TECHNICAL NOTES

U.S. DEPARTMENT OF AGRICULTURE WYOMING NATURAL RESOURCES CONSERVATION SERVICE

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SUBJECT: University of Wyoming Guide to Fertilizer Recommendations

This Technical Note transmits the University of Wyoming Guide to Fertilizer Recommendations, Publication B-1045. This information should be used in the development of all Nutrient Management Plans.

This publication can also be found at a County Extension Educator office or on the University of Wyoming website:

http://uwadmnweb.uwyo.edu/soilfert/Links_Fertilizer_Guidelines.asp

UNIVERSITY OF WYOMING

Cooperative Extension Service
Department of Plant, Soil, and Insect Sciences
College of Agriculture

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Guide to Wyoming Fertilizer Recommendations

by

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GUIDE TO WYOMING

FERTILIZER RECOMMENDATIONS

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CONTENTS

The Metric System

Conversion factors to convert U.S. units used in this publication to standard metric units are shown below.

To convert U.S. Units	To metric units	Multiply* (U.S. units) by factor shown
Bushel measure	Hectoliters	0.352
Pounds	Kilograms (Kgs)	0.454
Hundredweight (cwt)	Quintals	0.454
Tons (short) (T)	Metric tons (MT)	0.907
Acre (A)	Hectare (Ha)	0.405
Lbs/acre	Kgs/hectare	1.12
Hundred weight/acre (cwt/A)	Quintals/hectare	1.12
Tons/acre (T/A)	Metric tons/hectare	2.242
Barley, bushels/acre	Barley, quintals/Ha	0.538†
Oats, bushel/acre	Oats, quintals/Ha	0.359†
Wheat, bushels/acre	Wheat, quintals/HA	0.673†
Shelled corn, bushels/acre	Shelled corn, quintals/HA	0.628†
Lbs/bushel	Kgs/hectoliter	1.287

*Divide by factor shown to convert metric units to U.S. units

†These factors are based on U.S. standard bushel weights of 48 lbs for barley, 32 lbs for oats, 60 lbs for wheat and 56 lbs for shelled corn.

ACKNOWLEDGEMENTS

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INTRODUCTION

Soil Testing and Soil Test Interpretation

A soil test is a basic management tool for the estimation of fertilizer nutrient requirements to achieve a specific crop production goal. Soil testing is only one of many tools and techniques used to determine the fertility or nutrient status of soils and plants. In addition to soil testing, some other diagnostic methods are plant tissue analysis, field tissue testing, crop response measurements, and visual deficiency symptoms. These other tools can be used to diagnose plant-nutrient status, but soil testing is the primary predictive tool. Soil testing is used to determine current soil fertility levels and to predict the amount of plant nutrients needed for optimum crop production. Plant tissue testing compliments soil testing. Plant analysis is particularly useful for nutrients for which there is no soil test or for crops for which soil tests have not been correlated and calibrated. Plant analysis can help detect problems that may not be detected with a soil test. Plant analysis can also confirm whether a symptom is actually nutrient deficiency or some other problem. Plant analysis is also useful in determining plant quality, as in the case of the nutritional quality of forages fed to livestock.

Soil test results can be used in many ways, but the principal objective of most soil testing is to help predict the amount of nutrients needed to supplement the supply in the soil. A soil test is a chemical method of determining the nutrient-supplying power of the soil. A soil test usually measures only part of the total nutrient supply in the soil. Soil-test values are of little use by themselves. Most soil test values do not tell directly how much of the nutrient is actually available in the soil, but they are indexes that are related to the relative nutrient-supplying capacity of the soil. As an index, soil test values are used to indicate the probability of response or yield increase with fertilizer additions. These indexes are also used to indicate the amount that should be added for a given set of conditions. Figure 1 illustrates conceptually the probability of crop response to added nutrients for different soil-test levels. In the absence of other growth-limiting factors (moisture availability, rooting-depth restrictions, pest and disease pressure, etc.), a low-testing soil is very likely to produce a large yield increase in response to additions of the deficient nutrient. When available soil nutrients are high, the probability of response to fertilizer is low. In order to use soil tests in predicting fertilizer needs of crops, the soil-test values must be calibrated against fertilizer rate experiments in the greenhouse and in the field.

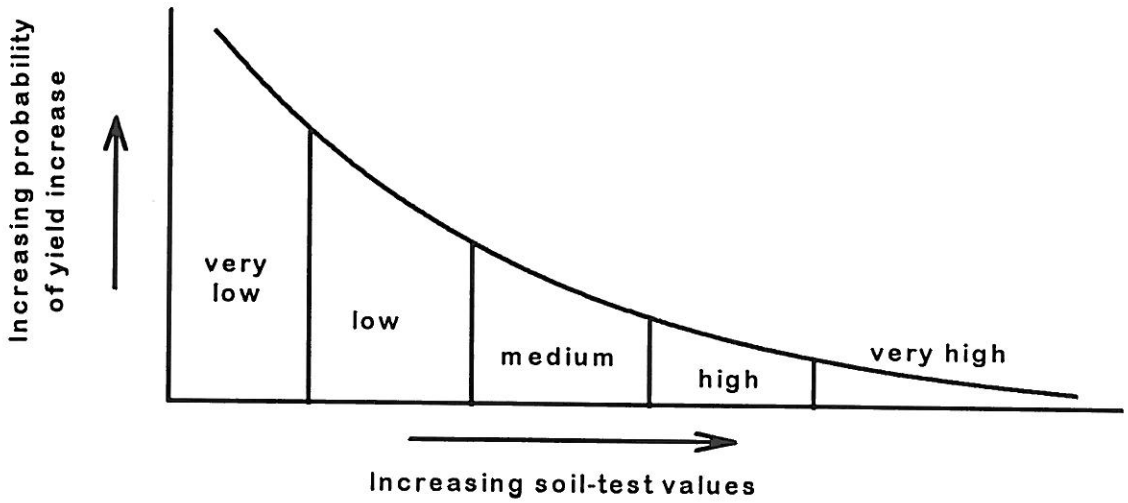

Figure 1. Probability of yield increase for relative soil nutrient levels.

The soil testing process consists of four basic parts. The first step, collecting the soil sample is the step that generally has the greatest possibility for introducing error. The sample submitted to the laboratory must be representative of the area to be treated. Odd or dissimilar areas should be avoided or sampled separately. Take adequate samples to prevent biasing results by natural soil variability. Each sample should consist of 10-15 cores or subsamples thoroughly mixed and should represent not more than 10-20 acres. The chemical analysis of the sample is probably the most accurate of the soil testing process. Laboratories take great care to implement proper quality control measures. Interpreting results and making fertilizer recommendations are subjective procedures based on the best available research data collected over many years and locations. Some specific production information supplied by the grower is also considered.

Fertilizer Recommendations

When a soil sample is submitted for analysis, a soil test report containing fertilizer recommendations is returned. In making a recommendation, the lab considers the actual chemical analysis of the soil sample, current calibration research, the recommendation philosophy of the laboratory, and other information supplied by the grower that may change the recommendation. For these reasons, recommendations often vary from one lab to another. A grower, dealer, and/or consultant should use the lab's recommendation as a guideline from which to start. They should adjust the recommended fertilizer rates based on management factors that the lab cannot consider. There are many factors affecting the amount of fertilizer that should actually be applied. Some of these are listed below.

Some factors may be used by the lab itself in adjusting fertilizer recommendations or giving fertilizer credits for past management. An information questionnaire should be submitted with the sample and filled out as completely as possible. The more complete and accurate the information supplied to the lab, the more suitable will be the fertilizer recommendation. Crop production factors upon which the University of Wyoming Soil Testing Laboratory adjusts fertilizer guidelines includes one or more of the following:

- Soil test results
- Crop to be grown
- Previous crop
- Yield goal
- Water supply or irrigation
- Manure applications
- Soil organic matter
- Elevation

Other factors are beyond the control or knowledge of the lab, but should be used by the grower, dealer, or consultant to tailor fertilizer recommendations to field- and soil-specific situations for optimum crop production. The following are some of the many factors a producer should consider in adjusting specific fertilizer applications:

- Crop to be grown
- Yield goal
- Past yield
- Irrigation
- Rainfall
- Soil moisture
- Price of crop
- Price of fertilizer
- Crop rotation
- Pest pressure
- Manure
- Management level
- Fertilizer history
- Planting date
- Hybrid or variety
- Results from plant analysis
- Tillage system
- Stand counts or population
- Government programs
- Tax burden
- Cash flow position
- Length of lease
- Interest rate
- Nutrients in irrigation water

Most laboratories use mathematical formulas rather than tables to generate fertilizer recommendations. The formulas are derived from calibration studies that determine plant response to the nutrient over a large number of fertilizer rates. These equations offer the following advantages:

1. Equations can be updated and changed readily with new research or ideas.
2. Equations can readily be stored and used by computers.
3. Equations eliminate the large differences in recommendations with some small differences in soil test levels that sometimes result when using tables.

Soil nutrient levels will sometimes be classified in relative levels ranging from Very Low to Very High. These ranges should serve as a guide and usually result in less precise fertilizer recommendations than equations. Relative nutrient ranges can indicate the relative probability of crop response to fertilizer applications of that nutrient.

Yield Goals

Setting realistic yield goals is one of the most important considerations for accurate recommendations. High yields are a combination of many production factors. Extra fertilizer will not achieve high yields without proper planting date, population, and other cultural factors. Growers who consistently use top-level management should set a high yield goal. The highest yield that has been produced is an unrealistic yield goal. Yield goals should be set at a level that is challenging but can be reasonably attained most years. This goal may change with other factors, such as soil moisture. For example, in a dryland wheat situation, with good fall rains, the yield goal should be higher than for a dry year. Keep in mind that the highest yields possible for your conditions are usually not economical to achieve. Maximum economic yields are usually somewhat less than the maximum attainable yield.

Soil Test Levels

When soil-test levels for phosphorus and potassium are low, fertilizer recommendations from some labs may be higher than others. Some labs base recommendations on the philosophy that soils should be built up to medium to high levels for optimum crop production. According to this philosophy, building these levels may result in the chance for additional yields during those years when environmental factors are right for higher yields. Note, however, that in some soils, it may be difficult or uneconomical to significantly change soil test levels of phosphorus or potassium and fertilizer used in this way may not be economical. Soils are very complex in their various nutrient reactions.

In soils where phosphate fertilizer has been used liberally, and in soils with high native levels of soil potassium, soil test levels may indicate no additional fertilizer is needed. At these levels, yield response to added nutrients is less likely, but there are situations which may benefit from additional fertilizer. The following situations may justify additional nutrient applications when soil tests are high:

1. Starter fertilizers on cold, wet soils
2. Fields with large amounts of crop residue.

3. Early planting.
4. Minimum or no till fields.
5. Cash flow/tax situation of customer.

   Phosphorus and potassium are relatively immobile in soil. If the buildup philosophy applies, these nutrients can be applied for future use. When income and expenses indicate high taxes, fertilizer may be purchased and "stored" in the soil for future use versus paying those dollars in taxes. Increasing soil nutrient levels to very high levels may not be advisable for some nutrients. Nitrate nitrogen in the soil is susceptible to leaching and denitrification and may become an environment hazard. Potassium is susceptible to luxury consumption, uptake exceeding plant requirements with no additional benefit to the plant, which can offset attempts to increase soil potassium.

6. Maintenance - crop removal levels.

   In high-testing soils, the farmer has the option of "mining" the fertility or applying maintenance amounts of fertilizer to sustain soil test levels. Soils with a high buffering capacity (slowly released nutrient reserves) for a given nutrient may be cropped for several years with no noticeable change in soil test levels. Soils with low buffering capacity may need nutrient applications to replace plant nutrients removed in the crop. By using crop removal figures, growers can estimate the amounts of nutrients removed in harvested portions of the crop.

ABOUT THIS GUIDE

This bulletin presents the fertilizer recommendations of the University of Wyoming Soil Testing Service. The service's function is to determine nutrient and physical crop production goals. This service is operated and maintained by University staff. Fertilizer recommendations are generated by a computer program. The soil test and the fertilizer recommendations allow production needs for several nutrient factors to be scaled to match the most limiting production factor. The soil test, particularly in the case of nitrogen, can be used to maintain optimum crop yields with minimum waste or environmental hazard.

The nutrient levels are recommended under assumption that other controllable growth limiting factors are optimum for maximum plant growth. These include planting time and rate; disease, insect, and weed control; selection of a recommended variety; adequate and timely irrigation and a complete, uninterrupted harvest. It is also assumed that the uncontrollable factors, such as temperature, growing season length, wind velocities, certain diseases, and animal damages are at average or normal levels for the area and time. An adequate fertility program enhances the benefits of other management activities, but it cannot overcome poor performance of any other management practice.

Laboratory soil test values are meaningless unless the test values have been correlated with plant growth response to the applied nutrients. Thus, field experiments are conducted continually to refine the soil test value-plant response relationship. Recommendations will be updated periodically as better soil-plant response relationships are established.

This guide has been prepared to allow county agricultural extension educators, growers, gardeners, and groundskeepers to better understand the different parts of the fertilizer and management recommendations shown on the computer printout for samples that have been analyzed by the University of Wyoming Plant Science Department, Soil Testing Laboratory. Other laboratories may use different analytical techniques, therefore use of this bulletin is recommended for use with soil test results form the University of Wyoming laboratory. This guide should be used with results from other laboratories only if it can be verified that the analytical methods used were those methods used by the University of Wyoming Soil Testing Laboratory. Should a change in crop, or yield goal be desired for the tested area, this guide can be used to prepare appropriate fertilizer and management recommendations without returning to the laboratory or computer.

USING THIS GUIDE

Adjustments in recommendations.

