Considerations when landspreading milk or manure/milk mixtures

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The guidance in this document is provided to assist farms in making decisions about emergency landspreading of milk or manure/milk mixtures and is intended to complement, not supersede, any regulatory requirements.

On average, 1,000 gallons of milk contains 46 lb nitrogen (N), 26 lb P_2O_5, and 17 lb K_2O. This is approximately 6 times more available N, 9 times more available P_2O_5, and 1.5 times more K_2O than an equivalent volume of liquid dairy manure (<4% dry matter). If nutrients from milk enter ground or surface water, degradation of water quality will occur. Milk also has a biochemical oxygen demand (BOD) that is about 5 times greater than dairy slurry. Thus, fish kills should be expected if milk enters surface water.

Plant availability of nutrients in milk

NITROGEN

On average, raw milk will contain approximately 46 lb of N per 1,000 gallons. However, the N content of milk varies directly with milk's protein content. It is recommended that farms use their component test values to establish a more accurate estimation of milk N content. This can be calculated using the simplified formula below.

True protein (%) × 13.5 = lb N/1000 gallons of milk

(Assumes a milk density of 8.6 lb/gallon and a protein to N ratio of 6.38)

Because nearly all of the nitrogen in milk is contained in readily degradable proteins, 100% of the total N should be considered plant available. The impact of surface versus incorporated applications of milk on potential gaseous N loss (volatilization) is not documented in the literature. Unlike manure, milk has very low concentrations of N in forms readily susceptible to volatilization. Therefore, volatilization losses from milk applications with no or delayed surface incorporation are likely limited and the full N value should be credited whether incorporation occurs or not.

PHOSPHORUS

There is approximately 26 lb of P_2O_5 per 1,000 gallons of milk. Phosphorus in milk should be considered 100% plant available. Like manure, milk contains more available phosphorus than nitrogen relative to crop needs. Thus, application of milk to meet crop nitrogen needs may oversupply phosphorus, potentially increasing the risk of phosphorus loss to surface water. Consider the following guidance when selecting a milk application rate:

- ✓ On soils testing less than 50 ppm P, milk could be applied at rates to supply the nitrogen needs of the following crop or nitrogen removal for a legume crop.
- ✓ On soils with 50–100 ppm P soil test, application of milk should be limited to rates which supply crop P removal.
- ✓ If milk needs to be applied to soils testing more than 100 ppm P, application rates should be limited to 75% of crop P removal.
- ✓ Alternatively, milk application rates can be determined using the phosphorus index strategy as part of a nutrient management plan.

POTASSIUM AND SULFUR

There is approximately 17 lb of K_2O per 1,000 gallons of milk. Potassium in milk should be considered 100% plant available. Milk is not as good of a potassium source compared to manure. For every 100 lb of available N, milk supplies 37 lb K_2O and manure supplies 157 lb K_2O.

Milk contains approximately 2 lb of sulfur per 1,000 gallons, similar to some dairy slurries. All sulfur should be considered 100% plant available.

NPM 04/2020

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Soil sampling after milk applications

After land application of milk or milk/manure mixtures, consider retesting soils for routine fertility before the next growing season. Variability in application rates and milk nutrient content will differentially impact soil nutrient levels across the field. Therefore, up-to-date soil tests will provide a better estimate of future nutrient application needs.

More information on soil sampling can be found in Univerity of Wisconsin Extension publication, A2809, *Nutrient Application Guidelines for Field, Vegetable, and Fruit Crops in Wisconsin*.

Land applying milk – field and application considerations

A nutrient management plan (NMP) can identify fields where milk can be applied to meet crop nutrient needs. If milk is land applied, the NMP should be updated to reflect the milk application and nutrient applications from manure and/or fertilizer should be reduced. If a farm does not have an NMP, milk applications should meet, but not exceed, the nutrient needs of the crop and application of other nutrients should be reduced or eliminated.

FIELD SELECTION

Due to the high concentrations of nitrogen and phosphorus in milk, applications should be made to fields with low risk for nutrient loss through leaching, runoff and erosion, and as close as possible to when crop nutrient uptake will occur. Identifying fields for application during the growing season may be difficult due to the potential for crop damage with application equipment and/or unsuitability of crop type for land application.

