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MEAT & LIVESTOCK AUSTRALIA

Why do cattle need phosphorus?

A guide for northern beef producers

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P
Phosphorus

Phosphorus (P) is:

- a major contributor to muscle and bone health
- essential for metabolism
- particularly important for improving cattle growth, health and milk production.

The need for phosphorus

For many regions in northern Australia, phosphorus (P) deficiency is a serious nutritional issue for beef herds and can cause major losses in productivity and profitability.

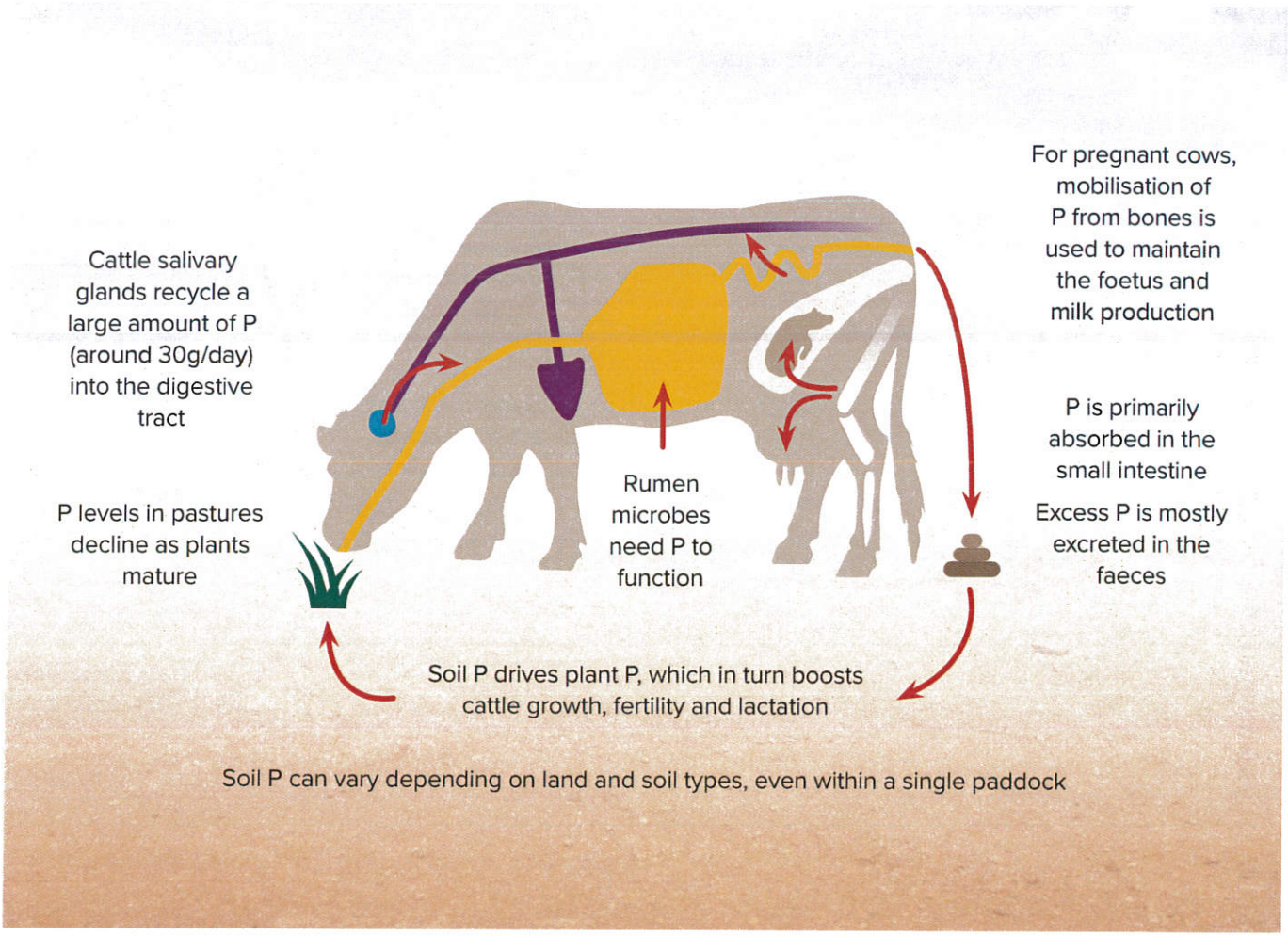
Cattle need phosphorus for almost every vital function of the body. It's used for:

- building bones and teeth
- metabolising fat, carbohydrates and protein
- producing milk
- increasing feed intake.

