



USE OF FERTILISERS AS MINERAL SUPPLEMENTS FOR RUMINANTS

1. INTRODUCTION

Livestock cannot always obtain the nutrients they need in sufficient quantities from the forage they consume or the diet they are fed. Direct mineral supplementation may be necessary:

- Where the soil's fertility is low, and pasture grown on it is lacking in nutrients. This occurs, for example, on beef grazing lands in northern Australia, where the soils are low in phosphorus. The low carrying capacity of pastures in this environment makes fertiliser application uneconomical. Hence it is necessary to provide direct supplementation to grazing animals.
- When the nutritive value of the feed is low, e.g., standing forage in dry seasons, when going into drought, or with rations comprised almost entirely of cereal grains.
- With high producing animals, e.g., lactating dairy cattle.

There are several Incitec Pivot fertiliser products that are suitable for use as mineral supplements for livestock, including Urea, Gran-Am (granulated ammonium sulphate) and Muriate of Potash (potassium chloride). These products cannot be fed on their own. They need to be mixed with other foodstuffs, e.g., molasses, salt, and grain, in licks, blocks and rations, to regulate their intake and overcome any palatability problems.

Importantly, there are many other fertilisers which must not be used for livestock supplementation. Notable among these are granular phosphorus fertilisers, i.e., Incitec Pivot DAP, MAP and SuPerfect (Single Superphosphate), which are too high in fluorine to be considered for dual uses as mineral supplements for livestock. Their use as such is likely to result in fluorosis.

This Agritopic provides general advice only. Professional advice should be sought on formulating supplements and rations, e.g., from animal nutritionists, as supplementation rates vary with the quality of the feed on offer and the class of animal. Publications are also available from State Departments of Agriculture and Primary Industry on livestock supplementation.

2. RUMINANTS – WHAT MAKES THEM DIFFERENT?

Many classes of animals, e.g., pigs and poultry, may benefit from supplementation with minerals such as calcium (Ca) and phosphorus (P). Ruminants, e.g., cattle and sheep, not only benefit from mineral supplementation with these elements, but may also benefit from supplementation with nitrogen (N) and sulphur (S), which are important constituents of protein.

Bacteria and Protozoa, present in the rumen or paunch of ruminants, play a vital role in the digestion of cellulose, from the cell walls in plants. The host animal cannot digest this material on its own. When these microorganisms pass from the rumen to the intestine, they are in turn digested, and become a valuable source of energy and protein for the host animal. The population of bacteria in the rumen depends on the supply of energy and nitrogen in the ingested food.

Where ruminants are provided with low quality feed or roughage, nitrogen (protein) is the major limitation. The bacterial population will fall and the whole digestive process will slow down. Cellulose will not be digested as rapidly. Food will be retained in the rumen for a longer period, and intake will fall. Livestock will not put on weight as quickly and may even lose condition. Production will fall.

Rumen bacteria can utilise non-protein nitrogen as well as protein nitrogen (from the forage) in the synthesis of their body proteins. If the feed contains less than 8% crude protein, supplementation with non-protein nitrogen helps maintain the bacterial population. Food intake will be higher and better use made of poor-quality roughage. Stock losses in times of drought can be minimized. In intensive livestock management systems, e.g., feedlots, animal production can be boosted.

Nitrogen is not the only element that may be low and limit production. Sulphur, another major constituent of protein, is also important. As with nitrogen, supplementation with non-protein sulphur may be beneficial where the feed is low in protein (and sulphur).

For ruminants, the diet should contain between 0.18 – 0.25% S (dry weight), and the N:S ratio should be no more than 13:1. Ideally, the N:S ratio should be lower, between 10:1 and 12:1. Sheep may have a higher sulphur requirement than cattle, as sulphur is extremely important in wool production. For ruminants, sulphur supplementation may be necessary if sulphur content of the diet falls below 0.18% S, and the N:S ratio exceeds 13:1.

Urea is the most used non-protein nitrogen supplement for ruminants. Urea forms ammonium in the rumen. The ammonium nitrogen in ammonium sulphate and ammonium phosphate can also be used by ruminal bacteria.

Sulphur can be administered as ammonium sulphate or finely divided (powdered) elemental sulphur.

