1**	69.2**	73.3**	71.5	71.3	81.4	77.0*	81.0	87.8	79.0	–**	96.3

* Approximate values obtained by TVA (Tennessee Valley Authority) (Ref.3). Other data are from literature.
** Unstable salt pair; the value given is for the stable pair.

Source: Fertilizers Europe (2014)

Fertilisers with a low CRH are more susceptible to:

- particles becoming soft and sticky;
- particles cracking;
- particle strength reducing;
- particles caking together; and
- formation of dust and fines.

These problems can lead to blockages in equipment and/or reduced spreading consistency.

Typically, blended products are more susceptible to absorbing moisture and the CRH of the blend is generally lower than the CRH of the individual products (Figure 1 and 2).

The Northern region of Australia is subjected to subtropical and tropical conditions consisting of higher temperatures and humidity, particularly during the summer period. As a result, product integrity (particularly for nitrogen-based and blended products) is easily affected. Given these products are commonly used for summer cropping, storage needs to be well planned and for shorter periods to maintain product quality. It has been common for growers to collect a limited amount of fertiliser (that is, a week's supply), store it on a farm and collect more when required. While environmental conditions during winter are more favourable for storing fertiliser, many growers still work with an 'as required' approach to sourcing fertiliser in the Northern Region. In contrast, in Southern and Western cropping regions, which are dominated by winter cropping, conditions tend to be more favourable to store fertiliser, particularly during autumn and winter. As such, farm infrastructure is built to store larger quantities of fertiliser for longer.

Compatibility

Most fertilisers can be mixed together. However, some products have poor compatibility when mixed and either react causing a potential safety risk, or the resultant blend has a CRH that is too low to form a stable product and the storage and handling ability is compromised. As a general rule, blends do not store as well as straight products. On-farm blending of products is not common practice, however by understanding the compatibility of products (Table 2), the proximity of them in storage can be optimised to ensure quality is retained.

Figure 1: Superphosphate (top left), urea (top right) and a 50:50 blend of the two (bottom).

Source: Fertcare

Figure 2: The same piles after 24 hours exposed to high humidity.

It is evident the blended pile has drawn more moisture from the air compared to the two straight products.

Source: Fertcare

Table 2: Compatibility of fertiliser blending materials.

	AMMONIUM NITRATE	CALCIUM AMMONIUM NITRATE (AN + DOLOMITE/LIMESTONE)	CALCIUM NITRATE (FERTILISER GRADE)	AMMONIUM SULFATE NITRATE	POTASSIUM NITRATE/SODIUM NITRATE	AMMONIUM SULFATE	UREA	ROCK PHOSPHATE	ACIDULATED ROCK PHOSPHATE	SINGLE/TRIPLE SUPER PHOSPHATE	MONOAMMONIUM PHOSPHATE	DIAMMONIUM PHOSPHATE	MONO POTASSIUM PHOSPHATE	POTASSIUM CHLORIDE	POTASSIUM SULFATE/ MAGNESIUM SULFATE (KIESERITE)	NPK, NP, NK (AN BASED)	NPK, NP, NK (UREA BASED)	LIMESTONE/DOLOMITE/ CALCIUM SULFATE	SULFUR (ELEMENTAL)
AMMONIUM NITRATE																			
CALCIUM AMMONIUM NITRATE (AN + DOLOMITE/LIMESTONE)																			
CALCIUM NITRATE (FERTILISER GRADE)																			
AMMONIUM SULFATE NITRATE	1	8																	
POTASSIUM NITRATE/SODIUM NITRATE	2		10																
AMMONIUM SULFATE			10	2															
UREA	3	2	10	2	13														
ROCK PHOSPHATE	4	4	10	4															
ACIDULATED ROCK PHOSPHATE				12															
SINGLE/TRIPLE SUPER PHOSPHATE	5			5			16												
MONOAMMONIUM PHOSPHATE	5	9	10	9			17												
DIAMMONIUM PHOSPHATE			10																
MONO POTASSIUM PHOSPHATE			10						19	19									
POTASSIUM CHLORIDE			10																
POTASSIUM SULFATE/ MAGNESIUM SULFATE (KIESERITE)	6	6	10	6			18												
NPK, NP, NK (AN BASED)			11																
NPK, NP, NK (UREA BASED)	6	6	10	6	14	6	4		5						6				
LIMESTONE/DOLOMITE/ CALCIUM SULFATE	4	4	10	4	15				16							4			
SULFUR (ELEMENTAL)									19										
	7	7	10	7	7											7			

Compatible Limited compatibility (chemically, physically and/or safety based) Incompatible (chemically, physically and/or safety based)

Footnote

1. Due to the hygroscopic behaviour of both products, the type of stabilisation of the ammonium nitrate grade could influence storage properties. **2.** Consider the safety implications regarding detonability of the blend (AN/AS mixtures) and legislative implications. **3.** Consider the safety implications regarding detonability of the blend (AN/AS mixtures), impact of free acid and organic impurities, if present, and legislative implications. **4.** Mixture will quickly become wet and absorb moisture resulting in formation of liquid slurry. There could also be safety implications. **5.** If free acid is present it could cause very slow decomposition and overall level of coating. **7.** Sulfur is combustible and can react with nitrates, for example, AN, KNO and NaNO. **8.** Due to hygroscopic behaviour of both products, the type of stabilisation of the ammonium nitrate based fertiliser could influence the storage properties. **9.** Consider the moisture content of the SSP/TSP. **10.** Consider the relative humidity during blending. **11.** Risk of formation of gypsum. **12.** No experience but this can be expected to be compatible. Confirm by test and/or analysis. **13.** Consider impurities in AS and the drop in the critical relative humidity of the blend. **14.** Consider the likely impact of additional nitrate. **15.** Consider the possibility of ammonium phosphate/potassium nitrate reaction with urea and relative humidity during blending to avoid caking. **16.** If free acid present, there is a possibility of hydrolysis of urea giving ammonia and carbon dioxide. **17.** Formation of very sticky urea phosphate. **18.** Potential caking due to moisture. **19.** If free acid is present, consider the risk of a reaction, for example, neutralisation with ammonia and acid attack with carbonates.

Source: Fertilizers Europe (2014)

Bulk density

Bulk density of a product is the weight of a given volume of product measured in kg/m^3. It is an important consideration as it relates to the storage space (volume) required to hold a given weight of product. For example, a truck that holds 20 tonnes of MAP will not hold 20 tonnes of urea, as urea has a lower bulk density and therefore takes up more space. See Table 3 for the bulk density measurements of commonly used fertiliser products. Bulk density within the same product can vary with particle size and therefore can be affected by poor handling and storage processes.

Table 3: Bulk density of commonly used fertiliser products.

Product	Bulk density (kg/m^3)
Urea	720–820
Ammonium sulfate	785–1040
DAP	875–1100
MAP	900–1100
Triple super	950–1200
Single super	900–1200
Muriate of potash	1050–1150
Sulfate of potash	1150–1360
Fowl manure	300–500
Compost	500–750

Source: Fertcare

Corrosivity

Most fertilisers are salts and are therefore corrosive to metal, particularly in the presence of moisture. Consequently, fertiliser should not be stored in metal storage facilities for long periods unless the metal has an appropriate protective coating. Where storage facilities are multi-purpose for fertiliser, grain or machinery, the addition of concrete wall barriers to minimise fertiliser contact with metal walls is suggested. Additional recommendations include using galvanised sheeting for the walls as well as hot dipped galvanised metal beams and trusses.

Fungicide amendments

A common practice is to treat fertiliser with fungicide, for example, flutriafol, which can be applied prior to purchase or while unloading on-farm. It is important to note that this may affect the flow rate and handling characteristics of the fertiliser, particularly some nitrate fertilisers or those which are dusty or poorly granulated.

Liquid fertiliser characteristics

Liquid fertilisers are a growing market, which can cost more per unit of nitrogen compared to granular products but offer many benefits, including:

- easier to handle and store compared to solid fertilisers, as they are less likely to be affected by environmental conditions;
- application can be made through a boomspray, which is likely to already be on-farm, therefore there is no need for spreading contractor costs or the need to purchase spreading equipment;
- can be applied during rainfall periods (depending on soil type) unlike granules; and
- an even application of nutrients can be achieved.

Like solid fertilisers, liquids have a range of properties that influence their ease of storage and usability. A range of liquid fertilisers are available for use in broadacre cropping including straight nitrogen products, as well as blended products consisting of nitrogen with phosphorus, sulfur or potassium or trace elements.

Specific gravity

Understanding the specific gravity of liquid fertilisers will assist with transport and storage considerations. Liquid nitrogen fertilisers are a solution of urea and ammonium nitrate (UAN) dissolved in water. The most commonly used products have a specific gravity of 1.32kg/L (1.32 tonnes per cubic metre), and a nitrogen content of 32 per cent nitrogen weight per weight (320gN/kg) with a pH ranging from 6.0 to 7.0. The specific gravity of blended liquid fertilisers ranges from 1.1kg/L to 1.5kg/L.

