AVOID SPREADING FERTILIZER, MANURE OR SLURRY ONTO FIELDS AT HIGH-RISK TIMES

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Description

- Do not apply nutrients via fertilizer, manure or slurry to fields at times when there is a high risk of either:
  - surface run-off e.g. in winter when soils are saturated or frozen, or when heavy rain is expected in the next few days, or
  - when there is a high risk of rapid percolation to field drains e.g. in winter and spring when soils are wet, or in summer when soils over-lying drains are dry and cracked .
- Do not apply apply nutrients to fields late in the growing season (i.e. autumn/early winter) or when crop uptake of nutrients is low. In many European countries, this means avoiding spreading between September and February, when there is a high risk of nitrate leaching.

Rationale, mechanism of action

Fertilizers, manures and slurries have high contents of readily-available nutrients. Avoiding applications of these materials at times when surface run-off or rapid preferential flow to drains is likely to occur reduces the risk of these flows transporting pollutants to watercourses. As manures and slurries are likely to have high concentrations of faecal indicator organisms (FIOs), the method also reduces the likelihood of these micro-organisms being directly transported into streams and rivers via surface runoff or preferential flow pathways.

Manure, slurry or fertilizer N spread late in the growing season adds mineral-N to the soil at a time when there is relatively little opportunity for N uptake by the crop. This adds to the pool of nitrate available for leaching over the following winter. Therefore, applications in autumn and early winter should be avoided [1]. Applications later in winter present less risk, as low temperatures slow the rate of conversion of ammonium to nitrate and there is thus less opportunity for nitrate to be leached below the rooting zone by the time growth starts [2]. Nitrate is leached out of the root zone most rapidly on sandy soils and on shallow soils with restricted rooting depth [1].

Solid manures do not have a high enough moisture content to initiate surface runoff or leaching themselves. This is the reason why the risk of water pollution (both surface and groundwater) from manure N and P only occurs when heavy rainfall follows the application. Manure application timing relative to rainfall thus greatly influences the amount of manure nutrient loss; reductions in N and P losses with an increase in the length of time between manure application and runoff have been shown [3].

Applicability

The method is applicable to all farming systems where fertilizers, manures and slurries are applied to land. High-risk times will be most frequent in high rainfall areas. Soils that represent the greatest risk of pollutant loss due to inappropriate timing of nutrient application include impermeable soils on sloping terrain, and

[1] Combined from three separate factsheets by R.M. Monaghan, New Zealand

shallow and sandy soils where leaching risk is high. Artificially drained soils containing preferential flow pathways are another risk category where timing of nutrient applications to land is particularly important. In the UK, timing to avoid high-risk periods is compatible with the Environmental Stewardship Scheme and there is no conflict with other methods. These timing recommendations should be acceptable to most farmers, although the prediction of rainfall and restriction on the timing of applications may cause practical difficulties for some. The adoption of this method will require a degree of education and advisory activity to persuade farmers that the spreading of nutrients at high-risk times should be avoided. Farmers may be particularly reluctant to avoid applying fertilizers or manures in early spring, when they usually aim to promote early season crop growth. Restrictions on timings of manure and slurry applications will require farmers to have storage facilities.

Effectiveness

The effectiveness of this option is strongly related to the ability to forecast weather events that might induce leaching or surface runoff. Examination of historical series of rainfall data can provide general guidance on the riskiest months for applying nutrients in a particular area. Rapid communication of reliable short term (few days) weather forecasts via email or text, as done in the UK within some priority catchments, will further improve the effectiveness of the method.

Manures and slurries:

N: Cuttle et al. [4] estimated the effectiveness of the option on an arable farm where manure is spread in autumn. Given a baseline nitrate loss of around 50 kg N/ha for a UK medium rainfall area (600-700 mm annual rainfall), they estimated that a reduction of around 25-30 kg N/ha per year (20-40%) could be expected on the area to which the option is applied. For grassland, they estimated reductions of 2 kg N/ha per year (model dairy farm) or 1 kg N/ha per year (model beef farm) across the whole area of the farms.

