

MANURE ON ALFALFA:

Why, When and How Much?

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Manure is an excellent source of nutrients for growing crops. Its' value has been recognized for thousands of years. Before the development of chemical fertilizers, it served as the primary source of nutrients. It has decreased in importance as a nutrient source in this century and in some cases has become a disposal problem. This has led many farmers to consider using it on legume crops such as alfalfa that don't need to have nitrogen added, but will utilize it and other nutrients in relatively large amounts. The first question to be considered, then, is why apply manure to alfalfa.

WHY?

There are two basic reasons for applying manure to alfalfa fields:

1. To supply nutrients needed by the crop, and
2. To use alfalfa as a means of removing excess nutrients.

We will discuss each of these independently.

Supplying Nutrients:

Alfalfa uses large amounts of nutrients. For example, a six-ton hay yield of alfalfa removes about 350 pounds of nitrogen (N), 40 pounds of phosphorus (P) and 340 pounds of potassium (K) (Hanson, et al.). The nitrogen is normally supplied by nitrogen-fixing bacteria living in nodules on the alfalfa roots. Phosphorus and potassium along with other secondary and minor elements must be supplied by the soil or nutrients added as fertilizer or manure.

Manure can supply many of the nutrients needed by alfalfa. Fresh dairy cattle manure applied at ten tons per acre would supply about 112 pounds of N, 21 pounds of P and 100 pounds of K (Miller, et al.). While alfalfa doesn't need the N, it will take it up and prevent it from contaminating ground water. The P supplied by the manure would be adequate for an average crop of alfalfa, but both P and K would need to be supplemented by fertilizer to produce high yields. Manure would likely also provide all the secondary and minor elements needed by alfalfa. Soils should be tested on a regular basis to monitor P and K levels and determine if lime is needed.

Removing Excess Nutrients:

Because most of the above-ground growth is removed as hay or haylage, alfalfa has the potential to remove large amounts of nutrients from the soil. When excess nutrients are available, alfalfa plants may take up more than they need for good production. One example is "luxury" consumption of K which the plant may remove two or three times the amount it actually needs.

Alfalfa also has a deep root system which enables it to remove nutrients from greater depths than most crops. Nutrients such as N in the nitrate form can quickly move below the root zone of shallow rooted crops. It then has the potential to enter the groundwater and cause pollution problems. In a study by Mathers, et al., alfalfa removed N to a depth of six feet during the seeding year and over ten feet during the second year. A total of about 270 pounds of N per acre was removed by the alfalfa crop. Dairy manure applied to sandy soils in Massachusetts at a rate to supply 100 pounds of N per acre did not increase nitrate levels in soil water at three feet deep (Daliparthi, et al.). Manure added at a rate to supply 300 pounds of N per acre caused increases in soil water nitrate levels in the fall of the second year of the experiment. Yields of alfalfa were also reduced the second year at one location.

Scherz and Miller (1972) applied up to 600 pounds of N per acre to an established alfalfa stand with little effect on yield or N uptake by the crop. Residual N in the soil the following spring was higher for the 400 and 600 pound per acre N rates in the top two feet of soil, but dropped to less than 20 ppm nitrate N at 30 inches. The 200 pounds per acre N rate resulted in only slightly higher nitrate levels in the soil.

WHEN?

The next question is when should manure be applied for alfalfa. In terms of the rotation the best time may be when a rotational crop such as corn is being grown. If manure can be applied before the soil is tilled, damage to the crop is avoided and nutrient efficiency is increased. This would be more important if solid manures are used. Also, corn - especially silage corn - removes large amounts of nutrients and responds well to manure applications. Any P and K not utilized by the corn crop would be available for the following alfalfa crop.

The next best time in the rotation would be during the last years of an alfalfa stand. At this time there is less risk of injuring the stand and not as much at stake if there is injury. Older stands tend to have a higher percentage of grass that could benefit from the nutrients in manure - especially nitrogen. So, the yield response is likely to be greater with older stands. Manure applied at this time may increase weed problems.