All fertilizer recommendations require information from the grower for crop, yield goal, expected water supply, cropping history, etc., and the soil test results from the University of Wyoming Soil Testing Laboratory. Recommendations for nitrogen (N), phosphorus (P), and potassium (K) at a specified yield goal for each crop listed in the contents are located in the tables of this guide. (Recommendations listed are calculated for the midpoint of the corresponding soil-test range.) Choose a realistic yield goal based on past experience and knowledge of the area. If the yield goal for crop is not stated, the yield goal for sufficient water listed in Table 1 will be used. Nutrient adjustment values per unit of yield will be given in a statement accompanying the recommendations. (All nutrient recommendation tables for crops shown in this publication are constructed for definite yield goal at the sufficient water condition.) The grower may select a different yield goal, and can use the listed adjustment factors to modify the fertilizer nutrient recommendations to fit his actual yield goal.

Table 1. Yield goals used in this publication for field crops under various water conditions. (The adjustment factors can be used to revise the nutrient requirements when the grower is increasing or decreasing his yield goal from the amount shown in the recommendations.)

	Adjustment factors lbs nutrient/yield unit			Yield	Yield goal by water condition		
Crop	N	P_2O_5	K_2O	units	Sufficient	Short	Dryland
Forage							
Grass and/or	40	15	35	T/A	6	4	2
legume	40	15	40				
Grains							
Corn, ensilage	9.0	3.0	8.0	T/A	30	20	--
Shelled corn	1.6	0.6	1.2	Bu/A	150	100	--
Sorghum, etc.[1]	9.0	3.0	8.0	T/A	10	6.7	--
Millet	2.0	0.6	1.7	Bu/A	--	--	35
Barley	1.55	0.7	1.6	Bu/A	100	67	35
Oats	1.15	0.5	1.3	Bu/A	135	90	45
Wheat	1.72	1.0	2.0	Bu/A	90	60	30
Commercial crops							
Dry bean	--[2]	1.75	4.0	Cwt/A	30	20	--
Potato	0.5	0.2	1.0	Cwt/A	350	230	--
Safflower	5.0	2.0	2.0	lbs/A	--	--	1,400
Sugarbeet	9.0	3.0	9.0	T/A	30	20	--
Sunflower	6.0	2.0	2.0	Cwt/A	30	20	15

[1] Sorghum, Sudan, or hybrids for ensilage, hay, or pasture.

[2] No adjustment for yield goal recommended by the computer program.

For example: You may have received a recommendation of 245 lbs N and 45 lbs P_2O_5 for 30 tons/acre corn ensilage per acre on your coarse-textured soil. Experience with this field and variety leads you to believe that 26 tons/acre would be a more realistic yield goal. Thus 30 - 26 = 4 ton, then 4 tons x 9 lbs N/ton = 36 lbs N and 4 ton x 3 lbs P_2O_5, so 245 - 36 and 45 - 12 will change the fertilizer recommendation to 209 lbs N and 33 lbs P_2O_5 per acre.

In the same way, the table values for recommended nutrients can be reduced for short irrigation water or dryland water conditions. An adjustment factor is shown with each table to facilitate the adjustment of each nutrient rate to a level consistent with the yield goal.

Water Supply

Water is an essential factor in plant growth. Terms relating to water supply are defined, as follows:

1. Sufficient - adequate water for full and timely irrigations for the desired crop. Fertilizer recommendations tables in this publication were constructed for sufficient water conditions.

2. Short - a 20-25% decrease during the growing season from what would be considered optimum irrigation with reasonable timing of applications for the desired crop. Yield goals approximately two-thirds of maximum may be realized, but more severe limitations of water applications should have yield goals assigned in the range of dryland production.

3. Dryland - average or better precipitation conditions on lands that have generally been considered as suitable for dryland crop production. The production goal is approximately one-third that obtainable under optimum irrigation.

4. Over irrigation is another category of water usage which can leach various amounts of fertilizer beyond the root zone on well drained soils. Some growers try to compensate for this by increasing fertilizer rates beyond what is recommended by soil test to maintain their yield goals. This increases fertilizer costs, nutrient accumulations in deeper soil layers, and contamination of surface and groundwater.

Stand Component Percentage Estimate Procedures

Forage crops occupy the largest fraction of Wyoming's irrigated agricultural land. Preparation of fertilizer recommendations for pure grass or legume stands is simpler than for mixed grass-legume stands. Preparation of fertilizer recommendations for mixed stands requires a good estimate of the percent grass and the percent legume in the stand.

The best way to obtain estimates of forage percentages is to separate a sample of the cut vegetation into grass only and legume only piles, then dry them, weigh each pile and calculate the percentage each is of the whole. An alternate method is to estimate the percent of area occupied by legume on each of three sample areas in the field, take the average of these estimates to obtain the percent stand for legumes. Subtract this estimate from 100 to obtain the estimate for percent grass in stand.

Nitrogen

Nitrogen (N) recommendations are based on the concept that plants will obtain much of their N supply from microbial decomposition of soil organic matter. In the laboratory the soil organic matter content is determined to prepare an estimate of N that should be available from this source. Other available N is assumed to be primarily present as nitrate N. Each sample for a nitrate test should be carefully dried before mailing. This can be done by spreading the sample on a newspaper and placing it in the sun for 4 to 8 hours. Samples not properly dried after they are collected will not provide an accurate soil test. Once the samples are dried they should be placed in individual bags and sent to the UW Soils Laboratory. Information required on the questionnaire for N status evaluation included amount and types of crop residues and manures, evaluation, moisture prospects, desired crop, yield goal.

For all crops, the soil-test nitrate-N concentrations are listed in the left column of the N-recommendation tables. For grass-legume mixtures (Table 5), percentages of grass and legume in the stand are listed across the top with the appropriate N recommendation for each nitrate-N level listed under them. All other crops have soil organic matter content listed across the top of the table. For elevations under 6,000 ft., this guide assumes release of 20 lb/acre of available N during the growing season for each percent of organic matter contained in the soil. The appropriate N recommendation for each nitrate-N range is listed under each organic-matter content range.

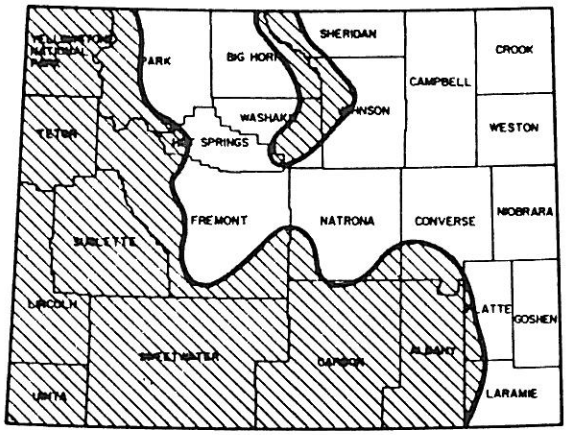

Figure 2. Areas of Wyoming over 6,000 ft. elevation (shaded).

Because of cooler air, soil, and water temperatures and a shorter growing season above 6,000 ft., N released from organic matter is not sufficient to be considered as a significant N source. For elevations above 6,000 ft. (Fig. 2), use the column under the lowest organic matter content. Nitrogen recommendations may also be adjusted for crop rotation effects and/or manure applications in the current year (Table 2).

Phosphorus

Phosphorus (P) recommendation tables have been designed to reflect the effect of coarse, medium, and fine-textured or high lime soils on the sorption of P fertilizer. The coarse-textured soils are the sands, loamy sands, and sandy loams. The medium-textured soils are the silts, silt loams, loams, and sandy clay loams. The fine-textured soils are the sandy clays, clay loams, silty clay loams, silty clays, and clays. The organic soils and high lime soils are considered the same as fine-textured soils for P recommendation purposes.

Table 2. Cropping history conditions that require adjustments in nitrogen recommendations.

Previous Crop or Manure Application	Adjustment in Nitrogen Recommendation	
	Pounds N subtracted	Pounds N added
Beans	30/acre	
Clean fallow	20/acre	
Corn stalks (dry)		20/ton of residue
Forage legume plowed down		
Stubble only	0.8 lbs N x % legume in past stand/acre	
Stubble and 1 ton or more of tops	1.2 lbs N x % legume in past stand/acre	
Small grain (stubble & straw residue)		20/ton of residue
Sugarbeet (if tops not pastured or removed)	50/acre	
Current manure application	5/ton of manure	

This table was formulated after considering information contained in literature citation numbers 42 and 52.

Potassium

The test for potassium (K) is an optional test since K fertilizer is recommended for only a small number of the samples tested. Soils in many arid and semi-arid regions contain high or very high K levels. Plants have a capacity for "luxury consumption" of K. This means the plant can take K in excess of that needed for crop growth without detrimental effects. Many irrigation waters in these regions also contain significant K that reduces fertilizer K requirements. The values on the map shown in Fig. 3 are calculated from the K concentrations of surface waters measured by the U.S. Geological Survey, 1974. In some crops, the partial substitution of sodium for K in some physiological plant functions will also reduce fertilizer K requirements. Potassium recommendations made in this guide are based on the K test value and the yield goal for the desired crop for only one growing season.

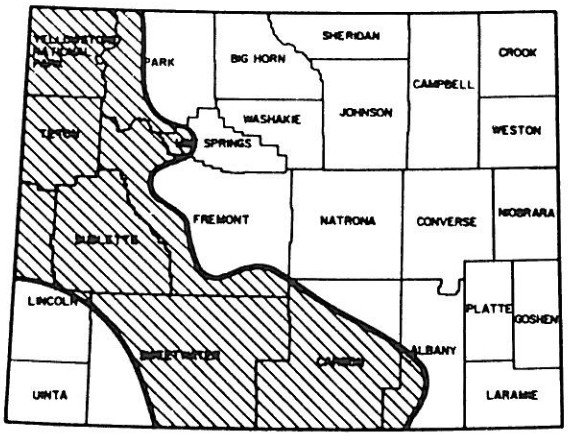

Figure 3. Average June, July, and Aug. 1974 lbs K_2O/acre-foot of surface waters for irrigation (shaded areas=2-5, unshaded=7-15).

Sulfur

Sulfur (S) as a nutrient is used by the plant in quantities similar to phosphorus. Sulfur release from gypsiferous minerals and organic matter can supply sulfur for either plant nutrition or soil amendment purposes. Organic sulfur forms must be converted to available forms by soil organisms. Some irrigation waters can also supply available S. Sulfate-S concentrations were reported by the U.S. Geological Survey for the 1974 water year for most Wyoming streams (Fig. 4). Walker(50) showed that Boulder loamy sand along the New Fork River near Big Piney in Sublette County, requires sulfur fertilization to grow legumes. Rehm(34) reported that, in the Sandhills area of Nebraska, if irrigation water contains 21 lbs sulfur/acre foot of water corn does not require sulfur fertilizer. Wyoming areas II, III, and IV have surface waters for irrigation that supply 25 lbs sulfur or more/acre foot of water. Carriers of other fertilizer nutrients can also supply available S (Table 3). For dryland crops with a good moisture supply, ammonium sulfate at 200 lbs/acre will supply 42 lbs N and 48 lbs sulfur which would be adequate if a sulfur deficiency existed. For the purpose of amending sodium-affected soils, special soil tests are required to determine appropriate soil amendment rates.

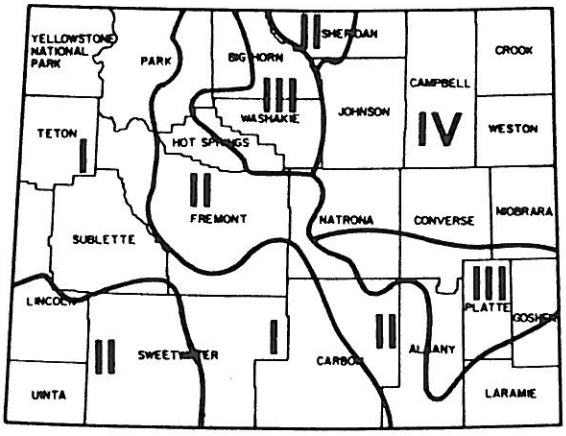

Figure 4. Sulfur content of surface waters available for irrigation in lbs sulfate-S/acre-foot of water. (I=3-24, II=25-87, III=88-187, and IV=187-2356).

Micronutrients

Tests for the micronutrients, iron, and zinc are optional. Cultural conditions and practices affect the availability of these to plants. Mid-season climate and soil conditions often improve iron and zinc supplies for plants. Iron fertilizer recommendations are confined to horticultural plantings (mostly trees and shrubs), while some zinc fertilizer recommendations are made for field crops. Chelated formulations of iron and zinc are available and are generally more effective, but also more expensive, than mineral salts. Fertilizer rates may be reduced by 50% to 80% when using chelated formulations.

Soluble Salts

Soluble salt contents of soils are inferred from the amount of electricity conducted by the water extracts from saturated soil pastes. All plants listed in this guide have been classified according to their tolerance to various amounts of salt in soils as indicated by the conductance values (Tables 40 and 41).

Soil Inoculant

Soil microorganisms are important for release of nutrients from soil organic matter and for uptake of nutrients by plants. Most of these organisms are already present in agricultural lands. However, inoculation with the Rhizobium bacteria when seeding legumes is a recommended and relatively inexpensive practice. These organisms nodulate alfalfa, beans, clover, fababeans, sainfoin, vetch, etc., and are a very important source of plant nitrogen (49). These organisms are host specific and the proper Rhizobium species must be selected to be effective. Consult product labels when purchasing these products. Inoculation with Rhizobium is more important when planting a new type of legume or when returning a legume to a field with a mixed crop history or a long absence of the legume being planted. Beyond Rhizobium bacteria, addition of other organisms is generally not needed on agricultural lands. Mycorrhizal fungi and blue-green algae are very important to crop plants, but their distribution is almost universal and little quality inoculum is available (50).

