UNIVERSITY OF IDAHO

College of Agriculture

Idaho
Forage Crop Handbook

Prepared by

UNIVERSITY OF IDAHO

College of Agriculture

Agricultural Extension Service

Agricultural Experiment Station

and

U. S. Department of Agriculture

Soil Conservation Service

IDAHO Agricultural Extension Service

Bulletin 363
June, 1961

Contents

Tables

Introduction

THE Idaho Forage Crop Handbook was developed primarily as a source of readily available information for all agricultural workers in the State. This should insure uniformity in recommendations by the several state and federal agencies using this handbook.

The editors wish to point out that these recommendations are, of necessity, rather general. However, they should serve well as guideposts for the more specific recommendations required in any given area.

A detailed table of contents is provided so that ready reference may be made to any specific forage crop or practice.

Crop Bulletins for Idaho

The University of Idaho College of Agriculture—Experiment Station and Extension Service—has issued more than 100 different publications on the important crops of the state and on crop management problems peculiar to Idaho conditions.

All of these crop bulletins are listed in a publications catalog available at all county agent offices. This catalog also may be obtained by letter request to the Mailing Room, College of Agriculture, University of Idaho, Moscow, or to the Agricultural Extension Service, University of Idaho, 317½ North 8th Street, Boise. Ask for Extension Bulletin No. 320, *Idaho Farm and Home Bulletins.*

Copies of all University of Idaho agricultural publications are available at county agent offices.

SECTION I

Seeding

A. Selection of Seed

1. Use certified seed for forage production. It assures varietal purity, high quality, high germination, and freedom from noxious weed seeds.
2. Seed only adapted varieties approved by the Experiment Station. There is a distinction between varieties recommended for forage production within the State and varieties recommended for seed production for use elsewhere.

B. Single Grass-Single Legume Mixtures

1. Recent research has shown that single grass-single legume mixtures are as productive as complex mixtures.
2. Single grass-single legume mixtures are easier and cheaper to establish and easier to manage properly than complex mixtures.
3. If the percentage of legume in pastures is so high that bloat is a problem, heavy nitrogen fertilization will increase the percentage of grass. The seeding rate of the legume in pasture mixtures may be reduced to lessen the bloat hazard.
4. After several seasons use, a complex mixture will usually become a one grass and one legume combination because of selective grazing and differences in competitive ability of the species used. Thus, the original planting might just as well be a single grass-single legume mixture.

C. Alternate Row Seeding

1. A single grass-single legume mixture is particularly well adapted to alternate row culture. To seed in alternate rows, block alternate feeds in the legume box and the grain box of the drill.
2. Alternate row culture increases the chances of successful seedling establishment as a result of decreased competition. This is most important in areas where successful seedling establishment is a serious problem and for slow developing species such as Birdsfoot trefoil.
3. Alternate row seeding assures the establishment of the desired proportions of grass and legume and the maintenance of that balance throughout the life of the stand.

D. Seedbed Preparation

1. A firm, clod-free seedbed is of primary importance in the successful establishment of small-seeded grasses and legumes. A firm seedbed holds moisture near the surface, helps control depth of seeding, and provides ready anchorage for the tiny seedling roots.

2. The soil surrounding the seeds after seeding should be moist in order to promote rapid germination, emergence and successful establishment of the forage species.
3. Weeds provide severe competition for forage crops. Prepare a clean, weed-free seedbed prior to seeding.
4. In sandy soil subject to wind erosion, the forage seeds may be drilled into stubble without seedbed preparation.