Salting out at low temperatures

Most liquids have a salt out temperature and for liquid nitrogen fertilisers, this is at or near 0°C. Salting out is the temperature at which crystals precipitate due to the solution being oversaturated and the water can no longer keep the salts dissolved. This can lead to blockages particularly in exposed pipes on machinery, which can cause handling and application issues. This residual material contains ammonium nitrate, which may explode by detonation, heat or shock. Therefore, it is important all equipment is thoroughly rinsed after use, particularly prior to any hot repair work involving welding or cutting.

Corrosivity

Liquid fertilisers are corrosive in nature, particularly ammonium nitrate and ammonium sulfate-based solutions. Damage may occur to any material made of steel, carbon steel, brass, copper, some aluminium and concrete. In order to prevent corrosion, it is recommended to use equipment made of polyethelene, PVC, ceramic or stainless steel. Some grades of aluminium may also be suitable.

It is not recommended to apply UAN through optical sprayers or equipment with large amounts of exposed circuitry, unless they have been protected. Several spray-based products are available to protect equipment. Alternatively, some contractors have had success simply spraying crop oils or vegetable oils onto areas that require protection.

Compatibility

To improve efficiency, growers will often try to combine paddock operations such as disease management and in-crop fertiliser applications. However, the low water content of liquid fertilisers often makes them a poor mixing partner. They also have high ionic strength, which can affect the stability of emulsifiable concentrates (EC) and cause layering to occur between products. Their high density and low viscosity can make them difficult to pump and agitate. To overcome this, it is recommended to always add about 20 per cent water to all mixes, which will assist with the mixing of crop protection chemicals. For EC products more water may be required and constant agitation of 300L/minute is recommended to keep the solution stable.

When checking for compatibility the following needs to be considered:

- physical compatibility;
- crop phytotoxicity;
- efficacy of crop protection products; and
- efficacy of surfactants and suspending agents.

Physical compatibility is affected by many factors including the water temperature, pH, hardness and impurities. Therefore, it is strongly recommended to do a jar test for physical compatibility prior to mixing. Avoid using 2, 4-D amine with liquid nitrogen fertilisers as they are not physically compatible.

The correct mixing order is as follows:

1. water – at least 20 per cent (some mixes may require 40 to 70 per cent);
2. chemical (as per normal mixing order);
3. adjuvant; and
4. liquid fertiliser.

Some mixes might be physically compatible however the efficacy of the chemical can become altered, making it either more or less efficacious, which can result in crop damage. In particular foliar fungicides used in winter cereal crops can lead to increased scorch when applied with some liquid nitrogen products.

Scorch or phytotoxicity can be influenced by a range of factors including:

- addition of oils;
- product formulation;
- moisture content on leaves;
- rainfall;
- temperature;
- rate of product application;
- dilution of product; and
- crop growth stage and growing conditions.

It is not recommended to leave liquid nitrogen fertilisers and chemical mixes in tanks for extended periods without agitation. Ideally all chemicals should be emptied from the tank. If this is not possible, thorough agitation of the mix will be required before application can commence.

Summary

Prices have historically been volatile; therefore on-farm storage of fertiliser is a practice that growers should consider to better manage supply risks and to take advantage of price averaging opportunities.

Handling and storage of fertiliser can often cause the physical properties of products to change due to abrasion, impact, crushing, heating and cooling and exposure to moisture. Fertiliser products should be stored properly and handled as little as possible in order to reduce changes to the physical properties of products.

Liquid fertilisers are generally easier to handle compared to solids and could be a good option where environmental conditions cause product integrity to diminish when stored for long periods.

Fundamentals for storage of solid fertilisers

Good on-farm storage practices are important to ensure the fertiliser's physical handling characteristics are not diminished. In general, the period for which a fertiliser can be satisfactorily stored depends on:

- storage conditions;
- the type of fertiliser – granular or liquid; and
- physical condition of the fertiliser.

There are several options for storage of fertiliser on-farm, depending on the product, grower's requirements and budget, including:

- sheds;
- silos (note: Fertilizer Australia does not recommend the storage of fertiliser in silos and growers do so at their own risk);
- outdoor storage for short term storage; and
- tanks for liquid fertilisers.

Ideally sheds offer the best protection from weather and are the preferred choice by most growers. Some useful recommendations to consider for indoor storage include the following points.

- Single-storey structure constructed from non-combustible materials, for example, concrete, brick or steel.
- Storage should have adequate ventilation to dissipate heat and expel fumes.
- Shed floors should be level, dry, even and free of potholes, dust and dirt.
- Store product at least one metre away from building eaves and beams.
- Do not store incompatible products near each other, for example, urea and ammonium nitrate-based fertilisers.
- Keep fertiliser away from flammable materials.
- Ensure fertiliser is protected from moisture, which can cause lumps and dust.
- Practise good stock management, for example, first in, first out.
- Fertilisers containing nitrogen (N) or potassium (K), including mixtures of them, are more likely to take up moisture in humid conditions. Straight phosphate (P) fertilisers are typically less affected by humidity. In general P fertiliser can be stored for longer periods than NPK blends or mixtures.
- Granules that have been physically degraded or contain fines will absorb moisture faster than non-degraded products. This can lead to product setting.

Outdoor storage of product such as granular pasture fertilisers – for example, super phosphate – is also an option as are bulker bags for smaller quantities or more stable products. To maintain product quality in these situations:

- store on raised, well-drained, dry, smooth surface;
- all fertiliser stored outside should be covered with a tarpaulin to prevent damage from the elements and ensure the tarpaulin is anchored well around the product;
- exercise caution when uncovering products, particularly in adverse weather conditions, and ensure that the stack remains stable during storage; and
- bulker bags should be stored on pallets to prevent contact with water.

Liquid fertilisers require less handling compared to granular products and can be stored for much longer periods without product degradation, however they must be stored in suitable tanks or intermediate bulk containers (IBC) if smaller quantities are required.

Shed storage

There are several different shed designs to store fertiliser, depending on the requirements of the grower. Often a fertiliser shed will be designed to be multi-purpose – storing grain, fertiliser, chemicals and/or machinery. Where possible, it is recommended bulk granular fertilisers be stored in closed sheds in order to protect products from the elements.

This shed is used to store fertiliser, machinery, chemicals and grain.
Photo: CussonsMedia

Site selection

Important factors to consider for a shed site include:

- Weather – direction of shed entrance. Can rain or moisture easily get in?
- Flood risk – ensure the site is not in a flood risk area. Is the site uphill to eliminate water run-off entering the shed?
- Drainage – where possible do not build storage near a waterway. If product run-off does occur, can you avoid it running into waterways?
- Geography – is the truck unloading area flat, firm and suitable for tipping?
- Soil stability – is the soil reactive or stable?
- Traffic management – is there enough room for trucks and loaders to get in and out, are there any overhead obstacles such as powerlines?
- Logistics – is the shed positioned central to the farm for ease of access and in an area that does not get wet to reduce the risk of trucks becoming bogged?

To reduce the likelihood of water running into the shed, elevating the height of the pad above the natural ground level should be considered. Installing a high strength concrete floor of more than 40 megapascals (MPa) will help ensure the longevity of the floor against corrosion by the fertiliser. The floor should be designed to bear the weight of loaders or equipment that will be used to load or unload product.

Wall height and design

Due to the corrosive nature of fertiliser, many sheds are built with precast concrete walls. The wall height will determine how high the stack can go and therefore how much the shed can hold. It is important to ensure the walls are designed to bear the weight of the fertiliser and any additional pressure that may be applied by a loader during unloading. A slight deviation on precast concrete walls are L Block walls, which form a curved edge along the ground. This makes unloading easier as the product doesn't stick against the wall edge. Ideally the metal sheeting that forms the rest of the wall should be galvanised to minimise corrosion.

L-block (triangular) concrete wall system used in a bulk storage shed.
Photo: CussonsMedia

Roof height

Roof height and design will depend on what other uses the shed will have. If a shed is used to store machinery, the roof height will be determined by the height of the machinery. If a preference is to allow a truck to tip product off, the roof height will need to allow for this.

Shed height is important for the storage of machinery and for the ease of unloading fertiliser.
Photo: CussonsMedia

Alternatively, another option includes sliding roof sheds. This option allows trucks to reverse in and tip off easily and the shed can also be used to store grain or other low machinery such as trailers. This might be a more affordable option as the costs to build are lower given less materials are required.

Sliding roof sheds, where the roof rolls back, allow trucks to tip fertiliser off easily.
Photos: CussonsMedia

Open or closed

Sheds can either have an open front, or enclosed with sliding doors. Open sheds are more cost effective, however some products may have to be tarped to protect them from the weather. Installing sliding doors is an effective way to minimise the potential for moisture to affect products and would be considered the best practice for on-farm storage. However, this option will increase the build cost.

Sheds can have an open front (top) or sliding doors (above).
Photos: CussonsMedia

Silo storage

Silos are becoming a popular option to store fertiliser. Important considerations when installing silo storage facilities include:

- Do not use grain silos, only use silos designed to store fertiliser.
- Only use silos that have been designed and constructed in accordance with the relevant Australian standards.
- Silos must be in good condition.
- If growers choose to store fertiliser in silos, it should be for short term storage only.
- As a generalisation, do not store blends in silos.