Soil Activators

Soil activators are another category of soil additives available for use on the farm, ranch, or garden soil. These products are often claimed to contain secret ingredients which promote crop development or beneficial soil properties. Considerable caution should be used with such products. Testing of several soil activators has shown little or no benefit to crops or soils (7,48). Salesmen for such products often describe fabulous results from their use. Obtain specific information about the tests and results obtained for the crops and soils of interest. If possible, determine where and by whom the tests were conducted. An independent opinion should be obtained before any purchase. Application and testing on only a small portion of the field to be treated is recommended before a large purchase is made.

Special Considerations

Only a very limited number of Wyoming growers are producing fruits or vegetables other than potato, for processors or the fresh produce market. Thus, fertilizer recommendations for lawns, vegetables, fruits, shrubs, vines, and trees are directed to home, garden, and ground conditions appropriate for elevations encountered. Commercial enterprises needing further refinement in fertilizer recommendations should contact the University county extension educator. Good seed of appropriate varieties and timeless of all operations, including weed and pest management, are necessary to achieve the desired benefit from applied fertilizer.

Special Statements

Following the nutrient recommendations tables for each crop, there is a list of special statements. Special situations are often encountered in the preparation of computer readouts for recommendations in the soil testing program. These situations instruct the computer to print out appropriate advisory statements which are shown in the special statements sections following the nutrient recommendations tables for each crop.

Example Calculations

Suppose you have rented some additional land and now want to grow 25 tons/acre of corn for silage after dry beans, and you have also applied 10 tons of manure per acre. The soil test results obtained from the University of Wyoming Soil Testing Laboratory analyses and the fertilizer recommendations for your sample

appear on the computer printout from the Soil Testing Laboratory in Figure 5. Descriptions of how to formulate the recommendations using the tables in this guide follow.

Soil test results that supplement the above information for determining the nitrogen recommendation are 14.5 ppm NO_3-N and 1.5% organic matter. From Table 8a, you will find that 175 lbs N/acre are required to produce 30 tons silage per acre. However, the first table in this publication shows that there is a 30 lbs N/acre benefit to the crop following beans, and that each ton of manure applied benefits the first crop to follow at the rate of 5 lbs N/ton applied. Thus, 10 tons multiplied by 5 lbs N/ton equals 50 lbs N/acre benefit from applied manure for the corn. Also, Table 1 preceding this example shows a 9 lbs N/ton adjustment factor, your yield goal is 5 tons/acre or 45 lbs N/acre because your yield goal was lower. Your nitrogen requirement per acre now becomes 175 minus 30 lbs N from beans minus 50 lbs N from manure minus 45 lbs N from decreased yield goal for a net of 50 lbs N/acre. If ammonium nitrate is the desired fertilizer, then divide 50 lbs N by 0.34 to get 147 lbs ammonium nitrate required to supply 50 lbs N/acre.

The soil analysis results used for making the phosphorus recommendation are the sandy loam soil texture, the low lime content and the 11.0 ppm P test. The sandy loam is listed as coarse-textured soil on page 5, and the lime content is not high so the coarse-textured classification is used. Thus, in Table 9 the 11.0 ppm P test requires 45 lbs P_2O_5 per acre on coarse-textured soils. (A high lime reading would have required the soil be treated as fine-textured, which would have meant a 90 lbs P_2O_5/acre requirement to obtain an equivalent response.) The 3 lbs P_2O_5/ton adjustment factor per ton for the 5 ton reduction in yield goal equals 15 lbs P_2O_5 to subtract from 45 to yield a net P_2O_5 requirement of 30 lbs/acre. If triple superphosphate is the material on hand, then from Table 3, divide 30 lbs P_2O_5 required by the P_2O_5 concentration (0.45) to find that 67 lbs of triple superphosphate would be required per acre.

The optional potassium soil test was 254 ppm K, and Table 10 shows that no potash fertilizer will be required for the 30 ton yield goal for which this table was constructed. A reduction in K requirement for the lower yield goal does not change the zero recommendation.

The optional iron test value was 6.4. Table 38 shows that any test value over 5 ppm Fe does not require iron fertilization. However, the optional zinc test value was 1.2 ppm Zn, and Table 39 shows that 5 lbs fertilizer zinc/acre should be applied for irrigated corn. If zinc sulfate is the material to be used then divide 5 by 0.355 (Table 3) to get 14 lbs zinc sulfate to apply per acre.

The soluble salt estimate produced an electrical conductivity reading on the saturation paste extract of 0.6 mmhos/cm. According to Table 40, corn should not be affected by this salt level.

Table 3. Commercial grades, main nutrient components, and form of some common fertilizer carriers.[1]

Fertilizer Materials	Commercial grade	Main nutrient component	Other Nutrients	Form
Nitrogen				
Ammonium nitrate	34-0-0[2]	N		dry
Ammonium sulfate	21-0-0	N	24% S	dry
Ammonium thiosulfate	12-0-0	N	26% S	fluid
Anhydrous ammonia	82-0-0	N		compressed gas
Diammonium phosphate	16-46-0 to 18-48-0	N	46% P_2O_5	dry
Monoammonium phosphate	11-52-0	N	52% P_2O_5	dry
Urea	46-0-0	N		dry
Urea-ammonium nitrate	32-0-0 or 28-0-0	N		fluid
Phosphate				
Ammonium polyphosphate	10-34-0	P_2O_5	10% N	fluid
Diammonium phosphate	18-46-0	P_2O_5	18% N	dry
Monoammonium phosphate	11-52-0	P_2O_5	11% N	dry
Triple superphosphate	0-45-0	P_2O_5		dry
Potassium				
Muriate of potash	0-0-62	K_2O		dry
Potassium sulfate	0-0-50	K_2O	18% S	dry
Iron				
Ferrous ammonium sulfate	14% Fe	Fe	8% S	dry
Ferrous sulfate	20% Fe	Fe	11.5% S	dry
Synthetic iron chelates	5-14% Fe	Fe		dry
Zinc				
Ammoniated zinc	13-0-0-15% Zn	Zn	13% N	fluid
Synthetic zinc chelates	6-14% Zn	Zn		dry
Zinc ammonium sulfate	16% Zn	Zn	15.5% S	dry
Zinc sulfate	35.5% Zn	Zn	12% S	dry
Sulfur				
Gypsum	18.5% S	S	23% Ca	dry
Elemental sulfur	100% S	S		dry
Ammonium sulfate	21-0-0-24% S	S	21% N	dry

[1]This table was formulated after considering information contained in literature citation 41.

[2]Fertilizers must by law, list the percentage of N, P_2O_5, and K_2O that they contain. Therefore, a fertilizer which has 34% nitrogen, no phosphorus and no potassium is listed as 34-0-0.

Figure 4: Sample soil-test report from the University of Wyoming Soil Testing Laboratory.

(Kelli Belden, PSIS, will provide a sample of a soil test report)

FERTILIZER AND MANAGEMENT RECOMMENDATIONS

Macronutrients (Nitrogen, Phosphorus, and Potassium)

FORAGES

Alfalfa, clover, birdsfoot trefoil, or cicer milkvetch (new seedings) (irrigated at elevations below and above 6,000 ft.)

Table 4. Nitrogen recommendations for **new seedings** of alfalfa, clover or cicer milkvetch. (Do not adjust nitrogen rates for soil organic matter levels.)

NO_3-N soil test ppm N	Fertilizer nitrogen lbs N/acre
0-3	40
4-6	20
>6	0

After Soltanpour, et al.,. This table was adopted after considering information in literature citations 15 and 42. P_2O_5 recommendations for alfalfa, clover or cicer milkvetch--see Table 6. K_2O recommendations for alfalfa, clover or cicer milkvetch--see Table 7.

Special Statements

1. **Situation:** New seeding with or without cover crop where P_2O_5 and K_2O recommendation is greater than zero.
   Statement: Amounts of P_2O_5 recommended are for a 1-year application. If soil lime content is low, it is advantageous to broadcast a 3-year application and plow it down before seeding. If lime content is medium to high, buildup of soil P may be difficult. Apply recommended amount annually and retest in 2 to 3 years.

2. **Situation:** High fertility on irrigated or dryland. Fertilizer recommendation equals zero for all nutrients.
   Statement: Soil fertility is generally very good for this crop. Based on University of Wyoming tests and the information supplied by growers, fertilization is not required.

3. **Situation:** Elevation of location exceeds 6,000 ft. for Ladino clover or Red Clover.
   Statement: Environmental conditions above 6,000 ft. of elevation will generally not permit satisfactory establishment or yields for this species.

4. **Situation:** Water supply for season will be less than normal for irrigated seeding.
   Statement: Fertilizer recommended is less than usual for irrigated seedings because your water source is somewhat limited this year. If next year's water prospects improve, double the fertilizer rate shown above.

5. **Situation:** New legume seeding with or without cover crop.
   Statement: Inoculation with nodule forming nitrogen fixing bacteria is advised for establishment of new types of legumes, fields not previously used for legumes or combined fields with different cropping histories.

6. **Situation:** New legume seeding with or without cover crop and NO_3-N soil test less than 6 ppm.
   Statement: If P and/or K are recommended, N may be economically applied in a multi-nutrient fertilizer such as 11-52-0. If P and\or K are not recommended, application of N alone will usually produce more vigorous seedling growth, but may or may not be economical. Nitrogen fertilizer will also increase weed competition.

Grasses and/or Established Legumes (Irrigated at elevations below and above 6,000 ft.) For the species being grown on dryland use one-third of the irrigated yield goal and adjust application rates using the correction factors listed below. (See page 7 for stand component-percentage estimation procedures.)

Table 5. Nitrogen recommendations for grass and/or legume. (Do not adjust nitrogen rates for soil organic matter levels.) Yield goal for 12% moisture hay is 6 tons/acre, 260 lbs N/acre required. Add or subtract 40 lbs N for each ton change desired in yield goal.

(a) Surface sample, 0-1 ft.

NO_3-N soil test ppm N	Vegetation	Percent in stand					
	Grass	100	80	60	40	20	0
	Legume	0	20	40	60	80	100
		Fertilizer nitrogen - lbs N/acre					
0-6		250	200	150	100	50	0
7-12		230	180	130	80	30	0
13-18		210	160	110	60	0	0
19-24		190	140	90	40	0	0
25-30		170	120	70	20	0	0
31-36		150	100	50	0	0	0
37-42		130	80	30	0	0	0
43-48		110	60	0	0	0	0
49-54		90	40	0	0	0	0
55-60		70	20	0	0	0	0

Table (a) is used when only a surface sample is submitted for analysis.

(b) Surface and subsoil samples, 0-3 ft.

NO_3-N soil test ppm N	Vegetation	Percent in stand					
	Grass	100	80	60	40	20	0
	Legume	0	20	40	60	80	100
		Fertilizer nitrogen - lbs N/acre					
0-6		250	200	150	100	50	0
7-12		238	188	138	88	38	0
13-18		226	176	126	76	26	0
19-24		214	164	114	64	0	0
25-30		202	152	102	52	0	0
31-36		190	140	90	40	0	0
37-42		178	128	78	28	0	0
43-48		166	116	66	0	0	0
49-54		154	104	54	0	0	0
55-60		70	92	42	0	0	0

Table (b) is used when subsoil samples are submitted along with the surface sample. For the 0-2 ft. depth, sum the NO_3-N contents and multiply by 1.11 before using table (b).

Tables 5a and 5b were formulated after considering information considered in literature citations 1, 12, 15, 22, 24, 25, 26, 33, 41, 42, 47, and 52.

Table 6. P_2O_5 recommendations by soil textural groups for grass and/or legumes. (See **Phosphorus** on page 8 for textural group descriptions.) Yields goal for 12% moisture hay is 6 tons/acre. Add or subtract 15 lbs P_2O_5 for each ton change desired in yield goal.

Phosphorus	Vegetation	Percent in stand					
soil test	Grass	100	80	60	40	20	0
ppm N P	Legume	0	20	40	60	80	100
		Fertilizer phosphorus - lbs P_2O_5/acre					
	Coarse-textured soils						
0-6		55	60	65	70	75	80
7-14		20	25	30	35	40	45
15-22		0	0	0	0	0	0
>22		0	0	0	0	0	0
	Medium-textured soils						
0-6		75	80	85	90	95	100
7-14		40	45	50	55	60	65
15-22		0	0	0	20	25	30
>22		0	0	0	0	0	0
	Fine-textured or high lime soils						
0-6		100	105	110	115	120	125
7-14		65	70	75	80	85	90
15-22		30	35	40	45	50	55
>22		0	0	0	0	0	20

This table was formulated by considering information contained in literature citations 1, 2, 12, 13, 15, 22, 24, 25, 26, 29, 33, 38, 40, 41, 42, 47, and 52.

Table 7. K_2O recommendations for grass and/or legumes. Yield goal for 12% moisture hay is 6 ton/acre. Add or subtract 40 lbs K_2O for each ton change desired in yield goal for alfalfa and 35 lbs K_2O for each ton change desired in yield goal for grass.

Potassium	Vegetation	Percent in stand					
soil test	Grass	100	80	60	40	20	0
ppm K	Legume	0	20	40	60	80	100
		Fertilizer phosphorus - lbs K_2O/acre					
1-30		210	216	222	228	234	240
31-60		160	166	172	178	184	190
61-90		110	116	122	128	134	140
91-120		60	66	72	78	84	90
121-150		0	0	22	28	34	40

This table was formulated after considering information contained in literature citations 13, 15, 24, 25, 26, 33, 41, 42, and 52.

Special Statements

1. **Situation:** N recommendation greater than 100 lbs
   Statement: Split N applications according to number of harvests and their yield potentials. Apply the first application in early spring for best results.

2. **Situation:** N recommendations for native meadows.
   Statement: Presence of early spring water on native meadows may encourage fall N fertilizer application. Apply fall N when the maximum daily temperature is below 50° F.

