Manure Effects on Pasture Legume Persistence

Geoffrey Brink, U.S. Dairy Forage Research Center

Grazing-based livestock producers frequently over-seed cool-season grass pastures with legumes such as red clover, white clover, or alfalfa to improve forage quality and seasonal distribution of production, and reduce supplemental nitrogen (N) need. Solid manure collected from bedded packs or liquid manure collected in pits could provide some N and must be utilized somewhere. Application to pastures recycles nutrients and has the potential to improve annual productivity.

However, manure effect on legume persistence is important because the benefits imparted by legumes to forage quality may be more important than improving productivity. Determining how manure type, application date, and sward management influence pasture productivity and legume persistence will provide management guidelines to utilize manure efficiently and maintain legumes in rotationally-grazed pastures.

Several factors influence how a grass-legume sward responds to manure application. The N in solid manure is primarily in the nitrate form because much of the ammonia has been lost as a gas during storage. Conversely, the N in liquid manure is primarily in the ammonia form. Ammonia-N can be lost during application, particularly if manure is applied in summer when temperatures are higher; but one advantage of liquid manure is that it can be absorbed by the soil, potentially reducing ammonia losses. Nitrate-N in solid manure must be moved into the soil by precipitation, and thus becomes available to plants more slowly.

Manure Source	Application Date	Sward Management
None		Grazed at vegetative stage
Solid	April	Grazed at vegetative stage
Liquid	April	Grazed at vegetative stage
None		Hay harvest; grazed at vegetative stage
Liquid	April	Hay harvest; grazed at vegetative stage
Solid	June	Grazed at vegetative stage
Liquid	June	Grazed at vegetative stage
Solid	August	Grazed at vegetative stage

Plants can absorb either, but typically take up nitrate-N more readily than ammonia-N. In addition, grasses absorb N more efficiently than legumes due to their fibrous root system, and exhibit a more rapid growth response. The management of the sward after manure is applied may also influence legume growth and persistence. Permitting the pasture to grow until harvested for hay may impose further competitive stress on the legume.

U.S. Dairy Forage Research Center scientists determined pasture and legume response to manure type, manure application date, and sward management practices typically used by producers (Table). All treatments supplied 60 lbs N/acre except 'None' (no N). Plots were grazed at vegetative stage (3 to 4 grass leaves) five times during the growing season, or harvested for hay (grass head emerged) in the spring and then grazed at vegetative stage three times.

Productivity of Grazed Pasture

The mean annual forage yield of a red clover-orchardgrass mixture grazed five times each year at vegetative stage and receiving no manure was 7,100 lbs DM/acre. At the end of the grazing season, red clover was found in half of the rows in which it was seeded (50% stand). Applying either solid or liquid manure in April and grazing throughout the season increased annual forage yield by 500 lbs DM/acre, a 7% increase in productivity.

In contrast, a mixture fertilized with solid or liquid manure in June or August produced 400 to 700 lbs DM/acre less than a mixture receiving no manure. Whether manure was applied in April, June, or August, persistence of red clover that was grazed during the season at vegetative stage was reduced from a 50% stand (no manure applied) to a 30 to 45% stand. Thus, mixtures receiving manure in the spring had greater annual yield due to greater grass growth, and mixtures receiving manure in mid to late summer had lower annual yield due to a loss of clover.

Productivity of Hayed and Grazed Pasture

A red clover-orchardgrass mixture harvested for hay in the spring and grazed at vegetative stage the rest of season was equally productive as that grazed at vegetative stage throughout the season (7,100 lbs DM/acre). Delaying harvest in the spring to hay stage, however, reduced clover persistence from a 50% stand (no haying or manure) to a 40% stand. Applying liquid manure to the mixture and following the same harvest regime reduced annual yield by 300 lbs DM/acre due to a further decline in red clover persistence (50% to 30%).

Summary

Results suggest applying manure in the spring to a grazed grass-legume mixture will improve annual productivity, but at the expense of legume persistence. Applying manure in mid to late summer did not improve annual production and further reduced legume persistence. Producing hay from grass-legume pastures has a detrimental effect on legume persistence, but persistence is further reduced when manure is applied. Since one of the primary benefits of adding legumes to pasture is improved forage nutritive value, manure should not be applied to pastures with good legume stands, generally in the seeding year and the following year.

Legumes improve forage quality and reduce nitrogen inputs in a pasture-based system.

Spring manure application to grazed grass-legume mixtures improves annual productivity, but at the expense of legume persistence.

Pasture plots at the U.S. Dairy Forage Research Center received eight different treatments.