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The environmental impact of nitrogen and phosphorus fertilisers in high rainfall areas

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Most common nitrogen and phosphorus fertilisers are very soluble and are designed for lower rainfall areas or soils that can retain these nutrients. In the high rainfall areas, especially on sandy soils, these nutrients can be leached into the groundwater and washed into waterways, even after short periods (months and years, rather than decades). Nitrogen and phosphorus can remain dormant in the sediments of watercourses and estuaries until used as food for algae when conditions are favourable.

Nitrogen in a nitrate form can cause health problems when it accumulates in groundwater used for drinking. It may be particularly harmful to young children and has been known to combine with food to make cancer-forming compounds.

Excessive use of phosphorus fertilisers has already contributed to algal blooms in waterways and estuaries in Western Australia. These algae can create a range of problems such as making life unpleasant near waterways (nauseating odours, aesthetics), causing skin irritations from contact with the water and, in extreme cases, poisoning. Economic impacts include damage to fisheries and lowering the value of real estate and tourism in affected areas.

It makes sense for the environment and the economics of a farm business to minimise the losses and maximise the effectiveness of these fertilisers. In other parts of the world, pollution from these fertilisers has incurred such significant costs that the type of farming had to be changed, heavily regulated or abandoned altogether. For example, all farmers in the Netherlands have to account for the nitrogen and phosphorus that enters and leaves their farms. They pay a levy for any nitrogen above 180 kg/ha that escapes their farms.

Nitrogen loss pathways

- Nitrate concentrations are highest in the watercourses with the first drainage after the autumn break. Care should therefore be taken with nitrogen fertiliser applications during periods of high rainfall, especially before and during winter.
- Dung and urine patches are far too concentrated for the soil to retain the nutrients in them and result in leaching to groundwater and escape to the atmosphere through conversion to gas.
- Ammonia gas can be generated from urea applied as fertiliser (or as urine) after rainfall at the end of spring and in summer. The fertiliser applied to warm, already wet soil usually results in the highest loss of ammonia.
- Other sources of nitrogen, like diammonium phosphate (DAP), ammonia nitrate and calcium ammonium nitrate, are not likely to turn to gas under our acidic soil conditions.
- Nitrate leaching occurs when soil nitrogen in nitrate form is dissolved and passes through the soil or when the soil becomes so saturated with water that there is an overland flow direct to waterways.

Minimise nitrate leaching from pasture

- **Nitrogen fertiliser rates** should not exceed 50kg N/ha in any single application and smaller applications should be applied during autumn. The sandier the soil, the lower the nitrogen rate applied in one application.
- **Nitrogen fertilisers** should not be applied near streams or drains**.**
- Ammonia sources of nitrogen (DAP and urea) usually leach less nitrate in cold, wet soils than nitrate (ammonium nitrate and calcium ammonium nitrate) sources of nitrogen.
- Apply nitrogen when the pasture is actively growing and can use the fertiliser, especially during periods of high rainfall events.

- Avoid applying nitrogen fertiliser to well drained soil if heavy rains are predicted.
- Avoid excessive pugging of fertilised paddocks in winter.

With increased use of nitrogen fertiliser on pasture over the past 15 years, concern is now being expressed about the potential impacts on the environment and human health. We have already shown significant nitrogen escaping into our watercourses from legumes, such as clovers. Adding more nitrogen fertilisers is likely to make matters worse if we are not careful.

Phosphorus loss pathways

- Most of the phosphorus enters watercourses in autumn during the first flush of winter rains before pasture plants have emerged and developed sufficient roots or during extreme storm events during the growing season.
- Phosphorus is not converted to a gas and will persist in the soil or sediment. It can become mobile in warm wet conditions or during waterlogging/anaerobic conditions.
- Ordinary superphosphate is 80 per cent water-soluble. Most of this can be washed deep into the soil or across it before annual plants have successfully established roots.
- Phosphorus is either dissolved and leached down into sandy soils or it runs across the surface when the soil profile fills up with water. On clay soils the water flows across the surface with the phosphorus attached to clay particles which are washed to nearby drains and waterways.
- Phosphorus and nitrogen can also be lost via short circuit pathways. This is neither leaching or runoff but through macropores, similar to small tunnels. Water travelling this route can reach streams very quickly and large amounts can be transported quickly, as nutrients have very little contact with the soil column.

Minimise phosphorus leaching from pasture

- Apply only the amount of fertiliser required for this year's pasture. This can be determined by a soil test.
- **Phosphorus fertilisers** should not be applied near streams or drains**. The phosphorus will make its way to the lower parts of the landscape with the passage of water.**
- Phosphorus is best applied in split applications, one early in winter after plants have germinated and begun to establish, and the other in spring.
- Avoid excessive livestock in areas near drains in winter. Livestock stir the soil surface and pug the soil, causing particles to lift off during the rain and carry phosphorus to drains.
- Avoid applying phosphorus fertiliser if heavy rains are predicted. Apply only after pooling from heavy rains has drained.

These management techniques are only effective if there are no other limitations or deficiencies. The soil should be tested to assess the need for lime and potassium. Tissue testing is also necessary to occasionally check for minor nutrient deficiencies.

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