3. UREA

3.1. Product choice

Urea is the most economical and commonly used non-protein nitrogen supplement for ruminants. Any urea fertiliser may be used for this purpose. Urea with a small particle size will dissolve more quickly, with less agitation, if urea solutions are to be prepared, e.g., for use in licks.

Incitec Pivot Granular Urea has a particle size comparable to other granular fertilisers. This enhances its handling characteristics and makes it more suitable for use in fertilizer blends. It does, however, make it more difficult to dissolve compared to products with a smaller particle size, such as Incitec Pivot Prilled Urea and Incitec Pivot Stockfeed Urea.

Prilled Urea is imported into north Queensland, and is available ex Mackay, Townsville, and Cairns. Stockfeed Urea is obtained by screening under-sized granules from Granular Urea at the time of its manufacture at the Incitec Pivot's production facility in Brisbane.

Once dissolved, there is no difference in the efficacy of any of these products. Those with a smaller particle size are simply easier to use. Nutritionally, the products are identical. There is no need to use a low biuret grade of urea when formulating livestock supplements. Biuret is only of importance when urea is used in foliar sprays. Urea is endothermic, i.e., it will cause the temperature of the solution to fall as it dissolves in water.

3.2. Drought and dry season feeding

At the onset of the dry season or in the early stages of drought, urea can be used to stimulate the appetite of ruminants and improve the utilisation of dry low-quality feed. Ample roughage is essential for this to occur.

For beef cattle, a typical urea rate is 60 grams (g) per head per day. Cattle should be introduced to urea slowly by building up to this rate. Start with 15 grams/head/day initially and increase by this amount weekly until the desired rate is reached. This not only applies to stock being introduced to urea for the first time, but also when there has been a break in the feeding program, e.g., due to wet weather.

As paddock feed is eaten out, non-protein supplementation becomes less effective. Stock will start to slip in condition and require a source of energy as well. Grains are high in energy. Other sources include whole cottonseed, molasses, hay, silage and to a lesser extent stubble and sugar cane tops.

Depending on the energy source and quantity fed, urea supplementation may be able to be stopped at this time, i.e., if the energy supplement is high in protein as well, e.g., lucerne hay.

Molasses is one of the more commonly used energy supplements:

- If feeding a low urea fortified molasses mix, the urea concentration must be built up slowly, i.e., gradually increased.
- If feeding a high urea molasses mix, start with the final or desired mix. If the urea concentration is gradually increased, stock may become accustomed to its bitter taste, resulting in higher intake of the final mix. This may increase the likelihood of urea poisoning.

3.3. Feedlots

For cattle being finished in feedlots, a rule of thumb is that non-protein sources of nitrogen should not make up more than one-third of the crude protein in the diet, and that urea should not be added at more than 1% of the diet for palatability reasons.

3.4. Preparation of licks

Care must be taken to ensure urea is completely dissolved in molasses licks, as it can be toxic if not mixed properly and livestock consume more than the intended amount. Dissolve the urea in water first, before adding the molasses. Some form of agitation is necessary, e.g., a mechanical mixer. Allow plenty of time to make sure the urea dissolves properly. If necessary, mix then allow to stand overnight, and remix the next morning to make sure all particles of urea have dissolved.

3.5. Urea poisoning

While poisoning may be attributable to accident, poor management or faulty equipment, the most common causes are:

- Increasing the supplementation rate too quickly, especially when stock is hungry.
- Stock drinking concentrated solution off the top of dry licks after rain.
- Urea not being properly dissolved in wet licks.

- Stock being able to drink liquid mixture instead of licking it off roller drums.

Death from urea poisoning is rapid (generally within 2 hours of ingestion of the urea) and often by the time symptoms appear (severe abdominal pain, shivering, excessive saliva, rapid breathing, unstable gait, bellowing and bloat), it is too late.

To have any chance of being effective, treatment must be quick. Vinegar (acetic acid) needs to be administered at quite high dose rates (2 to 4 litres as a guide for cattle) repeating the treatment if necessary. The vinegar makes the ruminal contents more acidic and delays uptake of ammonia by the blood.

