Understanding Alfalfa Nutrition

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Abbreviations: *N = Nitrogen, P = Phosphorus, K = Potassium, O = Oxygen, S = Sulphur, Mg = Magnesium, B = Boron, Mn = Manganese, Zn = Zinc, lb = Pound, ppm = Parts per million, OMAFRA = Ontario Ministry of Agriculture, Food and Rural Affairs*

Alfalfa, the "Queen of Forages", has not only a very high yield potential, but is also most palatable and nutritious, and has the highest feeding value of all commonly grown hay crops when harvested at late bud or early flower stage of maturity. It is therefore a heavy user of plant nutrients. As per Phosphate and Potash Institute (now International Plant Nutrition Institute) alfalfa at 8 tons yield removes 450 lb N, 120 lb P_2O_5, 480 lb K_2O and 40 lb each of Mg and S. This is 5.1 times higher than nutrient removal by barley at 70 bu/acre (105 lb N, 39 lb P_2O_5, 105 lb K_2O, 12 lb Mg and 14 lb S). A complete fertilizer program is, therefore, essential to a long-lived alfalfa stand.

As a legume, alfalfa is expected to meet its N requirements from the atmosphere. Hence application of N to alfalfa is not normally recommended. However, under cold conditions and in S deficient soils, N fixation by alfalfa is restricted. At Thunder Bay Agricultural Research Station (TBARS), alfalfa has responded to application of ammonium sulphate more than that to ammonium nitrate in early springs. Two years averages indicated that application of ammonium nitrate (mean over 13.5 and 27 lb N/acre) increased alfalfa yield only marginally (125 lb/acre), whereas application of ammonium sulphate, at equivalent rates of N, improved alfalfa yield by 825 lb/acre. It was also observed that application of ammonium sulphate @ 13.5 lb N/acre produced as much yield as ammonium nitrate @ 27 lb N/acre.

Dr. Sukhdev Malhi in Saskatchewan has reported that growth and yield of alfalfa can be reduced if soil is deficient in S most likely due to reduced N fixation by alfalfa. It may be noted that S deposition is coming down over the years. Alfalfa removes ~3 times as much S as barley; in other words, what barley removes in three years, alfalfa will remove in one year. A healthy alfalfa crop exhibits a bluish green colour and should have 0.2-0.5% S in top 15 cm tissue at 5% bloom. If your alfalfa field gives a pale green look especially at the tops, it could be a sign of S deficiency. Remember as well that S deficiency can exist without depicting any visual symptoms. Wood ash, which can substitute both lime and manure and can bring the soil pH to a desirable level (6.2 or above) for alfalfa, is a good source of S. Ten tons of wood ash could supply up to 22 lb S. Sulphur is a protein (including anti fungal proteins) forming nutrient. Its application

improved protein content in alfalfa by 2-3% point in experiments at TBARS. Ammonium sulphate, which contains both N and S, is the ideal source of S for alfalfa and can be applied @ 100 lbs/acre. Yield and protein content increase with the application of ammonium sulphate makes it economically rewarding.

Application of P and K to alfalfa should be based on soil test using P and K recommendation tables in the Agronomy Guide for Field Crops. For soils medium in available P and K, application of 18-45 lb P_2O_5 and 18-27 lb K_2O/acre is recommended at seeding. If the sodium bicarbonate phosphorus soil test is above 16 ppm P and ammonium acetate potassium soil test is above 151 ppm K, application of P and K to established alfalfa stands is not recommended by OMAFRA. *Some of the soil laboratories are recommending application of P and K at their removal rate by alfalfa to established stands even in the fields high or very high to excessive in P and K. Experiments at TBARS have shown no yield advantage of such applications. Growers who regularly apply manure to their alfalfa fields that are high, very high or excessive in P and K don't have to worry about P and K application to alfalfa through commercial fertilizers.* It will take several years to deplete soil phosphorus and potassium reserves if their amounts have been high in soils. Corn is another crop in the area that has high potassium requirements, though only one-third of alfalfa. Therefore, keep testing the soils once after every 2-3 years to avoid any nutrient deficiency. Early fall is considered to be the best time to apply these nutrients in the established stands. Potassium acts as cellular antifreeze and thereby improves winter survival in alfalfa. Tissue K content of 2% is desirable to avoid winter kill.

Do micronutrients help in improving alfalfa yields? Yes, they do, especially boron (in B deficient soils) which is critical for alfalfa and should be applied every year @ 1 lb B/acre. Critical level of B in alfalfa plant tissue is 20 ppm. In boron deficient tissues, cambial cells cease to divide. Alfalfa plants deficient in B depict pale to reddish coloured tops with shorter internodes. Boron deficiency inhibits protein synthesis. In trials at TBARS, application of B improved the protein content in alfalfa even when it didn't improve its yield. Boron imparts disease resistance to crops and also influences the colonization of Mycorrhiza (beneficial fungus) at the root surface and thereby influences P uptake. Some area growers have started applying ammonium sulphate, B and Zn to their alfalfa crops.

Research at TBARS on persistence and maximum yield in alfalfa has shown that highest yield of alfalfa was obtained when macro (N, P, K, S,) and micronutrients (Zn, Mn and B were applied together. However, we need to confirm these results over the next couple of years.