3. **Situation:** Irrigated--no yield goal given.
   Statement: Fertilizer recommendation is made for a yield goal of 6 tons hay/acre. Increase or decrease application of N, P_2O_5, and K_2O by 40, 15 and 40 lbs, respectively, for each ton change in yield goal if different from this.

4. **Situation:** Native meadows--no yield goal given.
   Statement: Fertilizer recommendation is made for yield goal of 2 tons hay/acre. Increase or decrease application of N, P_2O_5, and K_2O by 40, 15 and 40 lbs, respectively, for each ton change desired in yield goal.

5. **Situation:** Non-irrigated--no yield goal given.
   Statement: Nitrogen recommendation is made for yield goal of 2 tons hay/acre. Increase or decrease application by 40 lbs N/ton if yield goal is different from this.

6. **Situation:** Yield goal over 6 ton.
   Statement: Skillful management, especially of irrigation, is required to achieve your goal.

7. **Situation:** Soil P test 0-14 ppm.
   Statement: Buildup of soil P is recommended. Fall application will give better first season response than spring application. If soil lime content is high, spring application may be more effective.

8. **Situation:** High fertility on irrigated or dryland. Fertilizer recommendation equals zero for all nutrients.
   Statement: Soil fertility level is generally very good for this crop. Based on University of Wyoming tests and the information supplied by growers, fertilization is not required.

9. **Situation:** Percentage of legume and/or grass in mixture not given.
   Statement: Fertilizer recommendation for grass-legume mixture based on 50-50% of each in the mixture. If adjustment is required, please contact your university extension educator.

10. **Situation:** Short or limited irrigation. No yield goal given.
    Statement: Fertilizer recommendation is made for yield goal of 4 tons hay/acre because water source is limited this season. Increase or decrease application of N, P_2O_5, and K_2O by 40, 15 and 40 lbs, respectively, for each ton change desired in yield goal.

11. **Situation:** Short or limited irrigation on native meadows--no yield goal given.
    Statement: Fertilizer recommendations are made for yield goal of 1.3 tons hay/acre because water source is limited this season. Increase or decrease application of N, P_2O_5, and K_2O by 40, 15 and 40 lbs, respectively, for each ton change desired in yield goal.

12. **Situation:** Orchardgrass is the principal grass.
    Statement: In locations where soil moisture is low during the winter, a stand of this species will rapidly deteriorate.

13. **Situation:** Fertilizer recommendations requested for the following established range grasses with a yield goal usually less than 1 ton per acre:

Western wheatgrass	Slender wheatgrass	Sandberg bluegrass
Thickspike wheatgrass	Indian ricegrass	Needle-and-thread
Streambank wheatgrass	Green needlegrass	Bluebunch wheatgrass

Statement: Other practices such as shrub and weed control and/or reseeding possibly should precede fertilizer use. Twelve or more inches of annual precipitation are generally needed for a positive response to fertilizer.

14. **Situation:** Fertilizer recommendations requested for seedings of the following range grasses:

Western wheatgrass	Streambank wheatgrass	Indian ricegrass
Thickspike wheatgrass	Slender wheatgrass	Green needlegrass

Statement: Fertilizer may be beneficial for adequate stand establishment; particularly for reclamation or rejuvenation with native range grass species, but 12 or more inches of annual moisture will be required for positive response to fertilizer.

GRAINS

Corn (Ensilage or Grain); Sorghum, Sudan or Hybrids (for ensilage, hay, or pasture) (irrigated at elevations under 6,000 ft.)

Table 8. Nitrogen recommendations for corn. Yield goals are 150 bu/acre or 30 tons 70% moisture silage/acre with 270 lb N/acre required. Add or subtract 1.6 lbs N/bushel change in grain yield goal. Add or subtract 9 lbs N/ton change in silage yield goal.

(a) Surface sample, 0-1 ft.

NO_3-N soil test	Soil Organic Matter - %				
ppm N	0-0.5	0.6-1.0	1.1-1.5	1.6-2.0	2.0
	Fertilizer nitrogen - lbs N/acre				
0-6	255	245	235	225	215
7-12	225	215	205	195	185
13-18	195	185	175	165	155
19-24	165	155	145	135	125
25-30	135	125	115	105	95
31-36	105	95	85	75	65
37-42	75	65	55	45	35
43-48	45	35	25	0	0
48	0	0	0	0	0

Table (a) is used when only a surface sample is submitted for analysis.

(b) Surface and subsoil samples, 0-3 ft

NO_3-N soil test	Soil Organic Matter - % (surface sample)				
ppm N	0-0.5	0.6-1.0	1.1-1.5	1.6-2.0	2.0
	Fertilizer nitrogen - lbs N/acre				
0-6	255	245	235	225	215
7-12	230	220	210	200	190
13-18	205	195	185	175	165
19-24	180	170	160	150	140
25-30	155	145	135	125	115
31-36	130	120	110	100	90
37-42	105	95	85	75	65
43-48	80	70	60	50	40
49-54	55	45	35	25	0
55-60	30	0	0	0	0
60	0	0	0	0	0

Table (b) is used when subsoil samples are submitted along with the surface sample. For depths other than 0-3 ft, sum the NO_3-N and multiply by the appropriate factor (below) before using table (b).

Depth - ft.	0-2	0-4	0-5	0-6
Factor	1.308	1.176	0.766	0.714

Tables 8a and 8b were formulated after considering information contained in literature citations 11, 18, 20, 26, 36, 37, 39, 42, 44, 48,52, 53, 54 and 64.

Table 9. P_2O_5 recommendations by soil textural groups for corn. (See **Phosphorus** on page 8 for textural group descriptions.) Corn ensilage yield goal is 30 tons/A, add or subtract 3 lbs P_2O_5 for each ton change in yield goal. Shelled corn yield goal is 150 bu/A, add or subtract 0-6 lbs P_2O_5 for each bushel change in yield goal.

Phosphorus soil test ppm P	Fertilizer phosphorus - lbs P_2O_5/acre		
	Coarse-textured soils	Medium-textured soils	Fine-textured or high lime soils
0-6	80	100	125
7-14	45	65	90
15-22	0	30	55
>22	0	0	20

This table was formulated after considering information contained in literature citations 18, 20, 36, 37, 44, 50, 53, 54, and 64.

Table 10. K_2O recommendations for corn. Corn ensilage yield goal is 30 ton/A, subtract 8 lbs K_2O for each ton decrease in yield goal. Shelled corn yield goal is 150 bu/A, add or subtract 1.2 lbs K_2O for each bushel change in yield goal.

Potassium soil test ppm K	Fertilizer potassium lbs K_2O/acre
0-15	222
16-30	185
31-45	149
46-60	113
61-80	71
81-100	24
>100	0

This table was formulated after considering information contained in literature citations 18, 20, 36, 37, 44 53, 54, and 64.

Special Statements

1. **Situation:** Texture of sand, loamy sand, and sandy loam with N recommendation greater than 120 lbs/acre.
   Statement: Apply up to one-half recommended N preplant and remainder during the season.

2. **Situation:** All textures not listed above with N recommendation greater than 175 lbs/acre.
   Statement: Apply half of the recommended N preplant and remainder during the season.

3. **Situation:** No yield goal given for corn ensilage or grain.
   Statement: Fertilizer recommendation is made on a yield goal of 150 bu grain or 30 ton silage. Increase or decrease N, P_2O_5, and K_2O applications by 1.6, 0.6, and 1.2 lbs, respectively, for each bushel or 9, 3, and 8 lbs, respectively, for each ton change desired in yield goal.

4. **Situation:** High fertility on irrigated or dryland.
   Statement: Soil fertility level is generally very good for this crop. No fertilizer is recommended for _____. However, crop may benefit from small amount of _____ in a multi-nutrient starter fertilizer banded near the seed.

5. **Situation:** No yield goal given for sorghum, sudan or their hybrids for ensilage, hay or pasture.
   Statement: Fertilizer recommendation is made on a yield goal of 10 tons 70% moisture forage/acre. Increase or decrease N, P_2O_5, and K_2O applications by 9, 3, and 8 lbs, respectively, for each ton change desired in yield goal.

6. **Situation:** At elevations under 6,000 ft for sorghum, sudan or their hybrids.
   Statement: Particularly under drought or cool nights and early frost growing conditions test the harvested and/or pastured forage for prussic acid.

7. **Situation:** At elevations over 6,000 ft for sorghum, sudan or their hybrids.
   Statement: Production at this altitude will definitely be unsatisfactory.

8. **Situation:** No yield goal given for corn ensilage or grain under somewhat limited irrigation or short growing season.
   Statement: Fertilizer recommendation is made on a yield goal of 100 bu grain or 20 ton silage. Increase or decrease N, P_2O_5, and K_2O applications by 1.6, 0.6, and 1.2 lbs, respectively, for each bushel or 9, 3, and 8 lbs, respectively, for each ton change desired in yield goal.

9. **Situation:** No yield goal given for sorghum, sudan or their hybrids grown under somewhat limited irrigation for ensilage, hay or pasture.
   Statement: Fertilizer recommendation is made on a yield goal of 6.7 tons 70% moisture forage under limited irrigation/acre. Increase or decrease N, P_2O_5, and K_2O applications by 9, 3, and 8 lbs, respectively, for each ton change desired in yield goal.

Millet (dryland at elevations less than 6,000 ft)

Table 11. Nitrogen recommendations for millet. Yield goal is 35 bu/acre for which 75 lb N/acre would be required. Add or subtract 2 lbs N for each bushel change in yield goal.

Surface sample, 0-1 ft.

NO_3-N soil test	Soil Organic Matter - %				
	0-0.5	0.6-1.0	1.1-1.5	1.6-2.0	2.0
ppm N	Fertilizer nitrogen - lbs N/acre				
0-6	70	60	50	40	30
7-12	50	40	30	20	10
13-18	30	20	10	0	0
19-24	10	0	0	0	0
>24	0	0	0	0	0

This table was formulated after considering information in literature citation 21 and 54.

Table 12. P_2O_5 recommendations by soil textural groups for millet. (See **Phosphorus** on page 8 for textural group descriptions.) Yield goal is 35 bu/acre. Add or subtract 0.6 lbs P_2O_5 for each bushel change in yield goal.

Phosphorus soil test	Fertilizer phosphorus - lbs P_2O_5/acre		
	Coarse-textured	Medium-textured	Fine-textured or
ppm P	soils	soils	high lime soils
0-6	20	40	60
7-14	0	20	40
15-22	0	0	20
>22	0	0	0

This table was formulated after considering information in literature citation 21 and 54.

Table 13. K_2O recommendations for millet. Yield goal is 35 bu/acre. Add or subtract 1.7 lbs K_2O for each bushel change in yield goal.

Potassium soil test	Fertilizer potassium
ppm K	lbs K_2O/acre
0-60	30
>60	0

This table was formulated after considering information in literature citation 21 and 54.

Special Statements

1. **Situation:** No yield goal given for millet on dryland.
   Statement: Fertilizer recommendation based on yield goal of 35 bu/acre. Increase or decrease N, P_2O_5, and K_2O rates by 2.0, 0.6, and 1.7 lbs, respectively, for each bushel change desired in yield goal.

2. **Situation:** High fertility on irrigated or dryland. Fertilizer recommendation equals zero for all nutrients.

   Statement: Soil fertility level is generally very good for this crop. Based on University of Wyoming tests and the information supplied by growers, fertilization is not required.

Small Grains (Barley, Oats, and Wheat) (irrigated at elevations below and above 6,000 ft.)
(For dryland cropping use one-third of the irrigated yield goal and adjust applications rates to it using correction factors listed below.)

Table 14. Nitrogen recommendations for barley, oats, and wheat. For elevations over 6,000 ft. use only the 0-0.5% organic matter column. Yield goals are 100 bu barley, 135 bu oats, 90 bu wheat; with 155 lbs N/acre required. Adjustments for yield goal: Add or subtract 1.55, 1.15, 1.72 lbs N for each bushel change desired in yield goals for barley, oats or wheat. Some varieties of malting barley should receive 20 lbs less N/acre than recommended here.

(a) Surface Sample, 0-1

NO_3-N soil test ppm N	Soil Organic Matter - %				
	0-0.5	0.6-1.0	1.1-1.5	1.6-2.0	2.0
	Fertilizer nitrogen - lbs N/acre				
0-6	140	130	120	110	100
7-12	120	110	100	90	80
13-18	100	90	80	70	70
19-24	80	70	60	50	40
25-30	60	50	40	30	0
31-36	40	30	0	0	0
>36	0	0	0	0	0

Table (a) is used when only a surface sample is submitted for analysis.

(b) Surface and subsoil samples, 0-3 ft

NO_3-N soil test ppm N	Soil Organic Matter - % (Surface Sample)				
	0-0.5	0.6-1.0	1.1-1.5	1.6-2.0	2.0
	Fertilizer nitrogen - lbs N/acre				
0-6	140	130	120	110	100
7-12	130	115	105	95	85
13-18	115	105	95	85	75
19-24	100	90	80	70	60
25-30	90	80	70	60	50
31-36	75	65	55	45	35
37-42	65	55	45	35	0
43-48	50	40	0	0	0
49-54	40	0	0	0	0
>54	0	0	0	0	0

Table (b) is used when subsoil samples are submitted along with the surface sample. For the 0-2 ft depth, sum the NO_3 and multiply 1.11 before using Table (b).

Tables 14a and 14b were formulated after considering information contained in literature citations 18, 20, 25, 27, 28, 35, 36, 37, 44, 48, 50, 53, 54, and 64

Table 15. P_2O_5 recommendations by soil textural groups for barley, oats, and wheat. (See **Phosphorus** on page 8 for textural group descriptions.) Yield goals are 100 bu barley, 135 bu oats, and 90 bu wheat/A. Add 20 lbs P_2O_5 if planting as nurse crop. Add or subtract 0.7, 0.5, 1.0 lbs P_2O_5 for each bushel change desired in yield goals for barley, oats or wheat.

