Agriculture Notes

Dairy effluent: Application to pastures

David Hopkins, Colac, Revised Colin Waters, Ellinbank

July, 1999
AG0419
ISSN 1329-8062

If managed carefully, irrigation of dairy shed effluent to pastures and crops can make good use of the nutrients, organic matter and water, while helping to minimise the pollution of streams and ground water.

Application of dairy effluent to pastures can increase pasture growth considerably according to a number of overseas studies. New Zealand studies have reported additional pasture growth of up to 50% after irrigation of effluent. Higher increases were reported for a study where sludge was applied to pasture.

Protection of surface and ground water

Dairy shed effluent must be managed in such a way that it remains on the farm and does not contaminate waterways or sub surface (ground) water. This is enforceable by the Environment Protection Authority (EPA) under the State Environment Protection Policy (SEPP).

The SEPP further states that no solid or liquid waste from any intensive animal industry or milking shed operation shall be disposed of (irrigated or spread) in the following locations: within 800 metres of any potable water supply off-take controlled by a statutory authority, within 200 metres of any watercourse supplying potable water or within 100 metres of any surface waters.

If we are to satisfy these guidelines effluent should be applied to pastures or crops at the right time and in amounts that the plants can utilise the water and nutrients. If too much is applied at one time or if applications are repeated too often in the one place, then there is a high risk that it will either run off the surface to streams or soak into the soil and find its way to groundwater.

These risks are increased during wet times of the year when the soil is waterlogged. Ponds are used to avoid the need to irrigate effluent under these conditions. However, if ponds are not suited to your farm and direct irrigation is the only option, then careful irrigation over greater areas than normal (see below) are required to minimise runoff or leaching of nutrients.

What is in dairy effluent?

Dairy shed effluent largely consists of the manure and urine in washdown water, but also includes detergents, gravel from the cow's hooves, suspended soil particles, cow hair, milk, string, paper and other debris which can collect around the dairy.

The effluent needs to be collected and the gravel and other debris separated out before storage and irrigation, or in some cases, direct irrigation to pasture.

Nutrients

Approximately 8 - 10 % of the daily dung and urine is dropped in the yards, depending on distance walked, time spent in the yards, and stress experienced during milking. A small but valuable quantity of nutrients are contained in the effluent.

Table 1 shows the quantities of nutrients contained in the manure excreted by a 150 cow dairy herd in the shed and yards over a full lactation (285 days). These measurements were taken in a number of studies.

Table 1 Nutrients in fresh manure (kg per 150 cows per lactation)

	Nitrogen (N) kg	Phosphorus (P) kg	Potassium (K) kg
Average	375	75	405
Range	240 - 480	45 - 105	195 - 810

However the actual levels of nutrients in the effluent ponds is significantly less than the fresh manure and dung due to the dilution effect of the wash down water, settling out of most solids, and gaseous losses to the air.

A number of dairy storage ponds were sampled recently (1996) in south west Victoria to get an idea of their nutrient content (Table 2). The nutrients are expressed in milligrams per litre (mg/l) or its equivalent, kilograms per megalitre (million litres or 1000 cubic metres) of effluent.

Table 2 Nutrient content of dairy storage ponds in south west Victoria

	Nitrogen (N) mg/l or kg/ML	Phosphorus (P) mg/l or kg/ML	Potassium (K) mg/l or kg/ML
Average	180	31	420
Range	100 - 320	14 - 53	190 - 750

Source: D Hopkins

Availability of nutrients

Nitrogen availability to plants is generally less with effluent than with artificial fertilisers because the nutrients are bound up in the organic matter.

Estimates vary from 50% available nitrogen to more than 80%. Also losses of nitrogen can occur when sludge is spread onto pasture and allowed to dry out.

Phosphorus availability is about 50% according to overseas results.

Potassium has high availability and is a potential problem since it can replace magnesium in pastures making them more prone to cause grass tetany in cattle. This is only likely to be a problem if effluent is applied in the tetany season or restricted to a small part of the farm.

Loss of nutrients

Nutrient content of stored effluent is less than directly applied effluent. Some nitrogen is lost to the atmosphere whereas phosphorus and potassium and some of the nitrogen settle out in the sludge.

How much to apply

The primary aims in working out how much effluent to apply to your pastures or crops are to:

1. maximise the use of nutrients by the plants without causing nutrient overload or waterlogging and;
2. minimise the loss of nutrients by runoff to streams and drains or leaching through the soil to ground water.

Using the average nutrient content of dairy effluent from ponds in south west Victoria (table 2) as a guide, you can calculate the application rates which may apply to your farm.

However, remember that the nutrient content of effluent varies widely, so the only foolproof method of calculating application rates is to have your effluent analysed and use the following calculations to work it out for your farm.

Looking at table 2, nitrogen, phosphorus and potassium in most effluent analyses are measured in milligrams per litre (mg/litre). The number of mg/litre is exactly the same as the number of kg in one million litres (kg/megalitre or ML). It is useful to use kg/ML because we are used to applying kg of nutrients and pond volumes are often measured in megalitres.