Where possible, land applications of milk should be avoided on fields with:

- ✓ Soils of sandy or loamy sand textures, particularly in the subsoil.
- ✓ Soils shallow to bedrock.
- ✓ Large drying cracks at the soil surface.
- ✓ Seasonal or permanent high water tables.
- ✓ High to moderate potential for flooding.
- ✓ Tile drainage.
- ✓ Steep slopes or long slope lengths.
- ✓ Soil test phosphorus levels above 100 ppm.
- ✓ Estimated phosphorus index above 6.
- ✓ Estimated soil erosion rates for a crop rotation greater than tolerable soil loss (T).
- ✓ Alfalfa or other forage legume grown in the previous year and the legume was, or will be, terminated before planting another crop this season.
- ✓ Manure or fertilizer already applied for this growing season's crop.
- ✓ Nearby streams, rivers, lakes, wetlands, drainage ditches, and wells.
- ✓ Nearby neighbors who may be negatively impacted by odors during decomposition.

APPLICATION RECOMMENDATIONS

In addition to proper field selection, milk should be land applied in a manner that reduces potential off-site movement of nutrients into ground or surface water.

General application recommendations include:

- ✓ Apply only to soils suitably dry for application — soils at approximately 75% field capacity or less in the top 8 inches. Indicator of ~75% of field capacity (for most soil textures) is when soil forms a ball and no moisture appears on hand when squeezed.
- ✓ Avoid applying milk when rainfall is predicted, eminent or directly after a rainfall event. Check the Runoff Risk Advisory Forecast to gauge potential risk for runoff based upon regional weather and soil condition forecasts. http://www.manureadvisorysystem.wi.gov/runoffrisk/index
- ✓ Follow all NMP setbacks for manure and nutrient applications.
- ✓ Apply milk uniformly across a field using liquid manure application equipment.
- ✓ Where possible, milk should be shallow-injected or incorporated to reduce odors and the risk of runoff to surface waters.
- ✓ Milk should not be allowed to runoff or pond during application.
- ✓ Properly calibrate field application equipment to ensure delivery of intended rate.
- ✓ If milk must be applied to a tile drained field, till soil 3–5 inches deep before application. Tile drains should not be running.
- ✓ Consider multiple applications with less volume per application to reduce the potential for nutrient loss. Research from New Zealand suggests waiting at least 20 days between applications to allow for microbial degradation.

Land application of milk – crop considerations

In addition to meeting crop needs and NMP requirements, milk application rates should also be based upon sound agronomics. The following are potential additional considerations for milk applications to specific crops.

CORN (GRAIN OR SILAGE), SORGHUM-SUDAN, AND OTHER WARM SEASON GRASSES

- ✓ Due to high crop nitrogen need, corn grain, corn silage and warm season grass fields should be potentially prioritized for preplant milk applications. Consider sidedress applications on somewhat poorly drained and wetter soils to reduce early season nitrogen losses and increase crop nitrogen utilization. Milk applications are not encouraged on sandy soils and soils that are somewhat excessively or excessively drained.
- ✓ Preplant or early season sidedress milk applications may limit odor issues due to lower air and soil temperatures compared to later in the growing season. Soil incorporation of milk is recommended to reduce odor production and potential runoff with rainfall events.
- ✓ Recommended nitrogen application rates for corn are based on N:grain price ratio, soil group, and previous crop and typically range from 100 to 200 lb N/a. Consult Extension publication A2809 for details. Milk applied at 4,300 gallons/acre would provide 200 lb N/a.
- ✓ Applying milk over the top of plants should be avoided if possible. However, milk could be applied in a multi-cut forage system after harvest. Care must be taken to apply milk rates appropriate for the system and timed to reduce potential runoff and leaching. Ideally, milk would be applied within a few days after harvest to minimize crop damage and to reduce the amount of milk applied to plant biomass. It is unknown if the presence of milk solids on foliage at grazing or harvest will alter forage palatability, ensiling, and/or quality.
- ✓ In a warm season grass system, milk could be applied and soil incorporated after last harvest and followed by a small grain, brassica, or mixed species cover crop, if growing season conditions are conducive for cover crop growth.