E. Method of Seeding

1. Plant all seedings with a drill. Best results are obtained when drills are equipped with depth regulators. Drill seeding results in even distribution of the seed, assures that it is covered with soil, and increases the probability of successful stand establishment.
2. When grass-legume mixtures are used, the grass should be seeded through the grain box and the legume through the legume box attachment to gain uniform distribution of both types of seeds. (*See Alternate Row Seeding.*)
3. Many grass seeds are light and chaffy and may have awns. They will not feed through the drill evenly. One bushel of rice hulls may be mixed with the amount of seed desired on one acre. This mixture will feed through the drill readily and result in an even distribution of seed. Of course, the drill setting must be readjusted to the desired rate of seeding of the grass. (*See Table 1.*)
4. If the drill does not have press wheels, the field should be rolled or cultipacked prior to seeding. Cultipacking after seeding will result in severe crusting on many soils. Cultipacking assures close contact between the seed and moist soil particles which results in rapid germination and uniform emergence.

F. Depth of Seeding

1. Depth of seeding should not exceed ½ inch on heavy soil and 1 inch on light soil.
2. Small-seeded species should be planted shallower than large-seeded species. When mixtures are sown, the depth of seeding should be regulated to benefit the small-seeded species.

G. Time of Seeding

1. Spring seeding is generally recommended for all areas of Idaho.
2. In southern Idaho irrigated areas with a long growing season, forage crops may be successfully seeded as late as August 15 to September 1. This allows the seedlings to become well established before winter and results in minimum winter-killing as compared to later seeding.
3. Late fall seeding is recommended in limited rainfall areas where a few days difference in the spring emergence of seedlings may be the difference between success or failure

of the seeding. The seeding should be made late enough in the fall so that the seeds do not germinate until the following spring.

H. Seed Treatment

1. Treatment of grass seeds with a fungicide is usually beneficial in reducing seed rot, root rot, damping-off, and other seedling diseases. Use according to manufacturer's recommendations.
2. Treatment of legume seeds with a fungicide usually does not increase the stand and, thus, is of little benefit.

I. Inoculation of Legume Seed

1. Inoculate legume seed with the proper bacterial culture before seeding. Inoculation is particularly needed when a field is seeded to a legume that has not been grown there before.
2. Inoculation requires little effort, is inexpensive, and insures rapid establishment of highly efficient strains of nitrogen-fixing bacteria on the legume roots.
3. The advent of pre-inoculated legume seed has relieved the farmer of the inconvenience of mixing the seed and inoculum just prior to seeding.

J. Use of Companion Crops

1. Spring seeding without a companion crop will result in the most certain and most rapid establishment of forage crops.
2. The advantages of the use of a companion crop are:
   a. Reduction of erosion.
   b. Reduction of weed competition.
   c. It furnishes a crop of value during the year the forage crop is becoming established. However, companion crops should never be used in areas where a moisture shortage is likely to develop early in the season or on soils of low fertility.
3. Recent research has shown that the more competitive companion crops result in severely reduced forage yields the next year and moderate reductions in the second forage year. Thus, the detrimental effect of companion crops is not limited to reduced vigor and growth of the forage species during the seedling year.
4. Peas are the best companion crop, followed in order by barley, oats, and spring wheat. Peas mature early and have less competitive effect on the forage seedlings than any of the cereals. When peas are used as the companion crop, normal seeding rates may be used successfully.
5. When cereal companion crops are used, the seeding rate may be reduced by one-half without reducing grain yield very materially. The cereal should be seeded in double-width rows

and the forage mixture either seeded in alternate rows or seeded crosswise in a separate operation. On irrigated land, irrigate light and frequent until the forage crop is well established. Harvest the companion crop early, preferably as hay, silage or by grazing.

6. Under irrigation in southern Idaho, it is usually advisable to seed an early maturing cereal, manage it intensively, harvest the grain and remove the straw promptly. Seed the forage crop into the stubble prior to September 1 without land preparation. Then, irrigate the forage seeding carefully for rapid establishment. This allows for both a grain crop and forage establishment the same year.