P: field-based rainfall simulation studies indicated that dissolved P concentrations in runoff from a silt loam soil declined from 2.75 to 0.40 mg/l when rainfall occurred 35 days, rather than 2 days, after a surface broadcast application of 100 kg P/ha as dairy manure [5]. The reductions were mainly attributed to the reaction of manure P with soil. Cuttle et al. [4] estimated that this type of mitigation option could potentially result in a 25% reduction in the manure component of baseline P losses on sandy loam soils. On drained clay soils, moving slurry applications from autumn/winter to spring could potentially increase P losses [4].

Fertilizers:

N: Cuttle et al. [4] expected a moderate reduction in nitrate leaching losses in the affected areas depending on circumstances. The reduction, averaged over the farm area, will be smaller depending on the proportion of the farm affected, and in some circumstances would be negligible.

P: Cuttle et al. [4] estimated that option implementation would result in a moderate reduction in the fertilizer component of the baseline P loss. However, it is noteworthy that the fertilizer component contributes little to the total loss from sandy loam soils.

Time frame

The method mostly focusses on reducing incidental losses of nutrients from recently applied fertilizers, manures or slurries. If correctly implemented, this option will

therefore have an immediate effect by avoiding the mobilization and transfer of applied nutrients from soil to water. Avoiding applications of fertilizer, manure and slurry to fields late in the growing season (i.e. autumn/early winter) will lead to reductions in nitrate leaching losses in the winter following implementation. As with all mitigation methods, variable travel times of N and P compounds through soils and groundwater may mean there is a time lag between method implementation and evidence of a beneficial effect in the water body.

Environmental side-effects / pollution swapping

Moving slurry applications from autumn to spring on drained clay soils will increase the likelihood of elevated P and ammonium concentrations in drainage. There are also likely to be greater ammonia emissions from spring slurry applications to arable land and following summer applications to grassland. However, the method does have the potential to reduce nitrous oxide emissions from fertilizer applications. From a water quality protection point of view, storing fresh manure and slurry for some time before application to land has the additional advantage of lowering concentrations of readily available N and FIOs [4]; this strategy will however likely increase ammonia volatilization losses from the stored material.

Relevance, potential for targeting, administrative handling, control

For slurry and manure management, this method requires that farms have sufficient storage capacity to allow a choice of when to apply slurry. Even where storage is adequate for normal conditions, exceptional weather or poor planning can create a situation where stores are full during a high-risk period so that land spreading is the only option. It would generally be acceptable to apply manure or slurry to grass later in the season than for other crops, as long as the sward continued to take up N.

In the case of mineral fertilizers, the option can be relevant to all fields where fertilizers are applied. However, any required over-sight from local agricultural offices in the implementation of this measure would be almost impossible to achieve.

Costs: investment, labour

A wide range of storage methods are available to farmers who may need to increase their manure or slurry storage capacities. They include constructed lagoons, ponds and open or closed pits. Depending on the kind of facility and on its size, costs vary considerably, ranging from relatively inexpensive plastic sheeting (that performs well for solid manures) to much more costly constructed lagoons or pits. Some UK estimates of these costs are provided in [4]. Where it is not possible to spread slurry onto spring crops, nutrients can be supplied via fertilizers; nutrient status can then be taken into account at the next opportunity to spread [6].

Judicious timing of nutrient applications should generally be a zero cost method for minimising the risk of nutrient losses. In most cases the nutrients should not be required at high risk times, since the crop will not be rapidly growing. Avoiding losses of valuable nutrients will therefore be an obvious economic benefit to the farmer. There may however be indirect opportunity costs if the high risk times coincide with crop development in spring e.g. if eliminating spring top-dressings to arable crops or grassland caused a reduction in crop yield. These opportunity costs may be incurred perhaps one year in ten [4].

Other potential costs may include any expenses associated with the provision of weather information that can help to identify periods when nutrient applications should be avoided.

References

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