A third option would be to apply manure prior to establishing alfalfa. Schmitt, et al. (1993 & 1994) applied liquid manure to supply up to 900 pounds of N per acre prior to planting alfalfa. Manure was comparable to commercial fertilizer in alfalfa stands and first year yields for all treatments. On a soil testing high in P, there were no effects of manure rates on stand establishment or first year yields. On a moderate P testing soil, alfalfa yields were increased due

to manure application. Undersander, et al. (1991) have also reported that preplant applications of manure can increase yields of alfalfa. Research in Kentucky (Rasnake, 1994) has shown no response of alfalfa to N fertilizer at establishment. Therefore, it appears any response of alfalfa to manure application prior to seeding would be due to P and K, or other nutrients.

The least desirable time to apply manures on alfalfa would be on young established stands. These are at more risk of damage both from the manure and from application equipment. Solid manures should probably not be applied to young, established stands of alfalfa since these are more likely to cause injury to plants. Little damage to plants would be expected from applications of liquid manures if they can be applied by irrigation equipment and applications are made soon after harvest. Tractor drawn equipment such as "honey" wagons can cause damage to plant crowns that are run over by heavy loads.

Manure applied on the surface and not incorporated - especially during warm weather - can be expected to lose significant amounts of N through volatilization. As much as one-third of the total N in manure may be lost in this way? While this may not be a concern in regard to the alfalfa crop, it is a concern environmentally. Therefore, manure applications to established alfalfa stands during summer should be considered as a last resort.

HOW MUCH?

Manure applications should be planned with the needs of the crop in mind. If the crop is corn in rotation with alfalfa, rates should be based on the N needs of corn. In this situation, about 100 pounds of N per acre would be needed (AGR-1, 1996). This could be applied as two tons of broiler litter (Rasnake, et al., 1991), nine tons of fresh dairy cattle manure (AGR-1, 1996) or about an acre inch of swine lagoon waste (Sutton, et al., 1979). These rates assume the manure will be tilled in within two days after application.

If the manure is to be applied to the alfalfa crop, either at establishment or to an established stand, rates should be based on the need for P or K. Soil tests should be used to determine actual needs for these nutrients, but crop removal can be used to estimate a minimum need. As listed previously, a six-ton alfalfa hay crop removes 40 pounds of P and 340 pounds of K. Phosphorus could be replaced using two tons of broiler litter, 20 tons of fresh dairy cattle manure or two inches swine lagoon waste per acre. Replacement of the K removed would require eight tons of broiler litter, 32 tons of fresh dairy cattle manure or 3.8 inches of swine lagoon waste per acre. These comparisons indicate that it may not be practical to attempt to supply all the K needs of alfalfa with manure since this would result in over application of most other nutrients. A better approach would be to apply manure at rates to supply the P needs of the crop and add K fertilizer as needed.

If a farmer is primarily concerned with disposal of manures, application rates should be based on the crops ability to take up N. This is the maximum rate that can be applied without risk of groundwater contamination by nitrates. Using an established alfalfa stand producing six tons of hay per acre as an example again, the N removal is about 350 pounds. The maximum manure

applications, then would be seven tons of broiler litter, 30 tons of fresh dairy manure or three inches of swine lagoon waste per acre per year. These rates would have to be divided into several applications and some crop injury would be expected.

SUMMARY

Manure can be used on alfalfa or other crops in rotation with alfalfa. Timing and rates of application need to be managed to decrease the risk of injury to alfalfa stands and protect the environment. Efficiency of nutrient use will be less than when manure is applied for crops like corn that need N to be applied for good production. Alfalfa will use N from manure, but at the expense of biologically-fixed N. Some crop damage and reduced stand life can be expected when manure is applied to established alfalfa. Therefore, manure applications on alfalfa should be considered only when other, more efficient uses are not available.

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