4. SULPHUR

4.1. Product choice

The only fertilizer product marketed by Incitec Pivot that may be used as a source of non-protein sulphur is Gran-Am (granulated ammonium sulphate). Gran-Am is manufactured in Brisbane. It contains granulation and coating agents that may cause a sediment to form in mixing tanks, particularly if the water is alkaline or hard, or soluble grades of MAP are used in the mix as well. A scum may also form on the solution surface or be left on the internal walls of the mixing tank. If the sediment or scum cause problems, it may be necessary to purchase a higher purity solution grade of ammonium sulphate.

Sodium sulphate, and powdered grades of elemental sulphur (Flowers of Sulphur) may also be used as sulphur supplements.

Incitec Pivot Sulphur Bentonite cannot be used for this purpose. The sulphur it contains will not be released quickly enough in the rumen to be of benefit.

4.2. Supplementation

The principal source of sulphur for livestock is protein in green feed and grain. As pasture matures and protein levels drop, sulphur intake diminishes. The nitrogen: sulphur (N:S) ratio in pasture remains relatively constant as the pasture declines in quality. Hence, when supplementation with Urea commences, it would seem wise to commence supplementation with sulphur as well. Without it, utilisation of the Urea and dry feed might be reduced, and sulphur deficiency may occur.

A target N:S ratio of 10:1 is generally recommended in the diet and supplements for ruminants. This can be achieved by adding 1 kg of Gran-Am to every 5 kg of urea in the supplement; or where elemental sulphur is used, 1 kg of elemental sulphur to every 20 kg of urea.

Where urea and Gran-Am are used, the urea supplementation rate can be reduced by about 10%, to allow for the extra nitrogen supplied as Gran-Am, i.e., administering 55 instead of 60 g of urea per head/day. The combined urea plus Gran-Am mix needs to be administered at a 10 - 15% higher rate to apply the same amount of non-protein nitrogen.

In mulga country, supplementation with urea is seldom required, but sulphur is. Mulga is high in protein, but its digestibility is low. Extra sulphur can improve the utilisation of mulga leaf. Gran-Am can be used for this purpose, even though it contains some nitrogen.

Where molasses is used as an energy source, additional sulphur is unlikely to be required. Australian molasses is high in sulphur (ranging from 0.4 to 1.4% S, and typically around 0.7% S).

NOTE: Urea and Gran-Am are of no use to non-ruminants, e.g., pigs and poultry.

It is not necessary to remove horses from paddocks in which ruminants, e.g., cattle, are being supplemented. Non-protein nitrogen and sulphur is of no nutritive value to horses but at low intake rates, should not harm them, provided they are introduced to the supplement slowly. Horses, like other animals, can be poisoned by Urea if consumed in excessive amounts.

5. POTASSIUM

The body contains 2 g/kg K live-weight, making potassium (K) the third most abundant mineral in the body. However, while essential, potassium is regarded as a non-critical element for ruminants (cattle and sheep) as the concentration in feedstuffs is usually well more than requirements.

Estimates of the required potassium concentrations in feeds for animals vary but are of the order of 5 – 8 g/kg K in Dry Matter (DM) for growing animals and 8 – 12g/kg K in DM for lactating animals. Potassium requirements may be higher (towards the top end of these ranges) over summer and in tropical areas, to compensate for losses in sweat.

Green plant material usually contains more than 15 g/kg K in DM and can be as high as 100 g/kg K in DM, so the potassium requirements of animals grazing green pasture and forage crops is more than adequately met.

Where pasture growth is seasonal, the potassium content declines after senescence, even more so than dry matter digestibility or protein. Potassium is more soluble and readily leached from pasture than other nutrients. In southern Australia, which has a winter-dominant rainfall, the potassium content of plant material declines by late summer to less than one-third of the spring value. It is possible, therefore, that potassium supplements may be of value in these areas over summer, although the widespread feeding of lupin grain, which contains appreciably more potassium than cereal grains, probably negates this need.

While potassium deficiency is not likely to occur in beef cattle grazing on pasture, it may occur in feedlots. Cereal grains contain around 4 g/kg K in DM. Hence animals that are fed largely on a grain diet, e.g., in feedlots, will need potassium supplements.

Incitec Pivot Muriate of Potash (potassium chloride) may be used in formulating feedlot rations, though potassium bicarbonate is often preferred, particularly where cereal grains are fed in high amounts and cause acidosis.

Potassium bicarbonate buffers the pH of the rumen.

