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Factsheet

FERTILIZER PRACTICES FOR ALFALFA PRODUCTION

(Revision of Factsheet "Fertilizer Practices of Alfalfa Productions", September 1970)

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Alfalfa, a perennial forage species, is produced in Ontario primarily because it **does not** require nitrogen fertilization when grown as a pure stand or when it comprises more than 50% of the stand. When properly inoculated with a legume culture containing the correct strain of the bacteria, Rhizobium, and when soil conditions are suitable for alfalfa production, the plant will obtain its nitrogen supply from the atmosphere. In so doing, a forage is produced which is naturally high in protein when harvested at the right stage of development.

The first step in alfalfa production is the selection of suitable soil conditions. The soil should be alkaline in reaction. When the pH is acid, 6.1 or less, the soil should be limed one year before seeding, at rates indicated by a soil test. If lime is required and a magnesium soil test reading of 100 or less is obtained, dolomitic limestone should be used as the source of limestone.

Select fields which are naturally well-drained or which have been adequately tile-drained. For long-term production good surface drainage is also necessary. The ponding of water during winter rains or thaws often results in complete loss of alfalfa due to ice sheet injury. Subsurface or tile drainage is often necessary to prevent frost heaving and severe reduction in the alfalfa population after the first production year.

A critical period in the life of an alfalfa plant is the establishment period which lasts for six to eight weeks after seeding. Phosporus is the key element in alfalfa establishment. The vigor of the seeding can be increased several fold by the correct placement of the phosphorus at seeding. A practice known as band seeding will provide the correct placement where the phosphorus is drilled 2.5 cm or more directly below the seed. The seed is placed on the surface in a narrow band of 2 cm or less in width and should be covered by not more than 1 cm of soil. The placement of 75 to 100 kg 0-46-0/ha, or its equivalent in this manner may be the vital step that insures the 12 to 14 healthy plants per 0.1 square meter required for high production. Most farm seed drills can be adapted to permit band seeding. (For further details, see the OMAF factsheet **Fertilizer use in Forage Establishment**, Agdex 120/530). Nitrogen does not increase the seeding vigor of alfalfa; potassium will only increase the vigor under conditions of severe deficiency.

At the completion of the establishment phase, the vigorously growing crop begins to make large demands on the available phosphorus and potassium in the soil through its rapidly expanding root system. The amount of fertilizer to apply should be determined by a soil test. The fertilizer rates suggested from the soil test are designed to produce the highest economic yield when accompanied by good or above-average management. The use of general recommendations is of no value where economical production is desired. This is because each field on a farm, through years of fertilizer use and cropping practices, has developed its own distinctive phosphorus and potassium test values. Furthermore, fields, or portions of fields, may have inherited different soil test values due to differences in soil characteristics, such as clay content. Soil tests for P and K are available free of charge for farmers through the OMAF soil testing service at Agri-Food Laboratories, 503 Imperial Road, Unit One, Guelph, Ontario, N1H 6T9.

Large amounts of potassium, often exceeding 250 kgK20/ha may be removed in the harvested forage which may rapidly lower the potassium soil test. Therefore it is recommended that soil samples be obtained the fall before establishment and again after the second year of production.

Where the phosphorus and potassium requirement is not available from the OMAF Soil Testing Service, their soil test values for other crops or from a previous year may be used in conjunction with Table 1 for phosphorus and Table 2 for potassium to give a temporary estimate of the requirement. These tables should not be used with soil test readings from other soil testing laboratories unless the methods used are identical with those used by the OMAF Service.

Tests have shown that from 15 to 30% of the phosphorus applied on the soil surface can be taken up by the alfalfa crop in one season. These data indicated that alfalfa is relatively efficient in the use of fertilizer materials. Therefore, there is little need for deep placement or heavy applications prior to establishment. It must be assumed that the alfalfa root system is equally efficient in the uptake of potassium from the soil surface.

When production is required during the year of establishment by direct seeding without a companion crop, the phosphorus and potassium suggested by the soil test should be band seeded, or if band seeding equipment is not

Table 1 Phosphate Requirements for Forages Based on OMAF Soil Tests

	At seeding with or without nurse crop		At seeding when band seeded[1]		Established Alfalfa	
Sodium Bicarbonate Phosphorus Soil Test (ppm)	Rating	Phosphate (P_2O_5) Required (kg / ha)	Rating	Phosphate (P_2O_5) Required (kg / ha)	Rating	Phosphate (P_2O_5) Required (kg / ha)
0-3		130		130		90
4-5		110		110		70
6-7	LOW	90	LOW	90	LOW	60
8-7		70		70		50
10-12		50		50	MEDIUM	30
13-15		30	MEDIUM	40		20
16-20	MEDIUM	20		30		0
21-25		20		20	HIGH	0
26-30		0		20		0
31-40	HIGH	0		20		0
41-50	VERY HIGH	0		20	VERY HIGH	0
51-60		0	VERY HIGH	0		0
61+	EXCESSIVE[2]	0	EXCESSIVE[2]	0	EXCESSIVE	0

100 kg/ha = 90 lb/ac

[1] For use only where seed is banded directly above the drilled fertilizer.

[2] Excessive readings may cause reduced yield or affect nutrient balance in crops and increase the risk of water pollution.