Deficiencies often arise in tropical production systems because most northern soils have lower available soil P compared with southern Australia. This means there's often insufficient phosphorus in the pasture to meet animal requirements.

The cattle that have the highest phosphorus requirements are growing stock, late-pregnant heifers and cows, and lactating cows.

Figure 1: How phosphorus is used in beef cattle



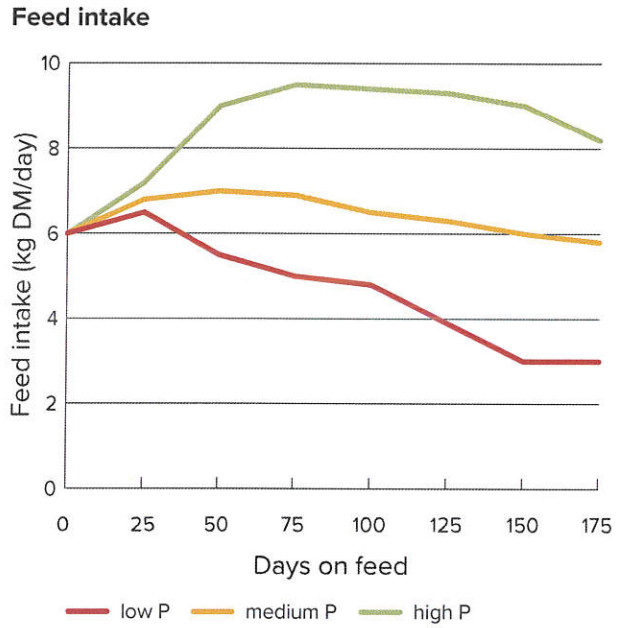
Several trials have demonstrated the benefits of phosphorus intake:

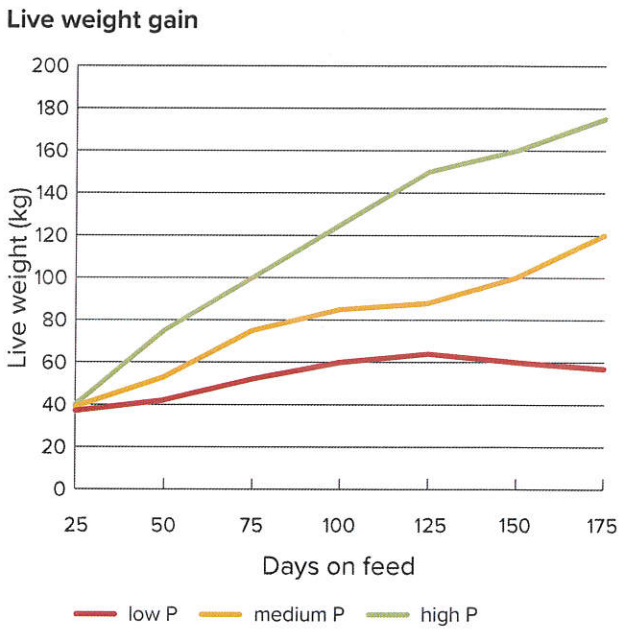
- ▲ 15–30% increase in **weaning rates**
- ▲ 6–12% increase in **birth weights**
- ▲ Up to 130kg increases in **breeder cow live weights**
- ▼ 15–50% decrease in **breeder mortality rates**

What has the research revealed?

Recent MLA breeder cow supplementation trials have provided a better understanding of phosphorus's role in northern beef herds, including when and where to provide the supplement cost-effectively.

Figure 2: The impact of phosphorus supplementation on feed intake and live weight gains





P supplementation of deficient cattle significantly increases feed intake. Cattle numbers should be adjusted to maintain a sustainable, long-term carrying capacity.

Improving growth rates in young cattle means:

- heifers reach joining weights at the desired time
- steers reach a target sale weight sooner.

