Fertilizing Alfalfa, Sweet Clover, Alsike Clover, Birdsfoot Trefoil, Red Clover and Grass-Legume

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Alfalfa, sometimes known as the "Queen of Forage Crops," is capable of producing high yields when supplied adequate water and nutrients. Sweet clover is mainly used as a "green manure" crop but can also be used as hay.

Inoculation:

Alfalfa and sweet clover and other legumes can fix nitrogen from the air but will use nitrogen from the soil first if it is available. When the soil nitrogen supply is depleted, legumes fix nitrogen from the air if they have been inoculated with the right strain of bacteria (rhizobia). The inoculum should be mixed with the seed at planting time. If the seed has been treated with a fungicide, check to see if it is compatible with the inoculum.

Yield Goal:

Yield is influenced by: 1) local climate; 2) soil type; and 3) management (timeliness of field operations, plant population, variety, soil fertility, weed control, etc.). Yields of non-irrigated alfalfa normally range from 1 to 5 tons per acre in North Dakota. Irrigated alfalfa can yield 8 tons per acre with good management.

Excessive fertilizer use, especially nitrogen and phosphorus, has potential to degrade ground and surface water quality. Establishing realistic yield goals, carefully soil sampling fields and fertilizing crops according to soil tests will help preserve water quality.

Fertilizer Recommendations:

Nitrogen fertilizer will sometimes increase the yield of alfalfa, but using nitrogen favors growth of grasses, which can eventually dominate the stand. Nitrogen fertilizer is, therefore, not recommended on good stands of alfalfa. Poor stands should be replanted with a suitable variety and the use of the proper inoculant. The amounts of phosphate and potash recommended for various yield goals are given in Tables 1 and 2.

Table 1. Nutrient recommendations for alfalfa.

	Soil Test Phosphorus, ppm				
	VL	L	M	H	VH

Yield goal	Bray-I Olsen	0-5 0-3	6-10 4-7	11-15 8-11	16-20 12-15	21+ 16+
ton/a		- - - - - - lb P2O5/acre - - - - - -				
2		35	25	15	10	0
4		65	50	30	10	0
5		85	60	40	15	0
6		100	70	45	15	0

		Soil Test Potassium, ppm				
		VL	L	M	H	VH
Yield goal	Bray-I Olsen	0-40	41-80	81-120	121-160	161+
ton/a		- - - - - -lb K2O/acre - - - - - -				
2		105	75	45	10	0
4		195	140	80	25	0
5		245	170	100	30	0
6		295	205	120	35	0

Bray-I P recommendation = (18.57-0.93 STP)YG
Olsen P recommendation = (18.57-1.16 STP)YG
Potassium recommendation = (55.71-0.38 STK)YG

The abbreviations used in the equations are as follows:
YG = yield goal
STP = soil test phosphorus
STK = soil test potassium

Table 2. Nutrient recommendations for alsike clover, birdsfoot trefoil, red clover and grass-legume.

		Soil Test Phosphorus, ppm				
		VL	L	M	H	VH
Yield goal	Bray-I Olsen	0-5 0-3	6-10 4-7	11-15 8-11	16-20 12-15	21+ 16+
ton/a		- - - - - - lb P2O5/acre - - - - - -				
2		35	25	15	0	0
3		55	40	25	10	0
4		70	50	30	10	0
5		90	65	40	15	0

		Soil Test Potassium, ppm				
		VL	L	M	H	VH
Yield goal	Bray-I Olsen	0-40	41-80	81-120	121-160	161+
ton/a		- - - - - lb K2O/acre - - - - - -				
2		95	65	40	15	0
3		140	100	60	20	0
4		185	135	80	25	0
5		230	165	100	35	0

Bray-I P recommendation = (20-STP)YG
Olsen P recommendation = (20-1.4 STP)YG
Potassium recommendation = (50.000-0.332 STK)YG

The abbreviations used in the equations are as follows:
YG = yield goal
STP = soil test phosphorus
STK = soil test potassium

Nutrient Requirements:

Nitrogen fertilizer need not be applied to alfalfa, trefoil and clover because they are legumes. Under favorable conditions

well inoculated alfalfa will fix between 100 and 300 pounds of nitrogen per acre per year. Sweet clover will usually fix less than alfalfa. Most of this nitrogen is found in the tops of the plants and is removed if the crop is harvested. Plowed down alfalfa stubble adds very little fixed nitrogen to the soil. In general, the first crop after alfalfa or sweet clover will have the benefit of 35 to 50 pounds of extra nitrogen per acre.

The phosphorus and potassium requirements of alfalfa and sweet clover are very high. For example, a 4 ton per acre crop of alfalfa will remove about 50 pounds of phosphate (P_2O_5) and 200 pounds of potash (K_2O).

Fertilizer Placement:

Broadcasting is the most efficient method of fertilizer application on established perennial crops. Recent data show deep band applications of P_2O_5 in old alfalfa stands is also an effective management tool. Under irrigation and during periods of frequent rainfall alfalfa has the ability to obtain nutrients from near the soil surface. Under dryland conditions in North Dakota it would be better to "build up" or increase the available level of phosphorus and/or potassium in the soil before planting alfalfa or other legume hay crops. The application of approximately 20 pounds of P_2O_5 per acre will increase the phosphorus soil test level by 1. In other words, if your phosphorus soil test level is 5 and you prefer to operate at test level of 12, the application of 140 pounds of P_2O_5 (305 pounds of 18-46-0) per acre thoroughly mixed in the top 6 inches of soil will raise the soil test level by 7. Likewise, the application of 10 pounds of K_2O per acre will increase the potassium soil test by 1.

Secondary and Micronutrients:

Sulfur may be needed on some sandy soils. If a deficiency is suspected, soil test for sulfur. If a deficiency exists, it can be corrected with the application of 50 to 75 pounds of calcium sulfate (gypsum) per acre or 10-20 pounds of elemental sulfur.

Boron is a micronutrient that may also be deficient on sandy, low organic matter soils, especially during dry weather. This nutrient can be added by applying 20 to 30 pounds of sodium borate (borax) per acre. Care must be exercised with this nutrient because if too much is added it is very toxic to alfalfa as well as other crops.

Responses to applications of zinc, iron, copper and manganese by alfalfa and sweet clover are rare in North Dakota.

Soil Acidity and Liming:

Alfalfa and sweet clover prefer to grow in soil with a pH between 6.5 and 7.5 but produce well on soils with a higher pH value. Rhizobia bacteria, necessary for the fixation of atmospheric nitrogen in root nodules, do not survive well in an acid soil. While some surface soils developed from marine deposits in western North Dakota are acid, almost all soils in the state have an accumulation of lime in the subsoil. It is, therefore, unlikely that an application of lime to acid surface soils would be of benefit.

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