Phosphorus soil test ppm P	Fertilizer phosphorus - lbs P_2O_5/acre Coarse-textured soils	Medium-textured soils	Fine-textured or high lime soils
0-6	20	40	65
7-14	0	20	45
15-22	0	0	25
>22	0	0	0

This table was formulated after considering information in literature citations 18, 20, 25, 27, 28, 35, 36, 37, 44, 50, 53, 54, and 64.

Table 16. K_2O recommendations for barley, oats, and wheat. Yield goals are 100 bu/acre for barley, 135 bu/acre for oats, and 90 bu/acre for wheat. Add or subtract 1.6, 1.33, 2.0 lbs K_2O for each bushel change desired in yield goals for barley, oats or wheat.

Potassium soil test ppm K	Fertilizer potassium lbs K_2O/acre
0-15	162
16-30	125
31-45	89
46-60	54
61-73	20
>73	0

This table was formulated after considering information in literature citations 18, 20, 36, 37, 44, 53, 54, and 64.

Special Statements

1. **Situation:** No yield goal given for barley on irrigated land.
   Statement: Fertilizer recommendation based on yield goal of 100 bu/acre. Increase or decrease N, P_2O_5, and K_2O rates by 1.55, 0.7, and 1.6 lbs, respectively, for each bushel change desired in yield goal.

2. **Situation:** No yield goal given for barley under limited irrigation condition.
   Statement: Fertilizer recommendation based on yield goal of 67 bu/acre because water source is somewhat limited. Increase or decrease N, P_2O_5, and K_2O rates by 1.55, 0.7, and 1.6 lbs, respectively, for each bushel change desired in yield goal.

3. **Situation:** No yield goal given for barley on dryland.
   Statement: Fertilizer recommendation based on yield goal of 35 bu/acre. Increase or decrease N, P_2O_5, and K_2O rates by 1.55, 0.7, and 1.6 lbs, respectively, for each bushel change desired in yield goal.

4. **Situation:** Malting barley is the desired crop.
   Statement: If protein levels of malting barley produced on your fields have been approaching disqualification levels, reduce the recommended rates by 20 lbs N/acre.

5. **Situation:** No yield goal given for oats on irrigated land.
   Statement: Nitrogen recommendation based on yield goal of 135 bu/acre. Increase or decrease N, P_2O_5, and K_2O rates by 1.15, 0.5, and 1.33 lbs, respectively, for each bushel change desired in yield goal.

6. **Situation:** No yield goal given for oats, under limited irrigation conditions.
   Statement: Fertilizer recommendation based on yield goal of 90 bu/acre because water source is somewhat limited. Increase or decrease N, P_2O_5, and K_2O rates by 1.15, 0.5, and 1.33 lbs, respectively, for each bushel change desired in yield goal.

7. **Situation:** No yield goal given for oats on dryland.
   Statement: Nitrogen recommendation based on yield goal of 45 bu/acre. Increase or decrease N, P_2O_5, and K_2O rates by 1.15, 0.5, and 1.33 lbs, respectively, for each bushel change desired in yield goal.

8. **Situation:** No yield goal given for wheat on irrigated land.
   Statement: Fertilizer recommendation based on yield goal of 90 bu/acre. Increase or decrease N, P_2O_5, and K_2O rates by 1.72, 1.0, and 2.0 lbs, respectively, for each bushel change desired in yield goal.

9. **Situation:** No yield goal given for wheat under limited irrigation conditions.
   Statement: Fertilizer recommendation based on yield goal of 60 bu/acre because water source is somewhat limited. Increase or decrease N, P_2O_5, and K_2O rates by 1.72, 1.0, and 2.0 lbs, respectively, for each bushel change desired in yield goal.

10. **Situation:** No yield goal given for wheat on dryland.
    Statement: Fertilizer recommendation based on yield goal of 30 bu/acre. Increase or decrease N, P_2O_5, and K_2O rates by 1.72, 1.0, and 2.0 lbs, respectively, for each bushel change desired in yield goal.

11. **Situation:** Crop is to serve as nurse crop for a new legume seeding.
    Statement: Growing barley, oats, or wheat for grain as a nurse crop for underseeded perennial forage is not recommended. Forage will be adversely affected by competition. Nurse crop should be harvested earlier as hay or silage. For nurse crop purposes, decrease N to 40 lbs/acre and increase P_2O_5 rate by 20 lbs/acre.

12. **Situation:** High fertility on irrigated or dryland. Fertilizer recommendation equals zero for all nutrients.
    Statement: Soil fertility level is generally very good for this crop. Based on University of Wyoming tests and the information supplied by growers, fertilization is not required.

13. **Situation:** Fertilizer recommendation requested for barley or oats or wheat when grown for hay.
    Statement: If drought or frost affects this crop before hard dough stage, the forage should be tested for its nitrate content. If grown for hay, awnless (beardless) varieties should be selected.

OTHER COMMERCIAL CROPS

Dry Bean (Irrigated at elevations below 6,000 ft.)

Table 17. Nitrogen recommendations for irrigated dry bean. (Do not adjust nitrogen rates for soil organic matter levels.)

NO_3-N soil test ppm N	Fertilizer nitrogen lbs N/acre
0-5	90
6-10	68
11-15	45
16-20	23
>20	0

This table was formulated after considering information in literature citations 7, 8, 9, 20, 35, 36, 54, and 64.

Table 18. P_2O_5 recommendations by soil textural groups for dry bean. (See **Phosphorus** on page 8 for textural group descriptions.) Bean yield goal is 30 cwt/acre. Add or subtract 1.75 lbs P_2O_5 for each cwt change desired in yield goal.

Phosphorus soil test ppm P	Fertilizer phosphorus - lbs P_2O_5/acre Coarse-textured soils	Medium-textured soils	Fine-textured or high lime soils
0-6	45	65	90
7-14	0	30	55
15-22	0	0	20
>22	0	0	0

This table was formulated after considering information in literature citations 18, 20, 35, 36, 54, and 64.

Table 19. K_2O recommendations for dry bean. Dry bean yield goal is 30 cwt/acre. Add or subtract 4 lbs K_2O for each cwt change in yield goal.

Potassium soil test ppm K	Fertilizer potassium lbs K_2O/acre
<36	48
37-45	24
>45	0

This table was formulated after considering information in literature citations 18, 20, 36, 54, and 64.

Special Statements

1. **Situation:** Yield goal given, no N recommended, and P_2O_5 and/or K_2O are 20 lbs/acre or greater.
   Statement: A small amount of N applied as a starter near, but not with, the seed may be beneficial. If small grain stubble and/or straw is plowed under, additional broadcast nitrogen is recommended at the rate of 15 N/ton of organic material incorporated not to exceed 50 lbs additional N/acre.

2. **Situation:** No Yield given.
   Statement: The P_2O_5 and K_2O recommendations are based on a 30 cwt/acre yield goal. If practical yield goal is different from this, increase or decrease P_2O_5 and K_2O rates by 1.75 and 4 lbs, respectively, for each cwt change desired in yield goal. No N adjustment is recommended for change in yield goal.

3. **Situation:** No N, P, and/or Zn recommended.
   Statement: Soil tests high in N, P, and/or Zn. No fertilizer is recommended for this/these nutrients(s). However, crop may benefit from small amount of N, P, and/or Zn in a multi-nutrient starter fertilizer banded near, but not with, the seed.

4. **Situation:** No yield goal given for somewhat limited irrigation of dry beans.
   Statement: Nitrogen is only a starter, the P_2O_5 and K_2O recommendations are based on a yield goal of 20 cwt/acre because the water source will be short this season. If practical yield goal is different from this, adjust P_2O_5 and K_2O rates by 1.75 and 4 lbs, respectively, for each cwt change desired in yield goal.

5. **Situation:** Beans to be grown in field not recently cropped to beans.
   Statement: Inoculation with nodule forming nitrogen-fixing bacteria is advised when beans are to be planted in field(s) not recently cropped to beans.

6. **Situation:** Nitrogen recommended is greater than 75 lbs/acre.
   Statement: Nitrogen recommendation is high. This nitrogen rate may delay maturity. Management practices should include one or more of the following: early maturing varieties; timely or early planting; application of 3-5 lbs Zn/acre banded near the seed at planting or 10 lbs Zn/acre broadcast and incorporated before planting if Zn soil test is less than 1.5 ppm; varieties with less dense canopy structures; fungicide treatments to reduce white-mold damage.

Potato (Irrigated at elevations below 6,000 ft.)

Table 20. Nitrogen recommendations for potato. Yield goal is 350 cwt/acre with 190 lbs N/acre required. Add or subtract 0.5 lbs N/cwt change desired in yield goal.

(a) Surface sample, 0-1 ft

NO_3-N soil test ppm N	Soil Organic Matter - %				
	0-0.5	0.6-1.0	1.1-1.5	1.6-2.0	2.0
	Fertilizer nitrogen - lbs N/acre				
0-18	160	150	140	130	120
19-24	150	140	130	120	110
25-30	140	130	120	110	100
31-36	130	120	110	100	90
37-42	120	110	100	90	80
43-48	110	100	90	80	70
>48	100	90	80	70	60

Table (a) is used when only a surface sample is submitted for analysis.

(b) Surface and subsoil samples, 0-3 ft

NO_3-N soil test ppm N	Soil Organic Matter - % (Surface sample)				
	0-0.5	0.6-1.0	1.1-1.5	1.6-2.0	2.0
	Fertilizer nitrogen - lbs N/acre				
0-18	160	150	140	130	120
19-24	150	140	130	120	110
25-30	145	135	125	115	105
31-36	140	125	115	105	95
37-42	130	120	110	100	90
43-48	125	115	105	95	85
49-54	120	110	100	90	80
55-60	115	100	90	80	70
>60	105	95	85	75	65

Table (b) is used when subsoil samples are submitted along with the surface sample. For the 0-2 ft depth, sum the ppm NO_3-N and multiply by 1.16 before using table (b).

Tables 20a and 20b were formulated after considering information contained in literature citations 20, 36, 44, 46, 50, 53, and 54.

Table 21. P_2O_5 recommendations by soil textural groups for potato. (See **Phosphorus** on page 8 for textural group descriptions.) Potato yield goal 350 cwt/acre. Add or subtract 0.2 lbs P_2O_5 for each cwt change desired in yield goal.

Phosphorus soil test ppm P	Fertilizer phosphorus - lbs P_2O_5/acre Coarse-textured soils	Medium-textured soils	Fine-textured or high lime soils
0-6	60	80	105
7-14	30	50	75
15-22	0	20	45
>22	0	0	0

This table was formulated after considering information in literature citations 20, 36, 44, 46, 50, 53, and 54.

Table 22. K_2O recommendations for potato. Potato yield goal is 350 cwt/acre. Add or subtract 1.0 lbs K_2O for each cwt change in yield goal.

Potassium soil test ppm K	Fertilizer potassium lbs K_2O/acre
0-40	312
50-70	226
71-90	179
91-110	131
111-130	83
131-150	35
>150	0

This table was formulated after considering information in literature citations 20, 36, 44, 53, and 54.

Special Statements

1. **Situation:** No yield given for full irrigation.
   Statement: Fertilizer recommendations based on yield goal of 350 cwt/acre. Adjust N, P_2O_5, and K_2O rates by 0.5, 0.2 and 1 lbs, respectively, for each cwt change desired in yield goal.

2. **Situation:** High fertility on irrigated or dryland. Fertilizer recommendation equals zero for all nutrients.
   Statement: Soil fertility level is generally good for this crop. Based on University of Wyoming tests and the information supplied by growers, fertilization is not required.

3. **Situation:** No yield goal given for limited irrigation of potato.
   Statement: Fertilizer recommendation based on yield goal of 230 cwt/acre because water source will be somewhat limited. Adjust N, P_2O_5, and K_2O rates by 0.5, 0.2 and 1 lbs, respectively, for each cwt change desired in yield goal.

Safflower (dryland)

Table 23. Nitrogen recommendations for safflower. Yield goal is 1,400 lbs/acre with 70 lbs N/acre required. Add or subtract 5 lbs N for each cwt change in yield goal.

Surface sample, 0-1 ft

NO_3-N soil test ppm N	Soil Organic Matter - %				
	0-0.5	0.6-1.0	1.1-1.5	1.6-2.0	2.0
	Fertilizer nitrogen - lbs N/acre				
0-6	65	55	45	35	25
7-12	45	35	25	0	0
13-18	25	15	0	0	0
>18	0	0	0	0	0

This table was formulated after considering information in literature citations 21, 30, and 54.

Table 24. P_2O_5 recommendations by soil textural groups for safflower. (See **Phosphorus** on page 8 for textural group descriptions.) Yield goal is 1,400 lbs/acre. Add or subtract 2 lbs P_2O_5 for each 100 lbs change in yield goal.

Phosphorus soil test ppm P	Fertilizer phosphorus - lbs P_2O_5/acre		
	Coarse-textured soils	Medium-textured soils	Fine-textured or high lime soils
0-6	20	40	60
7-14	0	28	48
15-22	0	16	36
>22	0	0	24

This table was formulated after considering information in literature citations 21, 30, and 54.

Table 25. K_2O recommendations for safflower. Yield goal is 14 cwt/acre. Add or subtract 2 lbs K_2O for each cwt change desired in yield goal.

Potassium soil test ppm K	Fertilizer potassium lbs K_2O/acre
0-40	62
41-80	43
81-120	24
>120	0

This table was formulated after considering information in literature citations 21, 30, and 54.

Special Statements

1. **Situation:** No yield goal given for safflower on dryland.
   Statement: Fertilizer recommendation based on yield goal of 14 cwt/acre. Adjust N, P_2O_5, and K_2O rates by 5.0, 2.0, and 2.0 lbs, respectively, for each cwt change desired in yield goal.