K. Rate of Seeding

1. The recommended rate of seeding of a forage crop is greater than necessary to produce the number of plants that would be considered a good stand. It is true that under ideal conditions 1 pound of high-quality seed of any of the forage crops uniformly distributed at the proper depth over an acre will produce a satisfactory stand. However, since ideal conditions are practically impossible, it is necessary to use much higher seeding rates to compensate for unfavorable conditions such as:

   a. Uneven distribution of seed.

   b. Uneven depth of seeding.

   c. Poor seedbed preparation.

   d. Poor germination of many seed lots.

   e. Adverse weather conditions.

   f. Disease and insect losses.

   g. Severe weed competition.

   Caution should be taken not to deliberately seed an extra high rate to compensate for poor seedbed, poor distribution of seed or poor germination.

2. There is no apparent advantage in forage quality or yield after the seedling year when seeding rates are higher than those recommended. Use of excess seed merely increases the cost of establishment.

3. The easiest and most accurate way to calibrate a drill is to count the seeds that it drops per foot. Run the drill over hard ground or a canvas and count the seeds dropped per linear foot of drill row and then compare with Table 1. Table 1 gives the number of seeds per pound, recommended planting rate per acre and seeds per foot at that planting rate for the common forage species.

4. If the seed is broadcast the planting rates should be increased by one-half to insure a uniform stand.

TABLE 1. — Seeding Rate of Common Forage Species and Seeds per Foot for Setting a Drill.

SPECIES	Approximate number of seeds per pound	Six-inch spacing* solid seeding		Six-inch spacing* alternate row grass and legume	
		lbs./ acre	seeds/ foot	lbs./ acre	seeds/ foot
Legumes:					
Alfalfa	200,000	6	14	4	18
Alsike Clover	700,000	2	16	1	16
Birdsfoot Trefoil	375,000	4	17	3	26
Ladino and White Clover	800,000	2	18	1	18
Red Clover	275,000	5	16	4	25
Sweetclover	260,000	5	15	4	24
Grasses:					
Mountain Bromegrass	90,000	10	10	8	17
Smooth Bromegrass	125,000	6	9	4	11
Reed Canarygrass	506,000	4	23	2	23
Alta Fescue	230,000	4	11	3	16
Hard Fescue	565,000	3	19	2	26
Meadow Foxtail	900,000	4	41	3	62
Tall Oatgrass	130,000	4	6	3	9
Orchardgrass	488,000	3	17	2	22
Timothy	1,319,000	3	45	2	61
Crested and Siberian Wheatgrasses	175,000	6	12	4	16
Intermediate and Pubescent Wheatgrasses	100,000	6	7	4	9
Streambank Wheatgrass	170,000	8	16	5	20
Tall Wheatgrass	79,000	10	9	6	11
Beardless Wheatgrass	135,000	8	12	6	18

*For seven-inch drill rows multiply the solid seeding and alternate row values by 1.17.

SECTION II

Fertilization—Northern Idaho

A. Non-irrigated Legumes and Legume-grass Mixtures

1. **Borated Gypsum** — Apply 200 pounds of borated gypsum per acre every year or 400 pounds per acre every other year in the fall or early spring. It supplies both boron and sulphur.

   Boron deficiency symptoms are becoming more prevalent, especially on alfalfa and red clover. Where this condition occurs or is suspected, be sure to apply borated gypsum. Alfalfa requires more boron than clovers. Where severe deficiency occurs make an initial application of 40 pounds of agricultural borax per acre and then use the recommended rate of borated gypsum in following years. **(Care should be taken to avoid an excess of boron as it is a soil sterilant at high rates.)** Red clover will receive sufficient boron if the recommended rate is used. One or two applications should be sufficient for the life of the stand.

   Table 2 presents various boron carriers, percent boron and the conversion factor for borax equivalent. Thus, 40 pounds of agricultural borax equivalent could be obtained from (40) (0.56) or 22.4 pounds of anhydrous rasorite.

TABLE 2. — Boron Carriers, Percent Boron and the Conversion Factors for Borax Equivalent.