Tabel 2 Potash Requirements for Forages Based on OMAF Soil Tests

	At seeding with or without nurse crop		Fall applications for new seedling and established stands	
Ammonium Acetate Potassium Soil Test				Alfalfa[1]
(ppm)	Rating	Potash (K_2O) Required (kg/ha)	Rating	Potash (K_2O) Required (kg/ha)
0-15		90		480
16-30		80		400
31-45	LOW	70	LOW	320
46-60		50		250
61-80		40		200
81-100		30		120
101-120	MEDIUM	20		70
121-150		20	MEDIUM	40
151-180	HIGH	0	HIGH	0
181-250	VERY HIGH	0	VERY HIGH	0
251+	EXCESSIVE[2]	0	EXCESSIVE[2]	0

100 kg/ha = 90 lb/ac

[1] Stand of 50% Alfalfa or more. Stands of less than 50% Alfalfa should be fertilized the same as other forages.

[2] Excessive ratings may cause reduced yield or quality of crops primarily due to magnesium deficiency. Natural levels above 251 occur occasionally on clay and clay loam soils, but are not expected to cause problems because soils naturally high in potassium are usually high in magnesium.

available, may be broadcast before seedbed preparation is begun. If the soil test is low to medium a further application should be made immediately after the last harvest before the fall rest period. A fertilizer application at this time is of particular importance if potassium is required. Potassium plays an important role in the storage of food reserves necessary for the winter survival of alfalfa. For adequate food reserve accumulation the potassium content of the plant tissue must be high during September and early October.

Applications of phosphorus for production are satisfactory at any time of the season; however, field conditions for use of spreading machinery are generally at their best in late August or early September or within ten days of the first or second cut. When potassium is also required, the application of a mixed fertilizer is an appropriate procedure. Research has shown little yield advantage of splitting the application of potassium. Only a small amount of each nutrient is taken up during the limited fall growth following a late August application, thus not markedly reducing the amounts remaining for production the following spring. Furthermore the recommended rates are designed to provide enough nutrients for three harvests during the following year.

Boron deficiency in alfalfa is known to occur on soils high in lime throughout the counties of Ontario, Victoria, Peterborough, Durham, Northumberland, Prince Edward, and Hastings. It also may occur on sandy soils or eroded hillsides in other parts of southern Ontario and has been diagnosed in the Thunder Bay district in northern Ontario. Boron-deficiency in plants is most noticeable in the regrowth which occurs in July and August, particularly during dry seasons.

Boron deficiency in alfalfa is recognizable by a yellowing or reddening of the leaves on the upper part of the plant. Stunting, and finally death, of the growing tip occurs, resulting in a telescoping of the upper branches (shortening of the internode) on each main stem. Flowers die, turn brown, and fail to produce seed. These symptoms should be distinguished from leaf hopper damage or potassium deficiency which result in yellow-red colors on the leaves, white spots in a crescent shape around the leaf tip, and no shortening of the internode. *(See OMAF Factsheet, Boron Fertilization of Alfalfa, Agdex 121-531.)*

Boron deficiency may be corrected by applying 1-2 kg/ha of actual boron per year. Many fertilizer companies will mix boron with other fertilizer on a special order. When establishing a new seeding apply the boron in the fertilizer mixture put on in the fall of the seeding year.

Boron may be toxic to other crops such as peas, beans, and small grains. Do not plant these crops where borax was applied to an alfalfa field the previous fall. Never sow borated fertilizers with cereal grains when seeding down.

Sulfur may be limiting production of alfalfa in areas of northern and northwestern Ontario. Sulfur deficiency is recognizable by a pale green to yellowish green color of the newly developing leaves, and by a distinctive contrasting lighter color of the leaf veins. Sulfur deficiency is most evident when the phosphorus, potassium and moisture conditions in the soil are favorable for rapid plant growth. Where sulphur deficiency is known to occur it may be alleviated by the application of 25 kg S/ha as pure ground gypsum ($CaSO_4$).

Plant analysis is a useful supplement to soil testing particularly in confirming suspected boron and sulphur requirements of alfalfa. The plant analysis measures the nutrient content of the leaves and the analysis is compared to 'normal' and "critical" values for the crop (Table 3). Plant analysis for the major nutrients, phosphorus and potassium, does not provide an estimate of the fertilizer requirement. Therefore, a soil sample should be taken at the same time and location as the plant sample.

Sample the alfalfa separately from other species in the stand. The plant cut at normal mowing height at the late bud stage is recommended. However, plants suspected of nutrient deficiency should be sampled as soon as the problem appears. Expert help will be required to interpret plant analysis results when the samples are not taken at the late bud stage.

Table 3 Intrpretation of Plant Analysis for Alfalfa[1]

Nutrient	Units	Critical Concentration[2]	Maximum Normal Concentration[3]
Nitrogen (N)	%	-	5.5
Phosphorus (P)	%	0.20	0.5
Potassium (K)	%	1.7	3.5
Calcium (Ca)	%	-	4.0
Magnesium (Mg)	%	0.20	1.0
Sulphur (S)	%	0.22	-
Boron (B)	ppm (µg/g)	20	90
Copper (Cu)	ppm	5	30
Manganese (Mn)	ppm	20	100
Molybdenum (Mo)	ppm	0.5	5.0
Zinc (Zn)	ppm	10	70

1 Values apply to the plant cut at normal mowing height at the late bud stage.
2 Yield loss due to nutrient deficiency is expected with nurient concentrations at or below the "critical" concentration.
3 Maximum normal concentrations are more than adequate but do not necessarily cause toxicities.