Purpose-built fertiliser storage silos, two silos on right, compared to grain silos.
Photo: CussonsMedia

Site selection

When considering silo site selection, it is important to consider the following:

- Soil stability – is the soil reactive or stable?
- All-weather access – can the silos be reached during wet conditions without risking becoming bogged?
- Traffic management consideration – can road trains unload and exit the area safely?
- Geography – is the site flat and level and not prone to flooding?
- Electricity – is power required for unloading and are there overhead power lines in the unloading area?
- Unloading area – is it flat, firm and suitable for unloading?

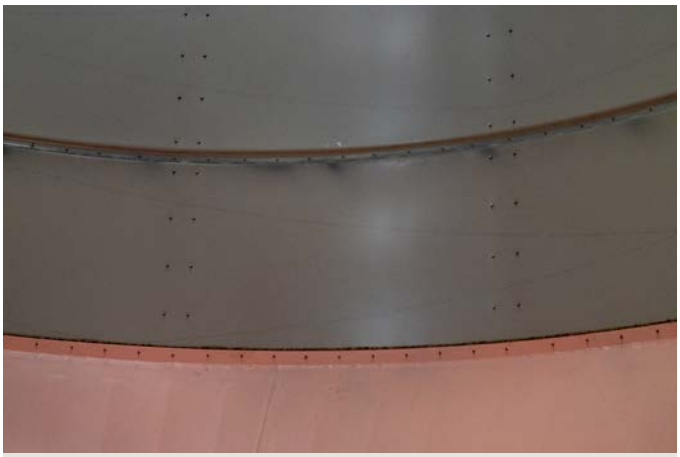
Pad

It is important that silos are placed on a stable concrete footing that is large enough and thick enough to bear the weight of the silo when full. For more information regarding specific details on footing design, contact silo manufacturers.

Silo design

It is recommended that silos have a base cone angle of at least 45°C, which will assist with fertiliser flow and therefore makes emptying easier (Incitec Pivot, 2022). The design and capacity of the silo should be appropriate for the fertiliser with the highest bulk density that will be used. Quality fertiliser silos have strengthened walls, often referred to as stiffeners to prevent wall collapse. Due to the corrosivity of fertiliser, the internal walls should be coated with an epoxy paint to protect from corrosion.

Fertiliser silos (right) have a steeper cone than grain silos (left).
Photo: CussonsMedia



The cone inside fertiliser silos is painted to protect from corrosion and to help empty fertiliser out of the silo.
Photo: CussonsMedia

Product selection

Not all products can be stored in silos due to their physical and handling properties. It is important to refer to the product safety data sheet or fertiliser distributor to discuss the storability of each product and whether it is safe to store in a silo.

As a generalisation, do not store blends in silos or other products with a low CRH, as these products attract moisture and may become sticky and therefore difficult to empty. See Table 4 for silo storage guidelines on a range of Incitec Pivot products.

Table 4: Silo storage guidelines for Incitec Pivot products

Products that may be stored in silos for a limited time	Products that should not be stored in silos
Straight Granular urea Gran-Am® (granulated ammonium sulfate) MAP Granulock® Z	Cal-Am® Cal-Am blends DAP DAP blends Sugarcane NPK blends Blends containing zinc sulfate monohydrate SuPerfect® SuPerfect/potash blends
Blends Urea/Gran-Am blends Urea/MAP or Granulock Z blends Urea/Gran-Am/MAP or Granulock Z blends	

Note: If an Incitec Pivot product is not listed in this table, it should be regarded as being unsuited to storage silos.

Source: Incitec Pivot.

Duration of storage

Silos should only be used for short term storage of products. Ideally products are best received on-farm close to their time of use. It is not recommended to use silos to store products from one season to the next.

Some silo manufacturers produce a range of silos that can be sealed and therefore can potentially store products for longer periods. However, this depends on the humidity of the air at the time of sealing. Sealing the silo to create a barrier between the product and humid air will not necessarily result in longer periods of trouble-free storage.

Safety

Always follow safe working practices when using silos as they are legally considered to be confined spaces and therefore should not be entered under normal conditions. During warm weather, high internal temperatures can occur inside silos, therefore increasing the danger for anyone entering the silo.

Fertiliser that sets or hangs up in a silo while unloading can cause the structure to collapse resulting in potential injury or death to farm workers. Always refer to the silo manufacturer's advice on the safe use of silos.

Some recommendations for the safe use of silos include:

- Do not put damp or wet fertiliser into a silo.
- Do not fill the silo so that the product touches the roof as this may cause moisture condensation.
- Always keep ladder and man-hole entry points locked to prevent access when not in use.
- Ensure lids and covers are closed properly.
- Only use silos for short term storage - do not store product from one season to the next.
- Do not exceed the weight load rating of the silo, being mindful that different products have different bulk densities.

Equipment used for handling solid fertilisers

Ideally, the handling of fertiliser should be limited. Where possible, the use of loaders or belt conveyors to load and unload is preferable. When using a loader, keep the correct angle with the bucket to minimise crushing the fertiliser and try to avoid driving the wheels into the product.

Not all growers have access to a loader or belt conveyor and therefore many utilise augers to load and unload fertiliser. It is important to note that augers will damage and crack granules resulting in fines and dust, which can cause the product to cake. Where possible the use of a tubulator or conveyor belt is preferable to ensure product integrity is maintained. Due to the corrosive nature of fertiliser, all machinery and equipment should be cleaned after use.

Brandt conveyor belt (left) and hopper (right) used to unload fertiliser into the shed. Photos: CussonsMedia

Hygiene requirements

It is important to keep fertiliser free of contaminants such as grain, weed seeds, gravel and other waste products or debris. While it is common practice to use loaders to empty or clean out sheds, another alternative to consider is an industrial sweeper, which can be used to clean both fertiliser and grain off the floor. Equipment used to handle or transport fertiliser should be rinsed and cleaned to remove any contaminants.

Hygiene is particularly important where fertiliser has been treated with fungicide. It is mandatory to wash any vehicle and handling equipment used to carry fungicide-treated fertiliser under the Grain Trade Australia (GTA) Grain Transport Code of Practice. Where possible, a pressure cleaner should be used to clean and flush out the bins of trucks. It is important the truck is cleaned thoroughly particularly if grain is being carried afterwards, to ensure maximum residue levels are not exceeded. Sheds used to store treated fertiliser should also be cleaned thoroughly once emptied and especially before storing grain.

Additionally, areas surrounding fertiliser storage sheds should be kept weed free to minimise the potential of weed seeds being blown in and contaminating fertiliser.

Dimensions and tonnages

Fertiliser silos come in a variety of sizes depending on the storage requirements. Sizes begin at 30 tonnes and increase up to approximately 100 tonnes, which will vary depending on the bulk density of the product being stored. Silos offer a good option to easily segregate products by having a silo for each product required.

Alternatively, sheds can be custom designed to meet the needs of each enterprise considering the quantity and number of products to be stored. The storage capacity of the shed is determined by the dimensions of the shed itself and the height of the internal walls and how high fertiliser can be stacked. If more than one product is required, concrete barriers can be used to create partitions within the shed to ensure products do not become mixed together.

Fundamentals for storage of liquid fertilisers

Liquids are dust-free and less likely to be affected by environmental conditions, making them suitable for long-term storage. Product quality is easily maintained from delivery through to their time of use and storage in an enclosed system prevents contamination. Due to the lower nitrogen content compared to granular products, more product and therefore storage may be required. Responsible storage of liquid fertilisers is important to ensure the safety of the environment and workers. Growers have a duty of care to ensure safe siting, use and regular maintenance is carried out.

Storage tanks

Standard water tanks are rated for water, which has a specific gravity of approximately 1.0kg/L, whereas tanks used to store liquid fertilisers must be suitably rated to account for the specific gravity of liquid fertiliser products, which can range from 1.1kg/L to 1.5kg/L. Therefore, concrete and galvanised tanks along with standard polyethylene water tanks are not suitable. Some liquid fertiliser products contain a corrosion inhibitor and therefore can be stored in mild steel or carbon steel tanks for short term purposes. For long term storage of liquid fertilisers, epoxy or polyurethane coatings are recommended for all contact surfaces. Corrugated iron tanks may only be used where a PVC liner is installed. Aluminium, stainless steel, high-density polyethylene (HDPE) and fibreglass can also be used.

It is important to note some liquid fertiliser products are not compatible and therefore caution is required when storing liquid fertiliser in tanks that have previously contained a different liquid fertiliser product. As a precaution a tank should contain less than 10 per cent of the previous product before filling with a different product. Table 5 shows some common tank sizes.

Table 5: Common storage tank capacities in volume and weight.

Poly	25,000L/ 33,000kg	50,000L/ 66,000kg		
Fibreglass	23,000L/ 33,360kg	43,000L/ 56,760kg	50,000L/ 66,000kg	23,000L/ 30,360kg

Source: CSBP

Site selection

The following should be considered when selecting a site for liquid fertiliser storage tanks:

- access for delivery tankers – allow for trucks up to 19m in length, ensuring access is possible during wet weather;
- allow the storage fill point to be within 6m on the left side of the discharge point of the tanker;
- avoid areas with overhead power lines, drinking water wells and bores;
- install tanks at least 10m away from water run-off areas and creeks, to reduce the potential for waterway pollution; and
- provide easy access to water for flushing pumps and washing down.