The average nutrient content of the effluent was:

180 kg/ML of nitrogen (N)

31 kg/ML of phosphorus (P) and

420 kg/ML of potassium (K)

One megalitre of water applied to one hectare is equivalent to 100mm rainfall or irrigation per hectare. So for every 100mm per hectare of effluent you will apply, 180kg of N, 31kg of P and 420kg of K.

These rates of nitrogen and potassium are high and the water component is equivalent to 100 mm of rain in one go which would result in runoff or leaching in many soils, potentially leading to pollution of streams or ground water.

Applying the effluent at 25mm/ha will put on 45kg of N/ha, 8kg of P/ha and 105kg of K/ha. This is about the maximum nitrogen to apply in a single dressing, a moderate amount of phosphorus and quite a high level of potassium.

Following on from above, every megalitre of effluent should irrigate 4 hectares to achieve an application rate of 25mm.

Therefore if your effluent contains similar amounts of nutrients to the average figures in table 2, applying rates of effluent of about 25mm/ha will not apply excess nutrients and should also minimise the risk of nutrients running off to streams or drains or leaching to ground water.

Table 3 Application areas for various effluent volumes using average nutrient contents from table 2

Effluent volume Megalitres (ML)	Recommended application area (Ha.)
0.5	2
1	4
2	8
4	16
6	24
8	32
10	40

**** Remember it is always best to have your effluent analysed and use the notes under 'How much to apply' to adjust application rates accordingly.***

Rotating applications

Avoid applying effluent to the same area year after year. This can lead to overloading with some nutrients such as potassium. Care also needs to be taken with salts which may be contained in the effluent. So, unless you test your effluent and monitor the soil where it is applied on a regular basis, it is recommended that you rotate your applications around 3 or 4 areas, moving each year. In the example of 1 ML applied to 4 ha. you could have 3 or 4, 4ha. areas which you rotate around. Many farmers spread it further than this, applying effluent to lower fertility paddocks over a large proportion of their farm.

When is the best time to apply effluent to pasture?

Effluent from your storage pond (second of 2 ponds or your single pond) should be applied over summer and

autumn, so that the pond starts each wet season empty. Applying effluent during the wetter months runs the risk of run-off to streams or leaching to ground water when soils are saturated.

Apply effluent when pasture or crops are actively growing so that they can utilise the nutrients. In southern Victoria the end of spring (say December) and then soon after the autumn break are ideal times. Quite often a single irrigation to a fodder crop at this time of the season will make a big difference in yield. Aim to empty the pond(s) before soils become saturated.

Sludge will also need to be removed from your first pond every 2 or 3 years. This can be applied to paddocks about to be cultivated for a crop, or sprayed thinly on pasture at similar times to the effluent. Vacuum tankers can be useful for this purpose.

Salts in dairy shed effluent

The EC levels (an indication of the amount of salts) in the samples analysed in table 2 averaged 4680 uS/cm and had a range of 2800 to 7700. These are relatively high and above the recommended upper limit for irrigation which are 1500-2000 uS/cm. If bore water is used for washdown then salt levels can be high.

Note that recycling effluent concentrates the salts even higher and more care needs to be taken in irrigating. If salt levels are high then it is better to apply small amounts of effluent over a large area and empty the ponds more often.

In some situations where effluent water contains a high proportion of sodium compared to calcium and magnesium, (a relationship called the sodium adsorption ratio (SAR), continued application on the same area may eventually cause soil structure and drainage problems. The average SAR in the above samples is about 4, which is below the level of concern of about 6. However some ponds contained high SAR levels and that effluent should not be applied to pastures in excessive amounts. Where SAR levels are above 6 it is best to seek advice before irrigating.

Animal health considerations

Diseases such as Johne's Disease, Salmonellosis. Leptospirosis, mastitis and Enzootic Bovine Leucosis can be contained in raw effluent and milk. Worm eggs, coccidial eggs, clostridial organisms and tetanus spores are also passed in manure. However in most cases the period of time before application to pasture and the dilution effect of the water, tends to greatly minimise the risk of these problems occurring in the herd.

However to ensure a further reduction in risk the following actions should be carried out:

- Young stock under twelve months old should not graze treated areas, and drains from treated areas must not flow into areas where young stock are being kept to minimise the risk of infection with Johne's Disease.
- Do not graze areas where effluent has been applied for at least one week in summer, and several weeks in winter.
- Graze areas to receive effluent just prior to application to allow increased sunlight penetration to kill organisms, and to allow the full rotation length before area is re-grazed.
- Spread effluent during the warmer months to reduce survival chances of offending disease organisms.
- Contact your veterinarian if you have concerns about any specific animal health problems associated with applying dairy shed effluent to pastures or crops.

Further information

If in doubt you can get further advice from your nearest DPI or EPA office.

Department of Primary Industries

Colac	03 5233 5500
Ellinbank	03 5624 2222
Kyabram	03 5852 0500
Leongatha	03 5662 2204
Warrnambool	03 5561 9900
DPI internet Site	www.nre.vic.gov.au

Environment Protection Authority

Traralgon	03 5176 1744
Wangaratta	03 5721 7277
Bendigo	03 5442 4393
Dandenong	03 9794 0677
Geelong	03 5226 4825
EPA internet site	www.epa.vic.gov.au

.