2. **Situation:** High fertility on irrigated or dryland. Fertilizer recommendation equals zero for all nutrients.

   Statement: Soil fertility level is generally very good for this crop. Based on University of Wyoming tests and the information supplied by growers, fertilization is not required.

Sugarbeet (Irrigated at elevations below 6,000 ft.)

Table 26. Nitrogen recommendations for sugarbeet. Yield goal is 30 tons/acre with 270 lbs N required. Add or subtract 9 lbs N for each ton change in yield goal.

(a) Surface Sample, 0-1 ft

NO_3-N soil test ppm N	Soil Organic Matter - % 0-0.5	0.6-1.0	1.1-1.5	1.6-2.0	2.0
	Fertilizer nitrogen - lbs N/acre				
0-6	255	245	235	225	215
7-12	215	205	195	185	175
13-18	175	165	155	145	135
19-24	135	125	115	105	95
25-30	95	85	75	65	55
30	55	45	35	25	0

Table (a) is used when only a surface sample is submitted for analysis.

(b) Surface and subsoil samples, 0-3 ft

NO_3-N soil test ppm N	Soil Organic Matter - % (surface sample) 0-0.5	0.6-1.0	1.1-1.5	1.6-2.0	2.0
	Fertilizer nitrogen - lbs N/acre				
0-6	255	245	235	225	215
7-12	230	220	210	200	190
13-18	205	195	185	175	165
19-24	180	170	160	150	140
25-30	155	145	135	125	115
31-36	130	120	110	100	90
37-42	105	95	85	75	65
43-48	80	70	60	50	40
49-54	55	45	35	25	0
55-60	30	0	0	0	0
60	0	0	0	0	0

Table (b) is used when subsoil samples are submitted along with the surface samples. For depths other than 0-3 ft, sum the NO_3-N and multiply by the appropriate factor (below) before using table (b).

Depth - ft.	0-2	0-4	0-5	0-6
Factor	1.308	1.176	0.766	0.714

Tables 26a and 26b were formulated after considering information contained in literature citations 3, 10, 18, 35, 36, 42, 44, 50, 53, 54, and 64.

Special Note: Manure not recommended for sugarbeet. Much of the N released from manure is released in the latter part of the season and tends to retard sugar accumulation resulting in decreased crop quality.

Table 27. P_2O_5 recommendations by soil textural groups for sugarbeet. (See **Phosphorus** on page 8 for textural group descriptions.) Yield goal 30 tons/acre. Add or subtract 3 lbs P_2O_5 for each ton change in yield goal.

Phosphorus soil test ppm P	Fertilizer phosphorus - lbs P_2O_5/acre Coarse-textured soils	Medium-textured soils	Fine-textured or high lime soils
0-6	90	110	135
7-14	60	80	105
15-22	30	50	75
>22	0	20	45

This table was formulated after considering information in literature citations 3, 18, 35, 36, 44, 50, 53, 54, and 64.

Table 28. K_2O recommendations for sugarbeet. Yield goal is 30 tons/acre. Add or subtract 9 lbs K_2O for each ton change in yield goal.

Potassium soil test ppm K	Fertilizer potassium lbs K_2O/acre
0-40	228
41-60	155
61-80	107
81-100	59
101-120	35
>120	0

This table was formulated considering information in literature citations 18, 36, 44, 53, 54, and 64.

Special Statements

1. **Situation:** No yield goal given for full irrigation.
   Statement: Fertilizer recommendation based on yield goal of 30 tons/acre. Adjust N, P_2O_5, and K_2O rates by 9, 3, and 9 lbs, respectively, for each ton change desired in yield goal.

2. **Situation:** Nitrogen application on coarse-textured soils.
   Statement: Apply up to half of the recommended N preplant and remainder not later than July 1. Reduce second application by 9 lbs N/ton if yield prospect decreased from original goal. Nitrogen can be banded close to the plant row on the unirrigated side of the row to reduce leaching losses under furrow irrigation.

3. **Situation:** Nitrogen application on medium and fine-textured soils.
   Statement: All of the nitrogen may be applied preplant or in many cases by sidedressing, but no later than July 1.

4. **Situation:** High fertility on irrigated land.
   Statement: Soil fertility level is generally very good for this crop. No fertilizer is recommended for _____. However, crop may benefit from small amount of _____ in a multi-nutrient starter fertilizer banded near the seed.

5. **Situation:** No yield goal given for limited irrigation of sugarbeet.
   Statement: Fertilizer recommendations based on yield goal of 20 tons/acre with limited water source. Adjust N, P_2O_5, and K_2O rates by 9, 3, and 9 lbs, respectively, for each ton change desired in yield goal.

6. **Situation:** Soil NO_3-N less than 20 ppm.
   Statement: If equipment is available, preplant nitrogen should be banded within three inches of the seed row for maximum N availability. Fertilizer should be placed below and to the side of the seed to avoid direct contact with the seed. Nitrogen placement with the seed can inhibit germination and emergence and reduce stands.

7. **Situation:** Nitrogen recommendation exceeds 80 lbs/acre.
   Statement: Fertilizers other than urea are recommended. Urea applied at moderate to high rates can greatly reduce stands.

8. **Situation:** Beets intended for early harvest.
   Statement: Reduction in applied nitrogen is recommended for beets planned to be harvested early. Adjustment may vary for specific circumstances. Average recommended adjustment reduction is about 10 lbs/acre for each week earlier than normal that harvest is scheduled to occur.

Sunflower (Irrigated at elevations below 6,000 ft.) For dryland, use one-half of irrigated yield goal and adjust application rate using correction factors listed below.

Table 29. Nitrogen recommendations for sunflower. Yield goal is 30 cwt/acre with 175 lbs N/acre required. Add or subtract 6 lbs N for each cwt change in yield goal.

(a) Surface sample, 0-1 ft

NO_3-N soil test ppm N	Soil Organic Matter - %				
	0-0.5	0.6-1.0	1.1-1.5	1.6-2.0	2.0
	Fertilizer nitrogen - lbs N/acre				
0-6	165	155	145	135	125
6-12	145	135	125	115	105
13-18	125	115	105	95	85
19-24	105	95	85	75	65
25-30	85	75	65	55	45
31-36	65	55	45	35	25
37-42	45	35	25	0	0
43-48	25	0	0	0	0
>48	0	0	0	0	0

Table (a) is used when only a surface sample is submitted for analysis.

(b) Surface and subsoil samples, 0-3 ft

NO_3-N soil test ppm N	Soil Organic Matter - % (surface sample)				
	0-0.5	0.6-1.0	1.1-1.5	1.6-2.0	2.0
	Fertilizer nitrogen - lbs N/acre				
0-6	165	155	145	135	125
7-12	150	140	130	120	110
13-18	135	125	115	105	95
19-24	120	110	100	90	80
25-30	105	95	85	75	65
31-36	90	80	70	60	50
37-42	75	65	55	45	35
43-48	60	50	40	30	20
49-54	45	35	25	0	0
>54	30	20	0	0	0

Table (b) is used when subsoil samples are submitted along with the surface sample. For a 0-2 ft depth, sum the NO_3-N values and multiply by 1.308 before using table.

Tables 29a and 29b were formulated after considering the information contained in literature citations 16, 18, 20, 24, 36, 37, and 53.

Table 30. P_2O_5 recommendations by soil textural groups for sunflower. (See **Phosphorus** on page 8 for textural group descriptions.) Yield goal is 30 cwt seed/acre. Add or subtract 2 lbs P_2O_5 for each cwt change in yield goal.

Phosphorus soil test ppm P	Fertilizer phosphorus - lbs P_2O_5/acre Coarse-textured soils	Medium-textured soils	Fine-textured or high lime soils
0-6	55	75	100
7-14	35	55	80
15-22	0	35	60
>22	0	0	40

This table was formulated after considering information in literature citations 16, 18, 20, 24, 36, and 47.

Table 31. K_2O recommendations for sunflower. Yield goal is 30 cwt seed/acre. Add or subtract 2 lbs K_2O for each cwt change in yield goal.

Potassium soil test ppm K	Fertilizer potassium lbs K_2O/acre
<60	60
61-120	30
>120	0

This table was formulated after considering information in literature citations 16, 20, 36, and 47.

Special Statements

1. **Situation:** No yield goal given for full irrigation.
   Statement: Fertilizer recommendation based on 30 cwt/acre. Adjust N, P_2O_5, and K_2O rates by 6, 2, and 2 lbs, respectively, for each cwt change desired in yield goal.

2. **Situation:** High fertility on irrigated or dryland.
   Statement: Soil fertility level is generally very good for this crop. No fertilizer is recommended for _____. However, crop may benefit from small amount of _____ in a multi-nutrient starter fertilizer banded near the seed.

3. **Situation:** No yield goal given for limited irrigation conditions.
   Statement: Fertilizer recommendation based on 20 cwt/acre. Adjust N, P_2O_5, and K_2O rates by 6, 2, and 2 lbs, respectively, for each cwt change desired in yield goal.

4. **Situation:** No yield goal given for dryland production condition.
   Statement: Fertilizer recommendation based on 15 cwt/acre. Adjust N, P_2O_5, and K_2O rates by 6, 2, and 2 lbs, respectively, for each cwt change desired in yield goal.

HORTICULTURE

Fruits, Ornamentals, Trees, Vegetables (Irrigated at elevations below and above 6,000 ft.) For dryland, use only one-third the irrigated fertilizer rate and apply it during the highest moisture season.

Note: Junipers, pines, and spruce fertilizer recommendations are two-thirds the amount shown below for N, P_2O_5, and K_2O.

Table 32. Nitrogen recommendations for fruits, ornamentals, trees, and vegetables. (Do not adjust nitrogen rates for soil organic matter levels.)

NO_3N soil test* ppm N	Fertilizer nitrogen lbs N/1,000 sq. ft.
0-15	3.0
16-31	2.5
32-47	2.0
48-63	1.5
64-79	1.0
80-95	0.5
>95	0

* 0-6 inch depth

This table was formulated after considering information in literature citations 13 and 20.

Table 33. P_2O_5 recommendations by soil textural groups for fruits, ornamentals, trees, and vegetables. (See **Phosphorus** on page 8 for textural group descriptions.)

Phosphorus soil test ppm P	Fertilizer phosphorus - lbs P_2O_5/1,000 ft^2 Coarse-textured soils	Medium-textured soils	Fine-textured or high lime soils
0-6	2.0	2.5	3.0
7-14	1.5	2.0	2.5
15-22	1.0	1.5	2.0
>22	0.5	1.0	1.5

This table was formulated after considering information in literature citations 13 and 20.

Table 34. K_2O recommendations for fruits, ornamentals, trees, and vegetables.

Potassium soil test ppm K	Fertilizer potassium lbs K_2O/1,000 ft^2
0-60	2
60-120	1
>120	0

This table was formulated after considering information in literature citations 13 and 20.

Lawns (Irrigated at elevations below and above 6,000 ft.) For dryland, use only one-third the irrigated fertilizer rate and apply it during the highest moisture season.

Table 32. Nitrogen recommendations for lawns (irrigated at elevations below and above 6,000 ft.). (Do not adjust nitrogen rates for soil organic matter levels.)

NO_3N soil test ppm N	Fertilizer nitrogen lbs N/1,000 sq. ft.
0-15	4
16-31	3
32-47	2
48-63	1
>63	0

This table was formulated after considering information in literature citations 5, 14, 15, and 20.

Table 33. P_2O_5 recommendations by soil textural groups for lawns. (See **Phosphorus** on page 8 for textural group descriptions.)

Phosphorus soil test ppm P	Fertilizer phosphorus - lbs P_2O_5/1,000 ft^2		
	Coarse-textured soils	Medium-textured soils	Fine-textured or high lime soils
0-6	2.0	2.5	3.0
7-14	1.5	2.0	2.5
15-22	1.0	1.5	2.0
>22	0.5	1.0	1.5

This table was formulated after considering information in literature citations 5, 15, and 20.

Table 34. K_2O recommendations for fruits, ornamentals, trees, and vegetables.

Potassium soil test ppm K	Fertilizer potassium lbs K_2O/1,000 ft^2
0-60	2
60-120	1
>120	0

This table was formulated after considering information in literature citations 5, 15, and 20.

Special Statements

1. **Situation:** Fertilizer recommended for deciduous trees or shrubs.
   Statement: Fertilizer rates shown for deciduous trees and shrubs correspond to those found in Horticultural Hints, B-680.9, which describes methods of applying plant nutrients. This publication can be obtained from your University county extension educator.

2. **Situation:** Fertilizer recommended for evergreens.
   Statement: Fertilizer rates shown for evergreens correspond to those found in Horticultural Hints, B-680.9, which describes methods of applying plant nutrients. This publication can be obtained from your University county extension educator.

3. **Situation:** Fertilizer recommendation equals zero for all nutrients.
Statement: Soil fertility is generally good for this species. Based on University of Wyoming tests and the information supplied by growers, fertilization is not required.

4. **Situation:** Fertilizer recommended for lawns.
Statement: Fertilizer application information for lawns is presented in Horticultural Hints, B682.1. This publication can be obtained from your University county extension educator.

5. **Situation:** Elevation of location exceeds 6,000 ft for any of the following:

apricot	pyracantha	cucumber
grape	wayfaring tree	eggplant
peach	autumn olive	pepper
pear	black locust	popcorn
common snowball	honey locust	sweetcorn
English ivy	spindle tree	tomato
highbush cranberry	cantaloupe	winter squash
privet	celery	watermelon
		buffalograss

Statement: Environmental conditions above 6,000 ft. of elevation will generally not permit satisfactory performance by this species.

6. **Situation:** Water supply for season will be less than normal for deciduous trees or shrubs.
Statement: Fertilizer recommended is less than usual for trees and shrubs because your water source is limited this year.

7. **Situation:** Water supply for season will be less than normal for evergreens.
Statement: Fertilizer recommended is less than usual for evergreens because your water source is limited this year.