Tank foundations should be level, particularly if installing fibreglass or cone-bottom tanks. Where cone-bottom or fibreglass tanks are being used, it is recommended to install concrete bases. Blue metal is a preferred base material for metal tanks. Foundations need to be designed with the full weight of the tank in mind, and ideally should be tested with water prior to delivery of fertiliser.

Storage areas should be bunded using materials impervious to water, such as concrete walls and floor. The volume of the bund as a minimum should be 110 per cent of the tank(s) volume or as otherwise stated by standard legislative requirements. Bunds should have a drainpipe located at the bund lowpoint to allow for drainage during wet weather. In Queensland, site bulk storage facilities may require approval and therefore the nearest regional office of the Queensland Environment Department should be contacted.

Duration of storage

Product quality will remain constant when stored under ideal conditions. Quality will only be affected where the core tank temperature drops below 2°C and salting out may occur.

Safety

It is recommended tanks be fitted with lockable inspection hatches, along with suitable vent pipes. An external sight gauge to assist with determining product level in the tank is desirable but if this is not available, then access to the top of the tank to assess levels will suffice.

Although not classed as a dangerous good, liquid fertiliser should be handled with care. Therefore, when handling these products, appropriate personal protective equipment such as eye protection, gloves and chemically resistant clothing should be worn.

Equipment required for handling liquid fertilisers

Ensure all tank fittings and couplings used are materials that will not corrode e.g stainless steel. Liquid fertilisers require higher pressures to deliver the same volume compared to water therefore pumps should be good quality. Centrifugal and most positive displacement pumps are suitable along with self-priming plastic pumps. Ensure all fittings on pumps that come into contact with fertiliser are made of carbon steel, cast iron, aluminium, stainless steel or polypropylene.

It is recommended that filters on boomsprays and pumps are made from high grade stainless steel, or plastics resistant to acid such as polyethylene or polypropylene. Hoses should be of the correct grade to handle pump pressures. Good quality suction hoses are recommended to prevent hose collapse during warm weather. Hoses made from polyethylene or PVC are preferred.

Boomsprays may require modification if brass or galvanised fittings are used. In this instance all parts including filters, nozzles, valves and control units should be removed and changed to plastic polymer, stainless steel, aluminium or ceramic material. Nozzles that deliver high volumes and large droplet sizes are recommended.

After application, all equipment should be flushed and rinsed off to prevent damage. Spray lines and tanks should also be washed out daily to prevent product salting out. If liquid fertilisers are applied with fertigation, all application equipment should be flushed out.

Industry stewardship

A sustainable future for Australian agriculture is important and therefore, as an industry, there is a responsibility to handle, store and use fertilisers appropriately. The proper use of fertiliser is essential to ensure that the environment is preserved while maintaining productivity.

Fertiliser handling code of practice

The fertiliser handling code of practice is used to promote best practice for operators and service providers in the industry, while handling products in public areas and company storage facilities (Fertilizer Australia). Its primary focus is to manage product loss and the associated environmental hazards. The code covers workplaces involved in the transportation, storage and handling of fertiliser at bulk facilities, major supply warehouses and country storage facilities. A copy of the code of practice is available on the Fertilizer Australia website www.fertilizer.org.au

Fertcare

Fertcare is a national training and accreditation program designed to train and equip all those involved in the fertiliser supply chain to promote productivity, environmental stewardship and food safety. Fertcare is an initiative of Fertilizer Australia, offering three levels of training and accreditation:

- Fertcare Level A is suited to those directly involved in the handling of fertilisers.
- Fertcare Level B is for sales staff and those who spend a significant amount of time discussing fertiliser with growers.
- Fertcare Level C is aimed at those who provide detailed fertiliser advice and recommendations based on soil and plant testing.

Fertcare encourages best practice from an environmental and food safety perspective, ensuring growers can rely on Fertcare accredited organisations to offer a responsible approach to fertiliser use.

MORE INFORMATION can be found at www.fertcare.com.au

Further reading

There are many organisations that make up the fertiliser industry within Australia, each providing a high level of expertise that growers can utilise. More information on fertiliser storage and handling can be found from the following:

Australian Soil Fertility Manual, CSIRO Publishing

CSBP www.csbp.com.au

Fertilizer Australia www.fertilizer.org.au

Fertcare www.fertcare.com.au

Incitec Pivot www.incitecpivot.com.au

Yara Fertilisers Australia www.yara.com.au

Decision-support checklist

Deciding to add fertiliser storage facilities to any business is an important decision that needs due consideration. The following list of questions has been designed as a prompt to aid that decision.

Economic considerations

- [ ] Is flexibility required to store other items, for example, machinery, grain, chemicals?
- [ ] Does the fertiliser supplier offer early order discounts?
- [ ] Is there a benefit of tax savings from a capital purchase?
- [ ] Would the potential cost savings outweigh the initial investment?
- [ ] What is the scale and timeframe of the return on investment?
- [ ] What impact do fertiliser price increases have on the business?
- [ ] Is it worthwhile to purchase fertiliser requirements early?

Supply considerations

- [ ] When are the critical times that fertiliser is required on-farm?
- [ ] Is fertiliser accessible from port/distributors when it is needed?
- [ ] What are the implications of not being able to get the fertiliser on time?
- [ ] If storage is used for other purposes, will space be available to enable early fertiliser purchases and delivery?

Fertiliser and storage type considerations

- [ ] How much fertiliser would be stored?
- [ ] What types of fertilisers would be stored and when would they be used?
- [ ] What are the characteristics of the fertiliser that could be stored on-farm?
- [ ] What environmental conditions might affect storage of fertiliser, for example, humidity?
- [ ] How long would you be prepared to store fertiliser for and how well will it handle?
- [ ] How many fertiliser products will be stored and do they need segregating?
- [ ] Can the required fertiliser be safely stored in sheds or silos or tanks?

Logistics considerations

- [ ] Is there an appropriate site available – for a shed, silo, tank or shuttles?
- [ ] Does the chosen site have all-weather access?
- [ ] Is the chosen site accessible to trucks and equipment used to load/unload?
- [ ] Is the site located centrally on the farm?
- [ ] What timeframe does the storage facility need to be completed in and are there suppliers that can achieve that?
- [ ] Are there plans for expansion in the enterprise and will the storage plans meet those requirements into the future?

Equipment requirements

- [ ] What equipment is available for loading/unloading?
- [ ] Is the current equipment in good condition and not likely to diminish product quality?
- [ ] Will new equipment need to be purchased and will this add value to the business, for example, loader?
- [ ] Will existing equipment need to be modified for application purposes, for example, boomspray?
- [ ] Will fertiliser cartage be handled by the business or does a contractor need to be secured?

GRDC

Grower case studies

Andrew Godde has seen a broad range of fertiliser storage options and is happy to store fertiliser in sheds and silos. Photo: CussonsMedia

Fertiliser in sheds and silos has a place at Culcairn

There are not many who have seen the range of set-ups for storing fertiliser that Andrew Godde has. In addition to farming, for many years, Andrew, his brother and their families ran Godde's Grain and Fertiliser, a grain and fertiliser distribution business based in Culcairn. Located 440km from Geelong, the business is well placed for the fleet of trucks to do one load per day carting grain into the Geelong port and returning with a load of fertiliser. That ability to backload has been an important factor in the success of the business and was a key marketing point when the family decided to sell Godde's Grain and Fertiliser in late 2021.

Fertiliser storage business

The business buys grain from growers at harvest time and then stores or warehouses the grain on-site before delivering it to Geelong and returning with a load of fertiliser. They deliver straight to farm or store a range of both cropping and pasture fertilisers in sheds designed and built by their father when he first started the business back in the 1980s.

SNAPSHOT

GROWERS: Andrew Godde

LOCATION: Culcairn, Riverina, NSW

FARM SIZE: 1700ha

ANNUAL RAINFALL: 600mm

CROPS GROWN: Wheat, barley, canola and grazing crops for sheep

SOIL TYPES: Red loam to grey clay

Being a mixed farming area, stored pasture fertiliser is generally sold in February, March and then in spring if the season shows potential. Andrew comments they used to start bringing back MAP in March so they had stock on hand in preparation for an April season break. That approach usually worked well although if there was a late break, they had to carry that stock. As for urea, they would start storing it in May ready for top-dressing in June through to August.

Andrew explains there is a diversity in the business's clients with a lot of very small operations that, while sowing, would come and pick up 5t of MAP every morning. In contrast their larger growers would take a B-double load directly on-farm at the start of every week. Most growers in his area have a field bin in which they temporarily store the fertiliser and then augur into their seeder. Unfortunately, this can lead to product degradation and creation of fines.

Roll-back roofs drive efficiency for unloading fertiliser and reloading grain at Godde's Grain & Fertiliser. Photo: CussonsMedia

The Godde family have invested in Kotzur dual-purpose grain and fertiliser silos (white silos) for the farming business. Photo: CussonsMedia

Godde's Grain and Fertiliser Storage Complex

The storage complex is made up of sheds with concrete bases and roll-back roofs. Andrew explains this design was the most efficient time wise, allowing them to unload trucks relatively quickly before loading them with grain on the other side of the yard and getting them back on the road. This meant they were not holding drivers up too long and were not spending too much time unloading.