6. PHOSPHORUS

Phosphorus makes up more than 20% of the body's mineral ash, being second to calcium. Nearly 80% of the phosphorus (P) in animals is found in bones and teeth. Pregnant and lactating animals have a high phosphorus requirement.

Phosphorus supplements are used where the diet is low in phosphorus, and for high producing animals, e.g., lactating dairy cattle. For beef cattle on unfertilised phosphorus (P) deficient country in Queensland, the recommended supplementation rate is 5 grams P per head per day for dry cattle and 10 grams P for lactating breeders. In North Queensland, the recommended time of year to feed phosphorus supplements is during the wet season (summer) when pastures are at their best and cattle are gaining weight.

Lactating dairy cattle may also require supplementation. Supplementation rates will depend on the quality of the feed on offer, and what other supplements are being fed in the bails. The advice of an animal nutritionist or Dairy Husbandry Officer should be sought.

Lot fed cattle on high grain diets do not require phosphorus supplements, as most grains are high in phosphorus.

The most used phosphorus supplements are dicalcium phosphate (DCP) and monocalcium phosphate (MCP). DCP typically contains 17 – 18% P and 25 – 26% Ca, and MCP 22% P and 16% Ca. These products have low solubility and are mixed in dry with the feed. MCP is the more soluble of the two, and therefore more readily available for absorption by the animal.

High purity technical grades of monoammonium phosphate (MAP), of the type used in fertigation programs, may be used in the preparation of licks for use in roller drums.

The granular phosphorus fertilisers marketed by Incitec Pivot, i.e., DAP, MAP and SuPerfect, must not be used as mineral supplements for livestock. These products contain around 2% fluorine (F). Their use in animal feeds and stock licks is likely to result in fluorosis (fluorine poisoning).

7. CALCIUM

Calcium is the most abundant mineral element in the body, about 99% of which is present in the bones. Calcium supplementation is not usually necessary under grazing conditions but is important in feedlots. DCP and MCP supply calcium and phosphorus. Grains are high in phosphorus, but they are low in calcium. Where beef cattle are finished on a diet consisting largely of grain, limestone (calcium carbonate) can be added to the ration.

Incitec Pivot does not market any calcium products that may be used as livestock supplements.

8. MAGNESIUM

Grass tetany or staggers (magnesium deficiency or hypomagnesaemia) most commonly occurs on lush fast-growing crops or pasture, and in high producing animals, e.g., lactating dairy cattle. In dairy pastures, high rates of potassium fertiliser can depress magnesium uptake by pasture species, and further increase the risk of magnesium deficiency in pregnant and lactating animals. The risk of Grass Tetany can be minimized by supplementation with finely ground magnesium oxide.

The granular fertilizer grade of magnesium oxide that is marketed by Incitec Pivot is too coarse to be used as a livestock supplement. It will not disperse quickly enough in the gut to be of nutritive value.

9. PRODUCT ANALYSES

The analyses of the Incitec Pivot products discussed in this Agritopic that may be used in ruminant supplementation are shown in Table 1.

Table 1: Product analysis.

Product	Nitrogen		Potassium % K	Sulphur % S
	% N	% Crude Protein*		
Urea	46	287		
Gran-Am	20.2	126		24
Muriate of Potash			50	

* Crude Protein is an estimate of the total protein content of a feed. It is determined by analysing the nitrogen (N) content of the feed and multiplying the result by 6.25. Crude protein includes true protein and other nitrogen-containing substances such as urea and ammonium. It is a requirement of Stock Feed Legislation that the Crude Protein content be declared on the product label.

10. IMPURITIES

Mineral supplements may contain impurities, e.g., fluorine (F) and cadmium (Cd), which may affect animal health and/or the marketability of animal products. Incitec Pivot Urea, Gran-Am and Muriate of Potash are low in these elements, containing less than 100 mg/kg F and less than 1 mg/kg Cd. Mineral supplements for dairy cattle should contain less than 400 mg/kg F and for beef cattle and sheep less than 2,000 mg/kg (0.2%) F.