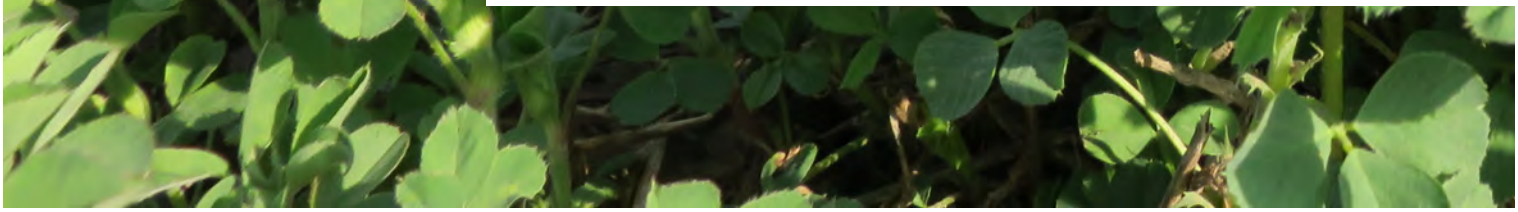
LEGUMES, INCLUDING SOYBEAN, ALFALFA AND CLOVER

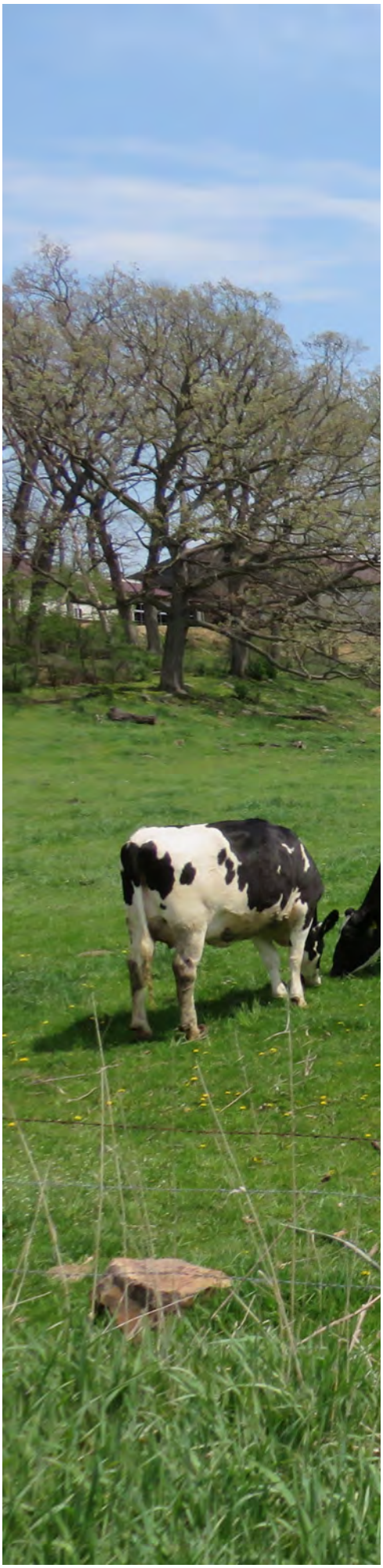
- ✓ Legume crops will preferentially use available soil nitrogen over fixing their own nitrogen. Thus, milk application will reduce legume nitrogen fixation. Because legumes do not need additional N, milk applications to legumes will not fully utilize milk's economic value as a fertilizer. There is a low risk for nitrogen leaching when milk is applied to legumes as long as the N application rate does not exceed crop removal of nitrogen or 205 lbs N per acre, whichever is less (Table 3).
- ✓ Alfalfa and clover can be topdressed with milk. Applications should occur as soon after harvest as possible to minimize crop damage and milk interception by plant biomass.
- ✓ Milk additions to soybeans may stimulate lush vegetative growth, potentially contributing to lodging and/or increase risk of infection by the white mold pathogen.

Table 3. Maximum recommended total available N and milk application rates to select legumes.

Crop	Yield range	Maximum N application (lb/acre)	Maximum milk application rate (gallons/acre)
Alfalfa or red clover	< 1.5 tons/acre	50	1,100
	1.5–2.5 tons/acre	100	2,200
	2.6–3.5 tons/acre	155	3,400
	> 3.5 tons/acre	205	4,500
Soybean	15–25 bu/acre	75	1,600
	26–35 bu/acre	115	2,500
	36–45 bu/acre	155	3,400
	> 45 bu/acre	195	4,200

*If manure or commercial fertilizer containing nitrogen (e.g. DAP or MAP) has been applied to a field, milk application rate must be reduced accordingly.