They decided not to use elevators because a belt elevator is another cost and the current system allows two or three trucks to unload at the same time by tipping into individual bays, whereas if they all had to use one elevator, it would not be as efficient.

The sheds did have doors on them when originally built and while they worked well when they were new, they were removed because they were prone to wind and because the roofs were movable, they sometimes had trouble with alignment.

Silo storage on-farm

The decision to sell the business meant the Goddes needed a solution to store their own fertiliser and grain on-farm. While they needed to find a solution quickly, Andrew believes they still would have chosen to purchase Kotzur dual-purpose silos rather than look to build another shed. The Goddes have used locally built Kotzur silos in the grain and fertiliser business over the last 25 years so, knowing the people and the quality of the products, they did not hesitate to purchase Kotzur transportable sealed silos. The cones of the fertiliser silos are much steeper than a traditional grain silo and the cone is also painted, which helps with the flow of fertiliser out of the silo.

Andrew believed buying the dual-purpose silos gave them the flexibility to store either commodity at different times of the year. When purchasing the silos, the Goddes plan was to put grain in at harvest time, empty it out by February or March and then store their cropping fertiliser in the silos. As it turned out, late in 2021, they were able to secure some 'reasonably' cheap MAP, which has been stored in the silos rather than any grain. Andrew says 2023 may be an opportunity to try the original plan.

Andrew will not hesitate to store urea in the silos but is not quite sure how long he would be happy to store it. He knows people have stored urea in these silos for 6 months and, being a silo that can be sealed for fumigation and with lower humidities than other areas, it should not get that much moisture in the silo. However, the storage time for urea will be something he learns with time.

Recommendations

As for summarising his experience, Andrew says there are lots of fertiliser storage options available. For a smaller farm, he recommends using a really good dual-purpose field bin, with painted, steeper cones and using the 100t Kotzur silos that are dual purpose for grain and fertiliser is a great option for bigger farms. Also, for growers with a big shed with a concrete floor, adding a little bunded area in the corner with some concrete tilt panels could also be a good option. Andrew also recommends thinking about the height of the sheds, adding it would make sense for a shed to be 10m in the peak of the roof to allow larger trucks to unload quickly.

From a financial point of view, with some areas having experienced some successful grain seasons, he says it is worth growers considering if they are in a position where they can buy their fertiliser for the next year's cropping early. For example, if fertiliser can be purchased early at a $200/t discount to typical prices, or even in extreme cases, $400 to $500/t, then silos can be paid for quite quickly over two to three seasons.

Summary

- Dual-purpose silos are a good option for flexibility.
- The ability to backload makes fertiliser cartage more cost effective.
- A roll-back roof allows for quick unloading at the business shed complex.

MORE INFORMATION Andrew Godde 0428 691 856

SNAPSHOT

GROWERS: Bryce and Graham Hathway and family

LOCATION: North Kalannie, Wheatbelt, WA

FARM SIZE: 17,500ha

ANNUAL RAINFALL: 280mm

CROPS GROWN AND TARGET YIELDS: Wheat 1.6t/ha, barley 2.0t/ha, oats 1.6t/ha, lupins 1t/ha and field peas 1.5t/ha

SOIL TYPES: Medium to heavy

Bryce Hathway (left) and his family have built dual-purpose sheds on their blocks for ease of logistics. Photo: CussonsMedia

Granules and liquids offer the best of both worlds in Kalannie

Bryce and his family are not novices when it comes to storing fertiliser on-farm, having done so since bulk fertiliser was first introduced. Over time, lessons were learnt and improvements made to ensure their storage facilities matched the expansion of their farm, located approximately 300km north-east of Perth. More recently, this has included building two new fertiliser sheds, which enables them to store all their fertiliser on-farm before sowing their winter crop program.

Fertiliser strategy

Running a large cropping program, the Hathways fertiliser strategy is generally the same across the board for cereal crops. They utilise variable rate technology to apply nutrients according to the production potential of their paddock. DAP is applied at seeding between 35 to 50kg/ha, along with liquid UAN, which is banded below the seed at 50L/ha. The Hathways are firm believers that, in their area, nitrogen applied at planting is safer than post-emergent applications and therefore they do not tend to deviate from their 50L/ha used upfront. If N is required early post-emergent, urea is used as it is softer on small crops compared to UAN. If the season looks promising, a top up of nitrogen with UAN or urea is applied later in the season.

Dual purpose

As fertiliser is only stored for a few months of the year, both sheds were built with a dual purpose in mind. The first shed measuring 18m (W) x 32m (D) was built in 2019 with the purpose of storing grain and fertiliser and can hold approximately 1000t of grain. It has precast concrete walls that are 2.1m high and galvanised sheeting to the roof. The concrete of the back wall is 200mm thick, to allow for additional pressure applied by the loader when outloading. The floor is concrete and it has an open-faced front.

Their most recent shed, completed in 2022 on their home block, was built to store fertiliser and machinery and measures 32m (W) x 18m (D). One end of the shed measuring 8m (W) x 18m (D) has been sectioned off for fertiliser and can hold up to 200t. It has precast concrete walls 2.5m high and galvanised sheeting to the roof and the back wall is 200mm thick. It has concrete flooring and sliding doors, which provide protection from the weather.

Liquids offer flexibility and ease of storage

The Hathways are able to store up to 640,000L of UAN on their farm in UAN storage tanks across their properties. Product is generally delivered during January or February ready for the winter planting program. The Hathways choose to band UAN over granular urea as they find it easier to store and it is more readily available to the emerging crop.

The original shed built in 2019 has 2.1m precast concrete walls and the back wall is 200mm thick to allow for additional pressure applied by the loader when outloading. Photo: CussonsMedia

The Hathways' 12,500L UAN nurse tanks mounted on a 9m flat top trailer. Photo: Bryce Hathway

The second dual-purpose shed completed in 2022 also has a loading ramp to load trucks at seeding. Photo: CussonsMedia

Morris Air Cart with 7000L UAN tank mounted on the front. Photo: Bryce Hathway

If the season is looking promising, later post-emergent applications of UAN ranging from 30 to 40L/ha are often applied in combination with herbicides. Combining UAN with herbicides offers flexibility to add some late nitrogen in better seasons and reduces the number of times the crop is driven over, which saves on spreading costs incurred with urea.

Equipment

The Hathways use a 23m Brandt closed tube conveyor belt, which can unload a road train in about 40 minutes. A Liugong 856 loader with an approximate 3.5t bucket is used to load fertiliser into trucks at seeding using a loading ramp built alongside the shed.

Their Morris 9445 air cart is set up with a liquid UAN tank on the front that holds 7000L. The UAN is banded below the seed with a 21m Morris bar. Two UAN nurse tanks, which are 12,500L each, are carried on a 9m flat top trailer and can fill the air cart three times.

The Hathways have two 46m Hydra boomsprays used for foliar applications of UAN. To transfer the UAN from tank to boom, they use a stainless steel hydro pump, which helps prevent the pump becoming corroded. Bryce mentioned it is vital that the boomspray is cleaned after applying UAN to avoid corrosion.

Logistics and weather

Running a sizeable operation on three different farm blocks, it was logical for the Hathways to build storage facilities including liquid storage tanks on each block. This saves travel time and therefore allows seeding to proceed in a timely manner. The Hathways have purposely positioned their UAN tanks next to water tanks for ease of filling the boomspray.

An important consideration when building their most recent shed was the weather and which way rain is likely to blow in. A lesson was learnt the hard way during 2021, when the unlikely event of a cyclone passing through the area resulted in rain blowing into the shed wetting all their DAP, which had not been tarped. Consequently, they were left with a layer of wet sludge along the floor. This was taken into account when the Hathways were deciding the orientation of their new shed.

Cost-saving opportunities

The closest port, Kwinana, is 300km away and therefore the decision to invest in storage facilities makes sense. Generally, Bryce and his family order fertiliser during harvest and collect it in January or February. This often coincides with grain being taken to port and offers the opportunity to backload with fertiliser, which is more cost effective.

The ability to store all their starter fertiliser on-farm enables the Hathways to purchase fertiliser earlier if prices are likely to increase. A perfect example of this occurred during 2021 when their fertiliser broker informed them fertiliser prices were set to increase and supply may be an issue. With this in mind, Bryce ordered their 2022 fertiliser requirements during seeding of 2021, knowing if product needed to be picked up earlier, they had the capacity to store it. For the Hathways, a major benefit of being able to store all fertiliser prior to seeding, is that it removes the pressure and downtime of having to travel to port to collect fertiliser during seeding.

Lessons learnt

Bryce has a few tips he has learnt along the way during the process of building their last two sheds. Firstly, he suggests to always build bigger than what you think you'll need, mentioning that nothing ever gets smaller in farming. Bryce also suggests using concrete with more strength (higher megapascals), which will help minimise corrosion from the fertiliser. Bryce recommends building a decent pad, one that is a fair bit higher than the natural ground level, to ensure water will not run into the shed. For their sheds, they raised the pad 500mm above the natural ground level. Overall, Bryce suggests not to skimp on things and do it right the first time and, where possible, costs can be reduced by doing things like the pad yourself, which is what they did.