8. **Situation:** Water supply for season will be less than normal for fruits and vegetables.
Statement: Fertilizer recommended is less than usual for fruits and vegetables because your water source is limited this year.

9. **Situation:** Water supply for season will be less than normal for lawn.
Statement: Fertilizer recommended is less than usual for lawns because your water source is limited this year.

Micronutrients

IRON (Fe)

Most Wyoming soils contain sufficient iron for plant use. However, on high lime soils, poorly drained soils or for aspen, cottonwoods, evergreens, petunias, roses or honeysuckle, low availability of iron may be a problem. Cultural practices such as incorporating plant residues and manure, improving drainage, irrigating more frequently with less water per application, or planting less sensitive crops in known problem areas can reduce the chlorotic leaves caused by a shortage of available iron for decorative plantings or vegetables. Oftentimes the chlorosis disappears as the weather gets warmer during the growing season. Direct iron feeding measures for field crops usually cost more than the yield improvement is worth, but higher costs for horticultural purposes are more often accepted.

Under conditions of low iron availability several horticultural and landscaping species may exhibit iron deficiency symptoms, especially chlorosis--yellow leaves with green veins. Corrective soil applications of iron as iron sulfate are soon converted by soil conditions to an unavailable form so repeated applications of it or an application of a higher priced iron chelate that maintains iron in the available form for a longer period is required (Table 32.). Either material can be used more efficiently as a foliar spray. Plants showing iron deficiency symptoms can be sprayed with an iron chelate solution or with a 1% iron sulfate solution at the rate of 20 to 30 gallons/acre (or until the foliage is completely wet), beginning two weeks after emergence. The iron chelate rates are shown on the container. The leaves do not have sufficient surface area to hold a complete seasons supply of available iron, and as the soil warms, iron is often made available by natural means in the soil for replant use. The initial iron spray needs to be followed by others at 10-day intervals for as long as the foliage yellowing persists. A 1% solution may be prepared by putting 8 lbs of iron sulfate (20% iron) in 100 gallons (or 1.25 ounces/gallon) of water that contains a wetting agent (surfactant such as Ortho X-77 at 1 cup/100 gallon or 1 tsp/gallon of water used).

Table 38. Iron recommendations for sensitive horticultural and landscape species.

Soil Test ppm, (Fe)	Iron Fertilizer - ounces Fe/1,000 ft^2 for irrigated horticultural and landscape species	Interpretation
0-3	8	Soil is deficient in available iron and corrective applications could be beneficial.
3.1-5.0	4	Soil has borderline deficiency in available iron and applications may or may not be beneficial.
>5	0	No iron applications required.

Table 38 was adopted from Soltanpour, et al., after considering information contained in literature citations 18, 35, 43, 53, 54, and 64.

Special Statements

1. **Situation:** Crops such as fruits, ornamentals, and vegetables. Iron test 0-3 ppm.
   Statement: Iron availability is low for this crop. Spray foliage with iron as recommended by your county extension educator. Iron applied to soil as iron sulfate has limited availability time.

2. **Situation:** Crops such as fruits, ornamentals, and vegetables. Iron test 3.1-5.0 ppm.
Statement: Iron availability is marginal for this crop. Spray foliage with iron as recommended by your county extension educator. Iron applied to soil in iron sulfate has limited availability time.

3. **Situation:** Crops such as corn, beans or potato. Iron test 0-3.0 ppm.
Statement: Iron availability is low for this crop. Direct iron fertilization usually does not produce an economic return, and as the season warms up and the soil dries out, more iron may become available to the crop. In the future, the incorporation of organic matter and improved drainage, can help. Also avoid planting beans after sugarbeet.

4. **Situation:** Crops such as corn, beans or potato. Iron test 3.1-5.0 ppm.
Statement: Iron availability is marginal for this crop. Direct iron fertilization usually does not produce an economic return, and as the season warms up and the soil dries out, more iron may become available to the crop. In the future, the incorporation of organic matter and improved drainage, can help. Also avoid planting beans after sugarbeet.

ZINC

Table 39. Zinc recommendations.

Soil test ppm, zinc (Zn)	Zinc fertilizer - lbs Zn/acre	
	Irrigated	Dryland
	corn, beans, potato*	
0-0.9	10	5
1.0-1.5	5	0
>1.5	0	0
	other crops	
0-0.5	5	0
>0.5	0	0

* When these crops follow sugarbeet, the test ranges become 0-1.4, 1.5-2.2, and greater than 2.2 (after Soltanpour, et al.).

Table 39 was adopted after considering information contained in literature citations 18, 35, 41, 43, 53, 54, and 64.

Soil applications of zinc sulfate need to be incorporated into soil where moisture is present to make zinc available to plant roots. Zinc chelates can be used for ornamentals to decrease expenses. Both materials can also be used in foliar sprays Chelate spray and soil application rates are shown on the package. Zinc sulfate soil application rates are shown in the table. The leaves do not have sufficient surface area to hold a complete seasons supply of available zinc, and as the soil warms, zinc is made available for plant use. The initial zinc spray needs to be followed by others at 10-day intervals for as long as the foliage discoloration persists. The 0.5% zinc sulfate (36% zinc) in 100 (or 3/4 ounces/gallon) gallons of water that contains a wetting agent (surfactant such as Ortho X-77 at 1 cup/100 gallon or 1tsp/gallon of water used).

Special Statements

1. **Situation:** All cases where zinc is recommended.
   Statement: Zinc recommendation is based on use of inorganic product such as zinc sulfate which is broadcast and plowed down. One application should be effective for 2 to 4 years.

2. **Situation:** All irrigated crops other than corn, beans, and potato with zinc test 0-0.5 ppm Zn.
   Statement: This crop does not usually respond to zinc application; however, availability from soil is low. For further information, contact your county extension educator or this laboratory at the University of Wyoming.

SOLUBLE SALTS

Table 40. Relative salt tolerance of field and forage crops.*

Field crops	Forage grasses	Forage legumes	Interpretation		
			Low	Moderate	High
			mmhos/cm		
		Sensitive			
Dry bean Onion	Meadow foxtail	Alsike clover Ladino clover Red clover White dutch clover	0-2.0	2.1-4.0	>4.0
		Moderately Sensitive			
Corn Oat (forage) Potato Rye (forage) Millet Sunflower Turnip	Bluebunch wheatgrass Garrison creeping foxtail (seeding) Grasses (general) Green needlegrass Intermediate wheatgrass Meadow fescue Needle-and-thread Orchardgrass Redtop Reed canarygrass Slender wheatgrass Smooth bromegrass Timothy	Alfalfa (seeding) Cicer milkvetch	0-3.0	3.1-6.0	>6.0
		Moderately tolerant			
Canola Oat (grain) Rape Rye (grain) Safflower Sorghum Sudan grass Sugarbeet Wheat	Beardless wildrye Canadian wildrye Crested wheatgrass Garrison creeping foxtail (established) Indian ricegrass Native ricegrass Streambank wheatgrass Tall fescue Tall wheatgrass (seeding) Thickspike wheatgrass Western wheatgrass	Alfalfa (established) Birdsfoot trefoil White sweetclover Yellow sweetclover	0-6.0	6.1-12.0	>12.0
		Tolerant			
Barley Asparagas	Altai wildrye Russian wildrye Tall wheatgrass (established)		0-9.0	9.1-15.0	>15.0

*This list is only an indication of the salt tolerances of major plant groups. These "indicator" plants can be useful in determining the salt tolerances of closely related plants or plants adapted to similar sites.

Table 41. Relative salt tolerance of horticultural and landscape plants.*

Woody fruits and trees	Ornamentals, grasses, and groundcovers	Herbaceous fruits, vegetables, and flowers	Interpretation		
			Low	Moderate	High
			--- mmhos/cm ---		
		Sensitive			
Apple	American linden	African violet	0-2.0	2.1-4.0	>4.0
Cherry & Prunus *spp.*	Cotoneaster	Bean			
Chokecherry	Little leaf linden	Carrot			
Currant	Mock orange	Onion			
Gooseberry	Oregon grape	Parsnip			
Pear	Redtwig dogwood	Strawberry			
Plum	Rose				
Raspberry					
		Moderately Sensitive			
Aspen	Clematis	Broccoli	0-3.0	3.1-6.0	>6.0
Black locust	Common snowball	Cabbage			
Cottonwood	English ivy	Cantaloupe			
Fir	Honeysuckle	Cauliflower			
Grape	Kentucky bluegrass	Corn			
Green ash	Lilac	Cucumber			
Honey locust	Orchardgrass	Flowers, general			
Maples (most)	Privet	Gladiolus			
Poplar	Service berry	Lettuce			
Siberian elm	Wayfaring tree	Pea			
Spruce	Yellow sage	Pepper			
Willow		Potato			
		Pumpkin			
		Radish			
		Spinach			
		Tomato			
		Turnip			
		Watermelon			
		Moderately tolerant			
Autumn olive	Blue grama	Beet	0-6.0	6.1-12.0	>12.0
Evergreens, general	Buffalo grass	Carnation			
Hackberry	Caragana	Chrysanthemum			
Juniper	Crested wheatgrass	Squash, zucchini			
Pine	Fine fescue				
Russian olive	Perennial ryegrass				
	Potentilla				
	Tall fescue				
		Tolerant			
Tamarix	Alkali grass	Asparagus	0-9.0	9.1-15.0	>15.0
	Creeping bentgrass				
	Iceplant				

*This list is only an indication of the salt tolerances of major plant groups. These "indicator" plants can be useful in determining the salt tolerances of closely related plants or plants adapted to similar sites.

Tables 40 and 41 were formulated after considering information in literature citations 4, 6, 18, 19, 20, 22, 32, 33, 53, 54, 58, and 60.

Special Statements

1. **Situation:** Moderate salt hazard.
   Statement: Salts are high for this species and may reduce growth or yield. For further information contact your county extension educator or the University of Wyoming Soil Testing Laboratory.

2. **Situation:** High salt hazard.
   Statement: Excessive salts may cause severe growth or yield reduction. For further information, contact your University extension educator or the University of Wyoming Soil Testing Laboratory.

3. **Situation:** General vegetable garden with electrical conductivity value between 2.0 and 3.0 mmhos/cm.
   Statement: Salts are high for beans, carrots, onions, and parsnips but should not be a problem for other garden vegetables.

4. **Situation:** Vegetable garden with electrical conductivity value between 3.0-6.0 mmhos/cm.
   Statement: Salt hazard is medium for most vegetables and will likely reduce yield. Salt hazard is high for beans, carrots, onions, and parsnips and will likely cause severe yield reduction. For further information, contact your University extension educator or the University of Wyoming Soil Testing Laboratory.

5. **Situation:** Evergreens, general, with electrical conductivity between 3.0 and 6.0 mmhos/cm.
   Statement: Salt hazard is moderate for fir and spruce and may reduce growth but should not be a problem for other evergreens.

6. **Situation:** Evergreen, general, with electrical conductivity between 6.0 and 12.0 mmhos/cm.
   Statement: Salt hazard is moderate for most evergreens and may reduce growth. Salt hazard is high for fir and spruce and may cause severe growth reduction or even death. For further information, contact your University extension educator.

SOIL TESTING SERVICES AND METHODS

Services

The following analyses are offered by the University of Wyoming Soil Testing Laboratory:

Routinely tested--

1. Soil pH
2. Soluble salts
3. Organic matter
4. Extractable phosphorus
5. Estimated lime content
6. Texture, by feel
7. Nitrate nitrogen, surface soil only

Subsoil test available on request--

1. Nitrate nitrogen

Tested only on request--

1. Extractable potassium
2. Extractable iron
3. Extractable zinc

Methods

Soil pH and Soluble Salts

The pH is determined with a pH meter on a soil paste. After the pH reading is recorded, the saturated paste is transferred to a pressure filter and filtration is assisted by air pressure between 60 and 80 psi. Soluble salts are determined on the filtered extract using a solubridge and reported as mmhos/cm. When the paste pH value is greater than 8.5, a 1:5 dilution pH is routinely determined on a separate sample (USDA Ag. Hdbk. 60, 46).

Organic Matter and Nitrates

Nitrogen fertilizer recommendations are prepared using both organic matter and nitrates. Organic matter is determined by wet oxidation with spontaneous heat of reaction. Potassium dichromate and concentrated sulfuric acid are used in the oxidation process. The results are determined by titration and reported as percent organic matter (USDA Ag. Hdbk. 60, 46).

Nitrate-nitrogen is determined by the chronotropic acid method. Extraction involves shaking 10 grams of soil in 50 millimeters of 0.2% calcium hydroxide solution for 15 minutes. Color intensity developed using sulfite-urea, antimony sulfate, sulfuric acid, and chronotropic acid, is read on a spectrophotometer. The result is reported as parts per million nitrate nitrogen. (Sims and Jackson, 39).

Extractable Phosphorus

Phosphorus is extracted with 0.5 M sodium bicarbonate solution adjusted to pH 8.5 with 1 M sodium hydroxide. Five grams of soil are shaken in 100 ml of the extracting solution for 30 minutes. The suspension is filtered through Whatman No. 42 filter paper. An aliquot is acidified, diluted and used for the molybdenum blue phosphorus determination by the ascorbic acid procedure with the color intensity being read on a colorimeter (Olsen and Sommers, 27). The results are expressed as parts per million of the element in the soil.

Extractable Potassium, Zinc, and Iron

Potassium, zinc, and iron are extracted by a single extracting solution developed by Soltanpour and Schwab(43). The solution is 1 M in ammonium bicarbonate and 0.005 M in diethylenetriamine pentaacetic acid (DTPA). This solution has an initial pH of 7.6. Ten grams of soil and 20 ml of the extracting solution are shaken for 15 minutes and filtered through Whatman #42 filter paper. Potassium, zinc, and iron are determined directly from the filtrate with an atomic absorption spectrophotometer. The results are expressed as parts per million of the respective element in the soil.