Phosphorus (P) fertilisers have a higher impurity content. The Fertilizer Australia “National Code of Practice for Fertilizer Description and Labelling” specifies that phosphorus fertilisers that contain more than 40 g F/kg P, and more than 100 mg Cd/kg P, while suitable for soil application, must not be used as mineral supplements for livestock or in stock rations. Incitec Pivot DAP, MAP and SuPerfect all exceed this amount of fluorine. SuPerfect also exceeds the cadmium limit.

11. QUALITY ASSURANCE

Quality Assurance (QA) programs require primary producers to seek assurances from their suppliers that their products are fit for the intended purpose, e.g., for use as a stock feed supplement.

A key objective of QA programs in livestock industries is to ensure that any agricultural chemicals used in the production of pasture, forage crops, hay, silage and grain was registered for such use and used according to label directions, so that pesticide levels in animal feeds are below the MRL (Maximum Residue Level) as listed by the National Health and Medical Research Council (NHMRC), and in turn do not lead to violations of MRLs in animal products.

While the primary focus of such QA programs is on feeds derived from plants, in which agricultural chemicals may be used for the control of insects, other pests, disease and weeds, assurances are also sought from suppliers of mineral supplements.

Incitec Pivot does add inhibitors and fungicide to some fertilisers, as listed below.

- eNpower® Nitrification Inhibitor - which is added to Urea and other fertilisers containing nitrogen in the ammonium form, e.g., eNpower Urea.

- NBPT (N-(n-butyl) thiophosphoric triamide) Urease Inhibitor – which is added to Green Urea NV.
- Fungicides, e.g., Flutriafol – which are added to planting fertilisers for the control of diseases such as Take-all in wheat and Blackleg in canola.

The use of these additives is clearly denoted in the product name.

These products are intended for use as fertilisers only and must not be used for any other purpose. They must not be used for direct ruminant supplementation, i.e., in the formulation of licks, blocks or in rations.

12. WARNING

The information contained in this publication is for use as a guide only. Local factors, such as feed quality and composition, and the class of animal being supplemented, must be considered, as these affect supplementation requirements and rates, and the way in which supplements are best administered.

Do not allow stock to have uncontrolled access to mineral supplement concentrates, e.g., before mixing. Clean up spills promptly.

Mineral supplements such as Urea can be poisonous to stock, if not fed properly.

Because conditions of use are beyond our control, Incitec Pivot Fertilisers hereby expressly disclaims any liability for commercial loss or damage to any person, animal, property, or thing in respect of any of the consequences of anything done or omitted to be done by any person in reliance, whether wholly or in part, upon the whole or any part of the contents of this publication.

13. STOCK FEED ACCEPTABILITY STATEMENT

- Incitec Pivot Granular Urea
- Incitec Pivot Prilled Urea
- Incitec Pivot Stockfeed Urea
- Incitec Pivot Gran-Am
- Incitec Pivot Muriate of Potash

The above products are suitable for use in the formulation of livestock licks, blocks and rations for ruminant supplementation.

Agricultural and veterinary chemicals, e.g., insecticides, antibiotics, and growth regulants, are not used in the manufacture of these products, nor are they added afterwards.

Fluorine and heavy metal impurity concentrations, e.g., cadmium, are below the maxima prescribed in Australian State Stock Feed Legislation.

14. SAFETY DIRECTIONS

Refer to the Safety Data Sheet (SDS) for more detailed safety advice. Before use, read the Product Label and the SDS. Use safe work practices and avoid contact with the eyes and skin. Avoid ingestion and inhaling dust. Protective clothing, eyewear and dust masks should always be used when dealing with this product. Observe good personal hygiene, including washing hands after use. Avoid loss of fertiliser to waterways.

15. WARNING

This document contains information of a general nature. Before using fertiliser seek independent agronomic advice. Fertiliser programs may need to be varied depending on the plants being grown, climatic and soil conditions, application methods, irrigation, agricultural and livestock management practices, the soil's fertility, and cultural practices. ('Unforeseen Elements')

Fertiliser may burn and/or damage crop roots or foliage. Foliar burn to the leaves, fruit or other plant parts is most likely to occur when fertilisers are foliar applied at high concentrations and/or on a regular basis, different products are mixed and sprayed together at cumulatively high rates, the water is of poor quality, or the spray is applied under hot dry conditions, e.g. in the heat of the day.

Fertiliser and supplements may affect animal health. Seek independent advice before using any supplements in livestock rations.

16. DISCLAIMER

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