SMALL GRAINS (e.g. WHEAT, OATS, BARLEY, RYE, AND TRITICALE) FOR GRAIN, STRAW, SILAGE OR COVER CROPS

- ✓ Preplant applications of milk to spring grain monoculture and grain/legume mixes provide an opportunity for soil incorporation of milk to reduce potential runoff and odor issues.
- ✓ Milk application rates should meet but not exceed crop N needs. High nitrogen applications to small grains can increase lodging and harvest issues.
- ✓ Recommended nitrogen application rates for wheat are based on N:grain price ratio, soil group, and previous crop and typically range from 55–85 lb N/a. Consult UW Extension publication A2809 for details. Milk applied at 1,800 gallons/acre would provide 83 lb N/a. For barley, rye, oats, and triticale, 1,000 gal/a of milk will supply crop N needs.
- ✓ Increased vegetative growth resulting from excess nutrient applications can create conditions that promote increased disease incidence.
- ✓ Milk applications over the top of growing crops, such as an early spring application to wheat, should be limited. Milk solids left on plant materials will slowly degrade and may increase the potential for nutrient runoff with rainfall events and increase production of odors.
- ✓ A milk application after small grain harvest should be incorporated and followed by a small grain, brassica, or mixed species cover crop to limit offsite movement of nutrients.

PASTURES AND HAY, GRASS AND GRASS-LEGUME MIXTURE

- ✓ Milk additions should occur shortly after grazing or harvest to increase the potential for milk to reach the soil. Milk solids left on plant materials can increase the potential for offsite movement of nutrients and organics with rainfall events.
- ✓ Milk additions should be timed to maximize the number of days between application and grazing or harvest. Milk that remains on foliage will slowly degrade, causing foul odors that may deter animal consumption. It is unknown if the presence of milk solids on foliage at grazing or harvest will alter forage palatability, ensiling, and/or quality.
- ✓ The nitrogen applied in milk will reduce nitrogen fixation and overall competitiveness of legumes, resulting in greater competitiveness of grasses and weeds. Prioritize applications to grass pastures or older grass-legume pastures being considered for future renovation.
- ✓ The total amount of nitrogen, as milk or fertilizer, applied to grass pastures should be split into two or three applications, with the final application occurring in mid-August (Table 4). Nitrogen from all sources, milk, fertilizer, or manure deposited by grazing animals or applied mechanically must be included in the total N application.

Table 4. Maximum recommended total available nitrogen and milk application rates to grass and grass-legume pastures and hays.

Pasture/hay	Yield range	Maximum N application (lb/ acre)	Maximum milk application rate (gallons/ acre)
Grass	All	130	2,800
Legume-grass	0.5–1.9 tons/acre	55	1,200
	2.0–3.0 tons/acre	115	2,500
	3.1–4.0 tons/acre	160	3,500
	>4.0 tons/acre	205	4,500

GENERAL CONSIDERATIONS FOR ALL CROPS

- ✓ Applications of milk to forage crops with excessively high soil test K levels may result in luxury consumption of potassium, particularly alfalfa. Harvested forage potassium levels should be monitored, particularly if feed is destined for dry cows or springing heifers.
- ✓ The presence of milk sugars may promote the growth of normal soil organic matter decomposers (saprophytes), such as fungi. Mats of white mycelium may be present. Proper identification of fungal species is needed, as saprophytic fungi are beneficial, not pathogenic, and do not warrant a fungicide application.

Adding milk to manure storage

Waste milk can be deposited in an existing manure storage facility and land applied when soil, weather, and field conditions are conducive to reducing the potential for runoff and leaching. The addition of milk to a manure storage system may increase the effluent's nutrient concentration, requiring adjustment of nutrient crediting in a farm's nutrient management plan. If milk is added to a manure storage system, a manure sample should be collected and analyzed prior to land application. Nutrient credits should be based on the percent of total nutrients assumed to be available for the manure. Guidelines on collecting a proper manure sample can be found in UW Extension publication, A3769, *Recommended Methods of Manure Analysis*.