Lime content

The lime determination is an estimate of the quantity present in the soil. It is determined by adding one part hydrochloric acid to five parts dry soil and observing the degree of effervescence. The lime content is categorized as none (0), low (0-1%) and high (greater than 2%) (Soltanpour, et al., 42).

Texture

Texture, relative amounts of sand, silt, and clay, is estimated by the feel of the soil in a wetted condition (Thien, 44).

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INDEX AND TABULAR SUMMARY

Growing conditons, salinity tolerance and fertility recommendation pages for crops covered by this guide.	Irrigated	Dryland	Under 6,000 ft. elevation	Over 6,000 ft. elevation	Salinity tolerance (p. 47, 48)	Page for N	Page for P	Page for K	Page for Fe	Page for Zn
Field Crops										
Barley (feed)	✓	✓	✓		Tol[1]	27	28	28	--	--
Barley (malting)	✓		✓		Tol	27	28	28	--	--
Corn (ensilage)	✓		✓		MS	21	22	22	44	45
Corn (shelled)	✓		✓		MS	21	22	22	44	45
Dry bean	✓		✓		Sen	30	30	30	44	45
Millet	✓	✓	✓		MS	25	25	25	44	45
Oats	✓	✓	✓	✓	MS	27	28	28	--	--
Potato	✓		✓		MS	32	33	33	44	45
Safflower	✓	✓	✓		MT	34	34	34		
Sorghum, sudan or hybrids	✓		✓		MT	21	22	22	44	45
Sugarbeet	✓		✓		MT	36	37	37	--	--
Sunflower	✓	✓	✓		MS	39	40	40	--	--
Wheat	✓	✓	✓	✓	MT	27	28	28	--	--
Forage Grasses										
Bluebunch wheatgrass	✓	✓	✓		MS	18	19	19	--	--
Crested wheatgrass		✓	✓	✓	MT	18	19	19	--	--
Garrison creeping foxtail (established)	✓		✓	✓	MT	18	19	19	--	--
Garrison creeping foxtail (seeding)	✓		✓	✓	MS	18	19	19	--	--
Grasses (general)	✓	✓	✓	✓	MS	18	19	19	--	--
Green needlegrass		✓	✓		MS	18	19	19	--	--
Indian ricegrass		✓	✓	✓	MT	18	19	19	--	--
Intermediate wheatgrass	✓	✓	✓	✓	MS	18	19	19	--	--
Meadow fescue	✓		✓	✓	MS	18	19	19	--	--
Meadow foxtail	✓		✓	✓	Sen	18	19	19	--	--
Native mountain meadows	✓		✓	✓	MT	18	19	19	--	--
Needle-and-thread		✓	✓	✓	MS	18	19	19	--	--
Orchardgrass	✓		✓	✓	MS	18	19	19	--	--
Redtop	✓		✓	✓	MS	18	19	19	--	--
Reed canarygrass	✓		✓	✓	MS	18	19	19	--	--
Sandberg bluegrass		✓	✓	✓	MT	18	19	19	--	--
Slender wheatgrass		✓	✓	✓	MS	18	19	19	--	--
Smooth bromegrass	✓		✓	✓	MS	18	19	19	--	--
Streambank wheatgrass	✓	✓	✓		MT	18	19	19	--	--
Tall fescue	✓		✓	✓	MT	18	19	19	--	--
Tall wheatgrass (established)	✓		✓	✓	Tol	18	19	19	--	--
Tall wheatgrass (seeding)	✓		✓	✓	MT	18	19	19	--	--
Thickspike wheatgrass	✓	✓	✓		MT	18	19	19	--	--
Timothy	✓		✓	✓	MS	18	19	19	--	--
Western wheatgrass	✓	✓	✓	✓	MT	18	19	19	--	--

INDEX AND TABULAR SUMMARY (cont.)

Growing conditons, salinity tolerance and fertility recommendation pages for crops covered by this guide.	Irrigated	Dryland	Under 6,000 ft. elevation	Over 6,000 ft. elevation	Salinity tolerance (p. 47, 48)	Page for N	Page for P	Page for K	Page for Fe	Page for Zn
Forage legumes										
Alfalfa (established)	✓	✓	✓	✓	MT	18	19	19	--	--
Alfalfa (seeding w/cover crop)	✓	✓	✓	✓	MS	16	19	19	--	--
Alfalfa (direct seeding)	✓	✓	✓	✓	MS	16	19	19	--	--
Alsike clover (est.[2] or g-1 mix[3])	✓		✓	✓	Sen	18	19	19	--	--
Cicer milkvetch (established)	✓	✓	✓	✓	MS	18	19	19	--	--
Cicer milkvetch (seed. w/cover)	✓	✓	✓	✓	MS	16	19	19	--	--
Cicer milkvetch (direct seeding)	✓	✓	✓	✓	MS	16	19	19	--	--
Ladino clover (est. or g-1 mix)	✓		✓		Sen	18	19	19	--	--
Red clover (est. or g-1 mix)	✓		✓		Sen	18	19	19	--	--
Red clover (seeding w/cover crop)	✓		✓		Sen	16	19	19	--	--
Red clover (direct seeding)	✓		✓		Sen	16	19	19	--	--
Sweetclover (est. or g-1 mix)	✓	✓	✓	✓	MT	18	19	19		
Sweetclover (seeding w/cover crop)	✓	✓	✓	✓	MS	16	19	19		
Sweetclover (direct seeding)	✓	✓	✓	✓	MS	16	19	19	--	--
White Dutch clover (est. or g-1 mix)	✓		✓		Sen	18	19	19	--	--
Fruits										
Apple	✓		✓	✓	Sen	41	41	41	44	45
Apricot	✓		✓		Sen	41	41	41	44	45
Chokecherry	✓		✓	✓	Sen	41	41	41	44	45
Currant	✓		✓	✓	Sen	41	41	41	44	45
Fruits (general)	✓		✓	✓	Sen	41	41	41	44	45
Gooseberry	✓		✓	✓	Sen	41	41	41	44	45
Grape	✓		✓		MS	41	41	41	44	45
Peach	✓		✓		Sen	41	41	41	44	45
Pear	✓		✓		Sen	41	41	41	44	45
Plum	✓		✓	✓	Sen	41	41	41	44	45
Raspberry	✓		✓	✓	Sen	41	41	41	44	45
Strawberry	✓		✓	✓	Sen	41	41	41	44	45
Lawn Grasses										
Blue grama		✓	✓	✓	MT	42	42	42	44	--
Buffalo grass	✓	✓			MT	42	42	42	44	--
Creeping bentgrass	✓		✓	✓	Tol	42	42	42	44	--
Lawns (general)	✓		✓	✓	MS	42	42	42	44	--
Kentucky bluegrass	✓		✓	✓	MS	42	42	42	44	--
Perennial ryegrass	✓		✓	✓	MT	42	42	42	44	--
Red fescue	✓		✓	✓	MT	42	42	42	44	--

INDEX AND TABULAR SUMMARY (cont.)

Growing conditons, salinity tolerance and fertility recommendation pages for crops covered by this guide.	Irrigated	Dryland	Under 6,000 ft. elevation	Over 6,000 ft. elevation	Salinity tolerance (p. 47, 48)	Page for N	Page for P	Page for K	Page for Fe	Page for Zn
Shrubs and Vines										
Caragana	✓	✓	✓	✓	MT	41	41	41	44	--
Clematis	✓	✓	✓	✓	MS	41	41	41	44	--
Common snowball	✓	✓	✓	✓	MS	41	41	41	44	--
Cotoneaster	✓		✓	✓	Sen	41	41	41	44	--
English ivy	✓	✓	✓	✓	MS	41	41	41	44	--
Highbush cranberry	✓	✓	✓	✓	MS	41	41	41	44	--
Honeysuckle	✓	✓	✓	✓	MS	41	41	41	44	--
Lilac	✓		✓		MS	41	41	41	44	--
Mock orange	✓		✓		Sen	41	41	41	44	--
Oregon grape	✓		✓		Sen	41	41	41	44	--
Potentilla	✓		✓		MT	41	41	41	44	--
Privet	✓	✓	✓	✓	MS	41	41	41	44	--
Pyracantha	✓	✓	✓	✓	MT	41	41	41	44	--
Redtwig dogwood	✓	✓	✓	✓	Sen	41	41	41	44	--
Roses (shrub)	✓		✓		Sen	41	41	41	44	--
Shrubs (general)	✓		✓	✓	MS	41	41	41	44	--
Spindle tree	✓		✓		MT	41	41	41	44	--
Wayfaring tree	✓		✓	✓	MS	41	41	41	44	--
Winged euonymous	✓		✓	✓	MT	41	41	41	44	--
Trees										
Aspen	✓	✓	✓	✓	MS	41	41	41	44	--
Autumn olive	✓		✓		MT	41	41	41	44	--
Black locust	✓		✓		MS	41	41	41	44	--
Cottonwood	✓		✓	✓	MS	41	41	41	44	--
Evergreens (general)	✓	✓	✓	✓	MT	41	41	41	44	--
Fir	✓		✓		MS	41	41	41	44	--
Green ash	✓		✓	✓	MS	41	41	41	44	--
Honey locust	✓		✓		MS	41	41	41	44	--
Juniper	✓	✓	✓	✓	MT	41	41	41	44	--
Pine	✓		✓	✓	MT	41	41	41	44	--
Poplar	✓		✓	✓	MS	41	41	41	44	--
Russian olive	✓	✓	✓	✓	MT	41	41	41	44	--
Siberian elm	✓		✓	✓	MS	41	41	41	44	--
Spruce	✓		✓	✓	MS	41	41	41	44	--
Trees (general)	✓	✓	✓	✓	MS	41	41	41	44	--
Willow	✓		✓	✓	MS	41	41	41	44	--

INDEX AND TABULAR SUMMARY (cont.)

Growing conditons, salinity tolerance and fertility recommendation pages for crops covered by this guide.	Irrigated	Dryland	Under 6,000 ft. elevation	Over 6,000 ft. elevation	Salinity tolerance (p. 47, 48)	Page for N	Page for P	Page for K	Page for Fe	Page for Zn
Vegetables										
Asparagus	✓		✓	✓	Tol	41	41	41	--	--
Bean	✓		✓	✓	Sen	41	41	41	44	45
Beet	✓		✓	✓	MT	41	41	41	--	--
Broccoli	✓		✓	✓	MS	41	41	41	--	--
Cabbage	✓		✓	✓	MS	41	41	41	--	--
Cantaloupe	✓		✓		MS	41	41	41	--	--
Carrot	✓		✓	✓	Sen	41	41	41	--	--
Cauliflower	✓		✓	✓	MS	41	41	41	--	--
Celery	✓		✓		Sen	41	41	41	--	--
Cucumber	✓		✓		MS	41	41	41	--	--
Eggplant	✓		✓		MS	41	41	41	--	--
Garden (general)	✓		✓	✓	MS	41	41	41	--	--
Kale	✓		✓	✓	MT	41	41	41	--	--
Lettuce	✓		✓	✓	MS	41	41	41	--	--
Onion	✓		✓	✓	Sen	41	41	41	--	--
Pea	✓		✓	✓	MS	41	41	41	44	45
Pepper	✓		✓		MS	41	41	41	--	--
Popcorn	✓		✓		MS	41	41	41	44	45
Potato	✓		✓	✓	MS	41	41	41	44	45
Radish	✓		✓	✓	MS	41	41	41	--	--
Rhubarb	✓		✓	✓	MS	41	41	41	--	--
Spinach	✓		✓	✓	MS	41	41	41	--	--
Squash (winter)	✓		✓		MS	41	41	41	--	--
Sweetcorn	✓		✓		MS	41	41	41	44	45
Tomato	✓		✓		MS	41	41	41	44	45
Watermelon	✓		✓		MS	41	41	41	--	--
Flowers										
Flowers (general)	✓		✓	✓	MS	41	41	41	44	45

[1]Sen=Sensitive
MS=Moderately sensitive
MT=Moderately tolerant
Tol=Tolerant

[2]est. = established stand.
[3]g-l mix = grass-legume mixture.

UNIVERSITY OF WYOMING

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Wyoming Producer

10-Nov-96
Sample ID 1
Laboratory ID 10000
Albany County

SOIL TEST DATA

RESULTS FOR STANDARD TESTS		RESULTS FOR EXTRA TESTS IF REQUESTED	
Soil Texture	Sandy loam	Potassium ppm	70.0
% Organic Matter	1.0	Iron ppm	****
Lime Estimate	None	Zinc ppm	****
Soil Paste pH	7.4	Subsoil Nitrate ppm	****
Soil Dilution pH	****		
Salt Estimate dS/m	0.3		
Phosphate-P, ppm	6.0		
Nitrate-N, ppm	1.0		

Dilution pH is only run if the paste pH is 8.5 or higher
Salt Estimate = Electrical Conductivity. If salts are high for a crop it will be noted on the recommendation page.
**** Means test was not requested.

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Wyoming Producer

10-Nov-96	Sample ID	1
Albany County	Laboratory ID	10000

FERTILITY RECOMMENDATIONS

Desired Vegetation	Grasses, general	
%Legume	****	
Yield Goal		2 Tons
Irrigation Type	None	

NITROGEN(N)	93	LBS/ACRE
PHOSPHOROUS(P2O5)	2	LBS/ACRE
POTASSIUM(K20)	-37	LBS/ACRE
IRON(FE)	****	LBS/ACRE
ZINC(ZN)	****	LBS/ACRE

**** Means test was not run and no recommendations can be made.

Fertilizer recommendations preceded by a minus sign indicate a surplus of that nutrient.
If practical yield goal is different from that shown, adjust application of N, P2O5 and K20 by 40, 15 and 40 lb for each ton change.

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11-96/7C