How to identify a phosphorus deficiency

It's not uncommon for beef producers to be unaware that a phosphorus problem exists in their herd. If stock are gaining weight and body condition is maintained once the wet season has started, there can be a misconception that stock are getting the nutrients they need from pasture – which isn't always the case.

Here are some ways to identify a phosphorus deficiency:

CLINICAL SIGNS

While clinical signs such as 'peg leg' – where cattle develop an arched body, staggering gait and brittle bones – are a sure indicator of an acute P deficiency, serious production issues could be occurring long before the deficiency is identified in the herd.

SOIL

Soil maps can provide a general indication of phosphorus deficiency. Soil P is difficult to use for diagnosis at the paddock level where there can be marked differences in soil types within a paddock.

Careful soil sampling which captures the variability across large paddocks is required to obtain a full appreciation of soil P status (Table 1). This may be expensive if multiple samples are needed. Soil Colwell P levels of >8 mg/kg suggest that the pastures contain sufficient P.

Table 1. Phosphorus (P) status of beef cattle and indicative soil P levels

P status	Acute	Deficient	Marginal	Adequate
Colwell P levels PB (mg/kg)	<4	4–6	6–8	>8

COLLECTING SAMPLES

Blood

Measuring the 'plasma inorganic phosphorus' (PiP) levels of cattle that have not been fed P supplements for at least two weeks over the wet season is the best method to determine if the pastures are providing enough P (the P-Screen Test).

To collect a sample, randomly select 20–25 head (growing animals, heifers in early-mid pregnancy or lactating first-calf cows) grazing the test paddock. Sample late in the growing season when both dietary protein and energy are considered adequate.

In continuously mated herds, introduction of growing steers (prior to the wet season) or pregnant heifers can improve the confidence in the diagnosis. Because the PiP test is the most accurate indicator of dietary P, it can also be used to assess the effectiveness of supplementation programs. However, testing supplemented animals will not establish whether or not you need to supplement in the first place.

Table 2 below shows the best estimates of P status in growing and breeder cattle for a range of plasma inorganic phosphorus levels and diet dry matter digestibility.

Table 2. P status in cattle for a range of plasma inorganic phosphorus (PiP) levels and diet dry matter (DM) digestibility

Category	**Diet DM digestibility**		
PIP (mmol/L)	>60% (Good pastures)	55–60% (Moderate pastures)	<54% (Low quality pasture providing maintenance requirements or less)
Growing cattle and breeders not-lactating and up to the last two months of pregnancy			
< 1.0	Acutely deficient	Acutely deficient	Deficient
1.0–1.5	Acutely deficient	Deficient	Marginal
1.5–2.0	Deficient	Marginal	Adequate
Breeders in the last two months of pregnancy and early to mid-lactation			
<1.0	Acutely deficient	Acutely deficient	Deficient
1.0–1.3	Acutely deficient	Deficient	Deficient
1.3–1.5	Deficient	Marginal	Marginal

If PIP is >2.0 mmol/L, cattle are generally expected to have adequate P intake. If dry matter digestibility is less than 50%, no growth response is expected – although there may be bone P replenishment.

Faecal

The main pathway of P excretion from the body is faeces. Chemical analysis of faecal P can be a guide if P intake is very low or high, but not in marginal deficiency situations. However, P supplementation must be removed for at least two weeks prior to sampling for an accurate measure, which could be highly impractical.

Pastures

Pasture samples can provide an indication of phosphorus levels, but the animals' daily grazing selection could mean the samples may not accurately represent the actual plants consumed.

Aim to evaluate the P status of a paddock in normal seasons – avoid exceptionally good or poor years.

Clinical signs of P deficiency such as peg leg are most evident in dry/drought years but the productivity gains apply to all seasons.

Bones

Bones are extremely useful indicators of an existing phosphorus deficiency; however, the tests require either a bone biopsy or an X-Ray – neither of which are cost-effective or practical for commercial properties.

What's the impact of a phosphorus deficiency in beef herds?

Phosphorus supplementation in acutely deficient pastures will increase feed intake over the growing season when both energy and protein are adequate and P has become the primary limiting nutrient. Because P supplementation of deficient cattle significantly increases feed intake, cattle numbers must be adjusted to maintain sustainable long-term carrying capacity.