Bryce believes incorporating liquid fertiliser into the program enables them to store a large amount of nitrogen on-farm before planting knowing its quality will be maintained. Although combining UAN with herbicides offers flexibility and less passes, Bryce mentioned some mixes of UAN and herbicides can lead to some significant crop scorch, so in these instances doing separate applications might be a better option.

Due to significant price increases in 2023, the higher cost per unit of nitrogen for UAN means it is currently not as economical as urea. For this reason, the Hathways may reduce the amount of UAN applied post-emergent during the 2023 season.

Summary

- Always build bigger than what you think you will actually need and do it right the first time.
- Consider the prevailing weather direction when deciding on a location for fertiliser storage facilities.
- Dual-purpose sheds offer flexibility.
- Liquid fertilisers are easy to store and offer flexibility.

MORE INFORMATION Bryce Hathway 0427 662 000

SNAPSHOT

GROWERS: Broden and Chris Holland

LOCATION: Young, Central NSW

FARM SIZE: 5000ha

ANNUAL RAINFALL: 600mm

CROPS GROWN AND TARGET YIELDS:
Wheat 4t/ha and canola 2t/ha

SOIL TYPES: Sandy clay loams

Broden Holland (left) and his family have repurposed a chicken shed for storing their DAP and urea.

Photo: CussonsMedia

Repurposing existing infrastructure makes sense at Young

Before taking advantage of some old infrastructure and refurbishing it, Broden Holland says that storing fertiliser was a bit of a logistical nightmare. Broden and his family would unload any fertiliser deliveries into three B-double trucks, which was troublesome if they had a number of trucks arriving at once. It also meant that they were not able to take advantage of any pricing or seasonal opportunities because they just did not have the storage capacity on-farm.

Chook shed

Broden's family used to farm chickens and have now converted one of two sheds into a fertiliser storage facility that instead of storing 25,000 caged chooks, now has the capacity to store 700t of urea and about 1000t of MAP. The shed was built in 1992 and is approximately 5m high, 8m wide and 80m long with open ends, although this is something they will look to enclose in the future. It has steel trusses with cool room panel walls and while Broden says it is not ideal to store fertiliser, it has worked. Originally the shed had opening ventilation on the side and only had a very thin wall of concrete, so the Hollands put up some curtain to keep the fertiliser in place and added chocks to the ventilation at the base of the walls to prevent them from opening.

To fill the shed, the Hollands have cut holes in one side of the shed to augur fertiliser and can unload about 50t per hole in about 15 minutes. At one end of the shed is a loading ramp, which Broden says has made loading fertiliser using the 16t loader with a 4t bucket much easier, safer and with less potential to cause damage. Using the loading ramp now takes five minutes to load a truck with 40t of urea.

Fertiliser strategy

Given the family history with chooks, they spread about 2000t of manure each year, with the aim to keep their phosphorus levels high at Colwell P levels of about 55. Given the high fertiliser prices in 2022, the Hollands cut back their MAP rate from 60kg/ha to 45kg/ha with the intention of increasing the rates when the MAP price is more cost effective. In the last few years, they have had the MAP delivered from late February up until sowing but, in the future, Broden believes they may start taking delivery earlier. The only exception to this will be if they decide to treat some of the MAP with Impact® fungicide. While it is an excellent option for early disease management, it is not ideal to store for long periods.

As for urea, they top-dress variable rate applications based on protein levels from the previous year. In 2020 the range was from 200 to 600kg/ha and in 2021, with an exceptional year, they were targeting yields of 6.5t/ha for the wheat and 3.5t/ha for the canola and so generally applied 450 to 500kg/ha of urea over three applications.

Shed allows for flexibility

For Broden, having the modified shed opens up a lot of potential in their business. Previously they could not store any fertiliser and had to use a load immediately after it was delivered. Up until 2020, before the shed was converted, their biggest year for urea was 300t because they would bring some fertiliser in, spread it and then repeat the process, so there was never any 'spare' on hand to make the most of the crop's potential or a weather front. In 2020 the Hollands spread about 600t of urea and in 2021 they spread 1300t. Having the shed allowed them to receive and store the fertiliser when it suited, so when they wanted to spread urea, it was on-hand.

As for how well the urea handled, Broden says all things considered, it handled better than he thought it would. They had a couple of loads in 2021 that were delivered in early June but not spread until September and, while there was a bit of a crusty top and some lumps, these were easily crushed up with the loader, which is easy to maneuver given the width of the shed. Although they can store grain in the fertiliser shed, the Hollands purchased more grain silos as their preferred storage option.

Storing machinery

The Hollands are happy to store machinery in the shed on the proviso they can have it spotless beforehand. The shed has a full concrete floor that's pretty flat so they run the bucket along and scrape most of it up and then use an industrial sweeper to sweep up any fertiliser from the edges of the walls.

The chook shed was gutted and holes added along one side so fertiliser can be augured into the shed, which has the capacity to store 700t of urea and 1000t of MAP. Photo: CussonsMedia

Future plans

In order to finalise the fertiliser storage facility, the Hollands will ultimately have to re-roof one of the chicken sheds. The alternative is a shed that is similar, but without the pitched roof and while not as long, is wider than the current fertiliser storage shed. They are also looking to add doors and better flaps to the auger holes.

In terms of fertiliser purchasing, Broden thinks he will be storing his MAP on-farm from December or earlier and all the urea will be on-hand by seeding time to make life easier.

Summary

- Repurposed chook shed works well.
- Loader can crush up any lumpy urea.
- Loading ramp adds ease for outloading.

MORE INFORMATION Broden Holland 0447 833 586

SNAPSHOT

GROWERS: Ian Rollinson, Rollinson Farming Co

LOCATION: Surat, Queensland

FARM SIZE: 15,000ha

ANNUAL RAINFALL: 580mm

CROPS GROWN AND TARGET YIELDS:
Wheat 3t/ha, barley 3.5t/ha, chickpea 2t/ha, sorghum 1.5t/ha and mungbean 1.4t/ha

SOIL TYPES: Self-mulching cracking clays

Ian Rollinson (left) built a large multipurpose shed that can store fertiliser, grain, machinery and chemicals. Photo: CussonsMedia

Multipurpose sheds are the only way to go at Surat

Ian Rollinson describes himself as a moisture grower who operates on the western edge of the Queensland cropping region. If there is moisture in the soil and he thinks he can make a dollar, he will grab the opportunity. The Rollinsons have three planting opportunities, the main winter season, early summer and the main summer. After some 'unsuccessful' experiences storing fertiliser in silos, and a missed opportunity to make the most of a drop in fertiliser price in 2019, Ian set about to build a substantial multi-purpose shed. While they missed that initial opportunity, it has been a valuable asset since.

Fertiliser program

The season, crop stages and what the grain and fertiliser markets are doing are all considered when determining the Rollinson's fertiliser program. With labour being an issue at planting time, the Rollinsons use a spreader ahead of rain events or direct drill 100kg/ha of urea ahead of planting to build base levels on their fallow country. When seeding cereals, 30 to 45kg/ha MAP is applied and if a rain event is coming through and there is good potential, they will use the spreader in-crop. With some soil types that are very sticky, spreading in wet conditions can be a bit hazardous.

Storing fertiliser when it makes sense

While purchasing and storing urea made sense in 2022 with wheat prices more than $400/t, Ian believes if they were $200/t, not many people in his district would be putting much urea on at all. Additionally, being located 100km south-west of Queensland's main feedlotting area, most of their grain will go direct into feedlots. 2021 was different, as it made economic sense with export quality wheat, to bypass the feedlot market and capitalise on price premiums internationally.

Generally, the Rollinsons will order the winter crop requirements early in the year and then make summer crop purchases as the year progresses. In 2022, they took advantage of early season prices (knowing they could store on-farm) and bought significant tonnages direct from Brisbane. While the Rollinsons do have their own trucks, they do not hesitate to use commercial carriers if the timing does not suit them to pick up fertiliser.

Outsourcing

The Rollinsons contracted a local shed builder to build their substantial 40m x 25m x 6m multi-purpose shed, which gives them the capacity to store about 4000t of fertiliser if they choose, however that is not Ian's preference. They strongly believe given the size of the shed, it made sense not to skimp on materials or

expertise to make sure the shed was built to a standard so it will still be a valued asset in 30 years. Having professionals build the shed meant it was done in a timely manner and the concrete was mixed and poured properly, something the Rollinsons did not have the confidence to do successfully themselves. The tilt concrete walls are about 2.7m high above the slab and 170mm thick. The slab is 200mm thick and double meshed with an expansion joint along the middle. The shed also was constructed with doors to help keep the weather and pests out. They have also put mesh around the outside of the shed to help prevent homing pigeons and Indian myna birds entering through the side walls of the shed.

The slab of the multipurpose shed is 200mm thick and the tilt concrete walls are 2.7m high and are 170mm thick. Photo: CussonsMedia

Sumac auger and telehandler

With a capability of unloading 6t/minute, Ian notes carriers love coming to unload at their property because their 36m Sumac 38cm belt auger is so quick. While some growers prefer to keep fertiliser off belt augers, Ian does not really see it as a significant issue because they are not regularly handling fertiliser. They also use a telehandler to load trucks quickly and if the fertiliser does become lumpy, the telehandler is good at breaking those lumps up.