Phosphorus deficiency results in poor appetite and feed intake, poor growth, high breeder mortality rates, reduced fertility and milk production, bone breakage and, in severe cases, bone deformities and peg leg.

Maintaining phosphorus reserves is particularly important for breeder cows when they're lactating and/or are in the last trimester of pregnancy. Extra phosphorus is required for milk production and for the bones and tissues of the developing foetus. When there's insufficient phosphorus in the diet, it's mobilised from the bones, which can increase bone fragility and injuries in stock being handled.

Supplementing cattle with phosphorus has many benefits, including:

Increased live weight gains

- Feed intake can increase significantly, resulting in improvements in growth rates of young cattle by up to 60kg/year and empty breeder cows weights by more than 100kg/year.
- Sale cattle are able to be sold earlier and/or at heavier weights, as well as at higher values.
- Cattle will grade better and achieve lower ossification scores compared with unsupplemented stock.

Improved reproductive performance

- Replacement heifers attain their critical mating weight sooner and shorter joining periods are achievable, which enhances productivity in young breeders.
- Conception rates in first-calf cows increase, as they're able to maintain their ideal body weight.
- The increased pasture intake of breeders improves body condition, ensuring increased milk production and weaner weights, better re-conception rates and weaning rates.

Reduced mortality rates

- Mortality rates decrease following phosphorus supplementation. This is directly related to better feed intake and improved body reserves leading into the dry season.
- Higher birth weights and improved milk supply lead to increased calf survival.

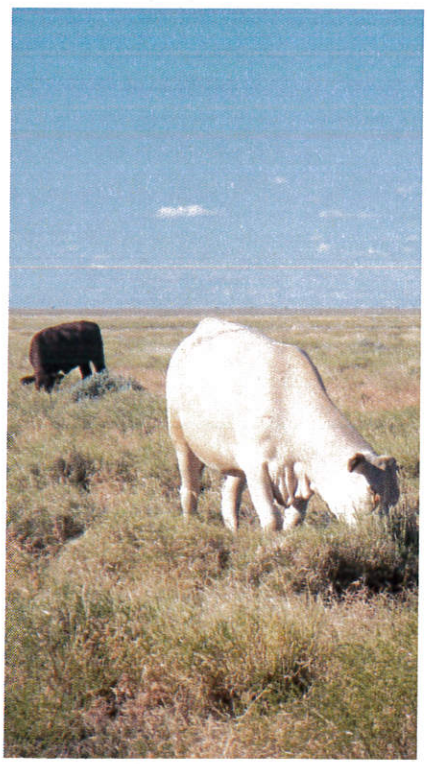
Providing phosphorus supplement where the pastures are deficient not only increases productivity and profitability, but it also ensures better animal wellbeing outcomes.

Supplementing P-deficient beef herds

All classes of cattle, whether they be steers, heifers or breeders, will benefit from phosphorus supplementation; however, the response of the cattle depends on the severity of deficiency, class of animal and diet quality. The greatest benefits from supplementation on deficient pastures are achieved over the wet season when grass is green and stock are gaining weight.

Breeders in late pregnancy or lactating breeders grazing dry season pastures in phosphorus-deficient country still have high P requirements.

For steers and heifers, providing additional supplementary phosphorus to animals on a protein-deficient diet during the dry season can be detrimental if nitrogen (protein) is not included in the supplement. During the dry season, protein becomes the primary limiting nutrient and feeding a 'P only' supplement will not improve performance but can be detrimental and even induce bone fragility.



Supplementation guide

The quality of inorganic phosphorous supplements can vary depending on the source and how they've been made. It's important to ask for an analysis of the supplement you choose and focus on the bioavailability of the phosphorous (what's available to the animal) rather than the total amount.

As a general guide, mono-calcium phosphate (MCP) has the highest bioavailability, followed closely by mono-dicalcium phosphate (MDCP) and dicalcium phosphate (DCP). MDCP is a blend of MCP and DCP but isn't always in the same proportions, which is why quality and pricing may vary.

If you use DCP, ensure it's hydrous DCP so that it's soluble in water – otherwise, it may be totally ineffective. Tricalcium phosphate (TCP) and rock phosphate aren't recommended as supplements for cattle due to the extremely low bioavailability of phosphorous.