The 36m Sumac 38cm belt auger can unload 6t/minute. Photo: CussonsMedia

Multipurpose

Headers and equipment that is not used often are stored in the shed and Ian notes they have also had up to 2500t of wheat in the shed at certain times. While that is a bit of a risk, Ian comments that the grain is not in the shed for long. Ian encourages those considering building a multipurpose shed just to do it as he said the convenience factor of having it to accommodate a range of situations is excellent. In 2021, he notes they were sent home from Meandarra with three road trains of chickpea. Having the shed meant he could dump the chickpea in it and come up with a revised marketing plan later.

The multipurpose shed is also used to store chemicals. Photo: CussonsMedia

Improvements for next time

With the need for infrastructure on another property, the Rollinsons are in the process of building another multipurpose shed. One of the lessons learnt from building the first shed is that they did not build the rear wall high enough to allow the fertiliser to peak right to the back wall but Ian notes that would also require more supports. He would also make the shed 8m high so small semitrailers could tip quickly and easily if he is only getting a smaller quantity of fertiliser delivered. Ian is also considering adding bunker walls and is interested in the triangular rather than T-shaped bunkers. He comments that most of the T-shaped ones are difficult to clean fertiliser out of, especially if trying to clean up with a bucket that can easily chip the concrete. Something that has also caught Ian's eye is a manufacturer in Warren, NSW who is making sealed sheds, something he believes the industry will see more of in the future.

Summary

- It makes sense to build quality multipurpose sheds for increased flexibility to store a range of machinery, grain and fertiliser at different periods.
- Professionals ensure the quality of the shed build.
- 40m x 25m x 6m shed has the capacity to store about 4000t.

MORE INFORMATION Ian Rollinson 0428 265 317

SNAPSHOT

GROWERS: David and Petrina Ronald

LOCATION: Quirindi, Liverpool Plains, NSW

FARM SIZE: 2000ha

ANNUAL RAINFALL: 670mm

CROPS GROWN AND TARGET YIELDS:
Sorghum 8t/ha, wheat 7t/ha (dryland), cotton 10t/ha (irrigated)

SOIL TYPES: Black vertisol

While David Ronald prefers not to store fertiliser, when he does, it is in his multipurpose shed after a poor experience with storing fertiliser in a silo. Photo: CussonsMedia

Storing fertiliser in silos is a no go at Quirindi

Using a sledge hammer and crowbar to remove 10t of urea that had set hard in a specialist fertiliser silo was the impetus for Liverpool Plains grower David Ronald to erect a kit shed to hold fertiliser for the short term.

Irrigated and dryland cropping

Operating an intensive farming operation, the Ronalds fertilise to achieve their target yields of 7t/ha of wheat, 8 to 10t/ha of sorghum and 6 bales/ha of cotton (all dryland) plus 10 bales/ha for semi-irrigated cotton. Their irrigated country is generally always in crop with wheat following the cotton and then when the wheat is harvested, another summer crop will be planted. Their dryland country is generally in a three year rotation of wheat, followed by a summer crop and then a fallow.

Soil tests drive nutrition strategy

Fertiliser requirements are driven by soil test results and on the irrigation country, this equates to nearly 100kg/ha of MAP plus urea. MAP with zinc is applied pre-planting for both dryland and irrigated crops using some modified strip till units out of America. The units are used to part the stubble and, with single disc units they have adapted, MAP and urea is applied 15cm to the side of where the planting row will go. The stubble clearer part of the unit then covers any fertiliser that has not been covered. To minimise spreading risks and to reduce the potential for losses through volatilisation in the summer cropping program, David prefers to apply most of the nitrogen before the crop is sown. On their irrigated country, additional in-crop fertiliser applications are made using a spreading contractor or fertigation.

Concrete bunkers

About 15 years ago, the Ronalds erected a kit shed with two 1.2m high concrete bunkers, each with the capacity to store 60t of fertiliser. David is reluctant to describe himself as a storer of fertiliser, preferring to order and take delivery of fertiliser from the Newcastle port as close as possible to when it is required. David has greater confidence to store MAP than urea saying MAP will last for six months, by which time preparation for the next crop is underway. In contrast, he is reluctant to store urea for any more than a couple of weeks. If there is any leftover urea, a loader with a large bucket is used to break it up before putting it in the spreader and getting it out onto a crop as soon as possible.

If David Ronald built another shed to store fertiliser, he would increase the roof height to make tipping easier for semitrailers.

Photo: Petrina Ronald

Shed height

David was not keen on building a shed with a rolling roof that has to be pushed to be closed and opened because as David said, "If you're down the paddock and there's a storm coming over the hill and roof is back, who's going to close it?" Instead, he wanted a pretty indestructible shed that was tall enough to tip dog trailers and single trucks. Nowadays with larger trucks, David commented that if they had made the shed just a bit higher at 7m, then large semitrailers would be able to tip more easily. While the shed is tall enough to store machinery, with year-round cropping it is not very often the shed is completely empty of fertiliser and therefore available for machinery storage.

Weather

For growers considering building a shed, David recommends considering the location carefully. In his instance, the restriction of a large powerline has meant the shed faces the weather which, David adds, could be rectified by putting doors on the shed. He also comments that they did not quite get the levels right when laying the concrete floor and when water does blow in, it pools in places. While he knows that they did not get their fertiliser shed 100 per cent right, David strongly recommends shed storage over silos any day.

Summary

- Consider height of shed for unloading of large semitrailers.
- Consider location of shed to keep out the weather.
- Happier to store MAP longer than urea in the shed.

MORE INFORMATION David Ronald 0427 005 786

Without a need for another multipurpose shed, Ben Taylor opted to add another fertiliser silo to store more fertiliser on-hand. Photo: CussonsMedia

Being proactive not reactive is the future for fertiliser storage at Condamine

SNAPSHOT

GROWERS: Ben, Kate and Sam Taylor

LOCATION: Condamine, Western Darling Downs, Queensland

FARM SIZE: 4000ha

ANNUAL RAINFALL: 585mm

CROPS GROWN AND TARGET YIELDS:
Wheat 2.5t/ha, chickpea 1.2t/ha, sorghum 2.5t/ha and cotton 8t/ha

SOIL TYPES: Heavy black clay, light black clay and red clay

Use fertiliser efficiently

For Ben Taylor soil testing is a no-brainer, and that was before fertiliser prices reached all-time highs. Soil testing allows Ben, his wife Kate and brother Sam, to ensure they are using this input in the most efficient way possible. The Taylors, in conjunction with their agronomist, develop a variable rate fertiliser strategy for the three different soil types using soil test results, NVDI and header data. Ben also believes that from a public environmental perspective, as an industry, it is our duty to be using fertiliser in an efficient manner.

Ordering months in advance

While the Taylors have had one 66t Ahrens silo for about five years, they used to store fertiliser for no more than two weeks. In the last 12 months that strategy has changed because of product pricing and availability, transport logistics and weather opportunities. Urea is applied with discs in January–February ahead of wheat before 20 to 38kg/ha of MAP is applied at sowing. Leading into the summer crop, the Taylors strip till wheat stubble applying a Starter Z fertiliser and occasionally a urea blend, depending on soil test results. Historically those products would have been on-hand a couple of weeks before they were required. Now they are ordering months in advance and collecting it from Brisbane port in a specific month, so having the capacity to store fertiliser is important. For example, in 2022 Ben pre-ordered a

fair proportion of his urea requirements in anticipation of a good yield potential as he has a full moisture profile and the grain price outlook was promising. Ben adds that traditionally in his area, fertiliser was generally purchased as required, but he is a firm believer storage of fertiliser for longer periods of time will be the new norm.

Carriers

The Taylors are close to a number of feedlots in the Condamine region and Ben notes in nine out of 10 years, they would deliver wheat from their storage facilities to the feedlots using their truck. However, in the last few years, with export quality wheat produced, they, and many others, have relied on carriers to transport grain to Brisbane and backload with fertiliser. While Ben has found carriers are really busy and it can be difficult to pick up fertiliser within the contracted timeframes, Ben still believes using carriers is a better option than employing more labour to use their own truck.

Capitalise on opportunities

Storing fertiliser on-hand has also given Ben and his family the ability to capitalise on good weather events. If seasonal conditions are looking promising and there is potential for yields above what they have fertilised for, Ben is inclined to use their truck to head into Dalby to pick up any additional fertiliser. Although the Taylors recently purchased a fertiliser spreader to increase application efficiencies through PA maps, their timing preference is to use a local aerial contractor for broadcasting urea in-crop. This is because, with storms popping up, Ben can make a quick phone call to the aerial applicator and in a matter of hours they can have large areas of urea applied and have capitalised on that rain event. Increasing fertiliser storage also gives the Taylors the opportunity to purchase and store fertiliser if the price is appealing.