Top tips

- Be aware that some sources of inorganic phosphorous may contain traces of heavy metals that may accumulate over an extended feeding period and could potentially show up in meat in rare and extreme cases.
- Consider the best supplement system for your situation e.g. loose mixes (covered lick sheds or exposed bulka bags), blocks or water medication.
- Excessive amounts of calcium should be avoided.
- Water medication systems are impractical where seasonal alternate surface water is available.
- In phosphorus-deficient high rainfall regions with sown pastures, phosphorus fertilisers are often more cost-effective than supplementing stock directly. In these situations, fertilisers increase pasture yields and diet quality.

Requirements

Unlike urea supplementation, there's no toxicity issue associated with phosphorus supplementation (unless urea is part of the supplement). The issue is not so much 'over-supplementing', but meeting the challenge of getting adequate phosphorus into cattle diets over the wet season when there's more opportunity for increased weight gains.

Table 3: Recommended supplementary P intakes for several classes of cattle and live weight changes

Class of cattle	Supplementary P intake required (g/head/day)		
	Acutely deficient	Deficient	Marginal
Wet season			
Breeder cows (450kg)	11–13	7–9	2–3
	12–14	9–11	3–4
Weaners and yearlings (250kg)	5–8	4–5	1–2
	8–10	5–6	1–3
Steers and heifers (350kg)	4–6	3–4	1–2
	6–8	3–5	1–2
Dry season			
Late-pregnant or lactating cows (450kg)	6–8	5–6	1–2

Are there any other considerations?

There are some other important factors to consider when compiling a phosphorus supplementation plan for northern beef herds.

Cropping: Phosphorus deficiency can occur in places where it's not expected to be a problem. Cereal cropping, especially when not accompanied by appropriate fertiliser application, has caused soil nutrient rundown in some regions. In these situations, cattle performance may be improved with phosphorus supplements. A serum phosphorus test is the best way to diagnose the problem.

Assessment of individual paddocks: Where marked soil variation occurs within properties, it's recommended to assess every major paddock when developing a comprehensive P supplementation program for the enterprise. If the assessment is performed on young grower or breeder cattle that have not received P supplement for at least two weeks prior to sampling and are on a positive plane of nutrition, this will most likely be a 'one-off' test unless phosphorus fertiliser is being applied.

Botulism: Phosphorus supplementation does not reduce the need to vaccinate against botulism. It will reduce the risk by avoiding the bone-chewing behavior that can lead to botulism.

Cost of supplementation: The cost benefits will vary depending on the level of deficiency being encountered. A 2018 trial in the NT suggested a cost of around $20/head/year to provide adequate phosphorus for breeders, although cost varies depending on the current price of phosphorus. Other costs such as distribution, freight and storage costs will change between properties and this also needs to be factored into the economic assessment. In this trial, the benefits of supplementation outweighed the cost:

- 30kg increase in annual heifer growth rates
- >30kg increase in weaner weights
- >100kg increase in breeder cow weights
- at least a 7% reduction in mortality rates
- at least a 30% increase in re-conception rates.

Conduct your own cost-benefit analysis depending on the severity of the deficiency in your pastures.

More information

Phosphorus testing laboratories

Queensland:

Biosecurity Sciences Laboratory
P: 07 3708 8762
E: bslclo@daf.qld.gov.au

Northern Territory:

Berrimah Veterinary Laboratory
P: 08 8999 2249
E: bvl@nt.gov.au

Western Australia:

DPIRD Diagnostics and Laboratory Services
P: 08 9368 3351
E: DDLS@agric.wa.gov.au

Resources

Phosphorus management of beef cattle in northern Australia (2012), Meat & Livestock Australia

Quigley S, Poppi D and Schatz T (2015). *Validation and demonstration of a diagnostic tool for phosphorus status of beef cattle*, MLA Final Report, Meat & Livestock Australia

Schatz T and McCosker K (2018). *Phosphorus supplementation of Brahman heifers in phosphorus deficient country in the NT*, Proceedings Australian Society of Animal Production, Category Animal Nutrition, Ref 2695.

Read MVR, Engels EAN, and Smith WK (1986). *Phosphorus and the grazing ruminant: The effects of supplementary P on cattle at Glen and Armoedsvlakte.* S. African J. Anim. Sc., 16 (1) Pages 7–12.

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