No need for a shed

The investment in an additional 66t Ahrens fertiliser silo rather than a bulk fertiliser shed made the most sense for the Taylors because their existing sheds are not big enough to efficiently maneuver a machine such as a telehandler and they did not need to build a new shed. While Ben admits he does not have a huge amount of confidence in storing urea in particular, they have stored it for months at a time all year round without issue. When auguring urea out of the silos, he opens the lids to prevent silo wall collapses. Ben also taps the sides of the silo with a rubber hammer and uses a combination of steel bars and the crank handle in the silo to get the fertiliser to run. The Taylors use an old Miitze auger that helps to break up any lumps. While the Taylors have belt augers, the Miitze is preferred to keep the fertiliser dust contained and prevent it settling on the motors.

Logistics to consider

When deciding the location of the silos, Ben said it was really important to choose a site that allowed fertiliser to be delivered in all-weather events. Whether there had been 5mm or 50mm of rain, growers need to have confidence that a truck can get in and unload or load. Although the Taylors farm a number of properties, they decided to have both silos at one location rather than need augers at different locations.

With flooding an issue, it is important that fertiliser storage facilities have all-weather access. Photo: CussonsMedia

Summary

- Use data to make efficient use of fertiliser.
- Order fertiliser in advance to lock in supply and capitalise on opportunities.
- Using fertiliser silos was a great option when there was not a need for an additional shed.

MORE INFORMATION Ben Taylor 0427 692 175

Phillip (left) and Tom Coggan are big supporters of applying liquid fertilisers with a dual liquid system on their Horsch planters. Photo: CussonsMedia

SNAPSHOT

GROWERS: Phillip and Tom Coggan, Coggan Farms

LOCATION: Inglestone, South West Darling Downs, Queensland

CROPPING AREA: 12,200ha (800ha irrigated)

ANNUAL RAINFALL: 550mm

CROPS GROWN AND TARGET YIELDS: Wheat 2 to 3t/ha, barley 2 to 3.5t/ha, sorghum 2 to 4.8t/ha and chickpea 0.8 to 2t/ha

SOIL TYPES: Red to Chocolate Briglow Balah to Moonie River Flats

Liquid fertiliser adds flexibility at Inglestone

After considering using liquid fertilisers for a number of years, the purchase of a new Ground Breaker planter in 2016 prompted Phillip Coggan and his family to make the switch to liquids. At the time, they were growing chickpea consistently and liked the idea of using a liquid starter fertiliser to bounce the chickpea out of the ground faster than traditional granular fertiliser. It is this rapid emergence the Coggans believe is one of the greatest benefits of using liquid fertiliser. Phillip commonly finds a shoot on a seed 24 hours after planting, even in dry conditions. He believes this is a significant advantage when deep sowing as it allows the plant to germinate faster, which is particularly important when there is a significant rain event coming and the seed could otherwise struggle to emerge.

Storing urea

Over the past few years, to alleviate supply issues, the Coggans have forward purchased urea, which has also been a cost saving. As opportunistic croppers, they have been double cropping the past few seasons so have required urea all year round. During these times they have had urea coming back from Brisbane port each day and they have generally been able to keep the urea in three road trains and spread it as it arrives, however sometimes they have had to store it in silos. The Coggans have been caught with moisture becoming trapped in the silo and the urea getting stuck and with a significant number of employees, employee safety when handling urea is a significant concern. So, in 2022 they changed the approach and used 250,000L of UAN across the program, finding it was both easy to use and accessible, as they could order it one day and apply it the following, something that was not possible with urea.

Liquid P and liquid N

Coggan Farms has two liquid tanks with two systems on three planters, so they can apply liquid nitrogen (UAN), a liquid starter fertiliser, FlowPhos 15 (phosphorus) or an inoculant. In 2022 they broadcast 100kg/ha urea before planting and then applied 30 to 40L/ha Flowphos 15 at planting before finishing with 75L/ha UAN before head emergence. The Coggans are

continually comparing the cost of a unit of N and P between the liquid and granular fertiliser. In 2023, after using a liquid phosphorus product for 5 years, they will be switching back to granular starter fertiliser (MAP) because the liquid cost has outpriced itself. In an ideal world where the cost of the liquid fertiliser is comparable, the Coggans would apply 50L/ha of UAN with 30 to 40L/ha of Flowphos 15 at planting before coming back during the season using streaming nozzles to apply at least 50L/ha of UAN before head emergence. Phillip has had very little leaf burning applying the UAN with streaming nozzles and have actually had more burning from broadcasting urea.

When they first began using Flowphos 15 at sowing, the Coggans used 15 to 20L/ha but now run heavier rates of 20 to 40L/ha because of the results they see with the higher rates. On the irrigation country, they have applied Flowphos 15 at 70 to 100L/ha at sowing on a 12-inch (30.5cm) row spacing.

The plumbing system on the semitrailer, which contains three 15,000L tanks, allows for product mixing in the tanks (that is, the addition of trace elements) and it can fill the nurse trucks from either side. Photo: Petrina Ronald

Coggan Farms has two sets of six 16,000L cone-bottom tanks at a central location on the property. Photo: Petrina Ronald

The two nurse trucks each contain two 5000L tanks and a 2000L water tank. Photo: Petrina Ronald

Liquid storage set-up

Coggan Farms has a registered site for UAN, which allows tankers to deliver the product on-farm. The local farm supplies agency assisted with this process, which involved ensuring there was an adequate slab for the tanks (150mm concrete), there is all-weather access, a tap on every tank so each tank can be isolated and that the pumping system is adequate for the task.

The Coggans have two sets of six 16,000L cone-bottom tanks purchased from Gatton in the one central location on the property. They have one main line that connects to all the tanks, which Tom Coggan says is important as it prevents losing product each time the camlock is disconnected.

Moving liquid fertiliser around the farm

The Coggans have a semitrailer with three 15,000L tanks, which they can use for liquid fertiliser including trace elements, fungicide or herbicides. This gives them enormous flexibility as they can use product from whichever tank and mix it, assuming it is compatible. They also have two smaller 8-wheeler trucks with two 5000L tanks and a 2000L water tank on the front that runs from the bigger truck to the planters. The smaller nurse trucks work really well in wet planting conditions, as it can fill either side. Phillip explained that if it is really wet, the nurse trucks can pull up on the road and the planters can drive up and fill from either direction. The filling process is really efficient as the Coggans use three inch (76mm) high flow pumps that can pump 1000 to 1200L/min. As Phillip says it is much quicker than running a tractor around with a grouper bin or a chaser bin full of urea.

In 2022, for the post-emergent application of UAN, two of the three 15,000L tanks were filled with UAN leaving the front tank for rinse water. Using the front tank for rinse water meant they could flush 100L of rinse water through the sprayer without spilling any liquid on the ground.

Benefits of liquids

A significant benefit of liquid fertiliser according to Phillip is that it is a commodity, just like diesel. So when there is likely to be a price rise, he has the capacity to purchase and easily store the products for later use. For example, in 2023 the family has some UAN leftover from 2022, which is about 40 per cent cheaper than the current price.

Although it might appear complex running a liquid system on planters, the Coggans believe it is all worth it for the logistical benefits. One of the biggest benefits of the liquid starter is both aircart tanks can be filled up with seed. So, on the 18m planters,

they have the equivalent of 17,000L of seed on board with 10,000L of liquid, which allows them to keep planting to a 15-hour window, so the team is not trying to fill up in the dark. The Coggans use a chaser bin to fill the seed up, so the planters can be filled in under ten minutes. Keeping the planting to a 15-hour window also means the broadacre team is not impacting the livestock team to keep the planters moving.

One of the biggest benefits of using UAN for Coggan Farms is it can be applied at any time and unlike urea, it is not necessary to wait for a rain event.

Lessons learnt

Introducing a new system did not come without learning some lessons. The first was the need for really good filtration systems, preferably on the planter and on the system that fills the planter. The Coggans found they were initially agitating the system too much, which resulted in blockages so they added a three-inch (76mm) Banjo filter that is very easy to clean. The monitoring of the pressure gauges is important to detect if the pressure is running too high, indicating dirty filters.

This is where it is important to have skilled operators who "can do more than just drive up and back in a paddock" because running liquids systems on planters is just like running two spray rigs. When staff start planting, the system is put in test mode every hour for the first day, just like testing nozzles on a spray rig. To alleviate as much human error as possible, the Coggans have outlawed in-cab switches on the end of runs and now have the machines set so as soon as they are lifted out of the ground, they switch off.

When they first applied a liquid starter fertiliser, the Coggans initially applied about 15L/ha, which they believe is not enough to get the benefit of the liquid phosphorus. Because the Coggans had some leftover Flowphos from 2022, they have diluted it 50/50 so they are getting the desired rate of phosphorus and the extra water helps with the seed emergence and also keeps the pressure running at an ideal level.

Future plans

In an ideal world the Coggans would prefer to apply both starter fertiliser and liquid nitrogen through the planter however it must be cost effective. Therefore, they have started investigating options where granular fertilisers are converted into liquids.

Summary

- Liquid fertilisers are commodity products like diesel.
- Liquid fertilisers allow greater flexibility and efficiency than granular fertiliser.
- Skilled staff are essential to operate planters with liquid systems.

MORE INFORMATION Phillip Coggan 0427 630 798

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