BORON CARRIERS	Percent boron	To convert to borax equivalent, multiply by
Borated gypsum	1.0	10.00
Borax, granular	11.3	1.00
Anhydrous rasorite	20.2	0.56
Plant food borates	14.3	0.71
Water-soluble compounds:		
Solubor	20.5	0.55
Borospray	18.5	0.61

2. **Nitrogen** — Do not apply nitrogen to forage stands that have a high percentage of legumes. If the legume stand is poor and the grass stand is good, apply 30-50 pounds of nitrogen per acre in the early spring. The lower rate should be used on coarse-textured, droughty soils and the higher rate on finer textured soils.
3. **Phosphorus** — Make a soil test to determine needs. Bottom lands high in organic matter are generally lower in phosphorus than the uplands.
4. **Potash** — Make a soil test to determine needs. Present experiments have failed to show any economic response from the use of potash on mineral soils. Organic soils have usually given an economic response to potash application.
5. **Manure** — In general, where there is a limited supply of barnyard manure, it should be used on cash crops. If more manure is available it should be applied to the new hay and pasture seedings first. When manure is used, reduce the

amount of nitrogen supplied by commercial fertilizer by 4 to 5 pounds per acre for each ton of manure applied.

B. Irrigated Legumes and Legume-grass Mixtures

In general, the nutrient needs, except nitrogen, will be very similar to those required for non-irrigated mixtures. If the legume portion of the mixture is low, apply 60 to 80 pounds of nitrogen per acre. Split applications, one-half in the fall and the rest about the middle of June, provide increased benefits over a single application. If late growth is desired, as in an irrigated pasture, apply an additional 20 to 30 pounds of nitrogen per acre around the first of August.

C. New Forage Seedings

1. Apply about 100 pounds of ammonium sulfate per acre prior to seeding. Make a soil test to determine phosphorus and potash needs.
2. In the two extreme northern counties legume seedlings respond well to 150 pounds of 16-20-0 per acre or equivalent.
3. Manure, where available, is of value in establishing new seedings.

D. Supplemental Information

1. The proportion of grass to legume in the mixture can be modified by fertilization. The grass portion may be increased by applying a nitrogen fertilizer which does not contain sulphur and by reducing the rate of gypsum.. The legume portion may be increased by omitting the nitrogen and applying fertilizers that contain sulfur, phosphorus and boron. (*See Tables 2 and 3.*)
2. When ammonium sulfate or single superphosphate are used, the application of borated gypsum may be reduced or deleted depending upon the rate used. Both of these fertilizers supply sulfur and since borated gypsum also supplies sulfur, the amount of borated gypsum required to provide the needed sulfur is reduced. (*See Table 3.*) Make sure that an adequate supply of boron is present also.

TABLE 3. — Plant Nutrients Contained in Various Fertilizers.

	N %	Available P_2O_5 %	S %	Borax Equivalent
Ammonium Nitrate	33.0			
Urea-Nugreen	45.0			
Ammonium Sulfate	21.0		24.0	
Calcium Cyanamid	20.0			
Anhydrous Ammonia	82.0			
Calcium Nitrate	15.5			
Aqua Ammonia	20.0			
Single Superphosphate		20.0	10.0	
Treble Superphosphate		45.0	2.0	
16-20-0	16.0	20.0	14.0	
11-48-0	11.0	48.0	3.0	
Gypsum			18.0	
Borated Gypsum			17.0	10.0

SECTION III

Fertilization—Southern Idaho

A. Non-irrigated Legumes and Legume-grass Mixtures

1. **Nitrogen** — Do not apply nitrogen to forage stands that have a high percentage of legumes.
2. **Phosphorus and Potash** — Use a soil test to determine needs.

B. Irrigated Legumes and Legume-grass Mixtures

1. **Nitrogen** — Forage mixtures with a high percentage of legume need no additional nitrogen. Mixtures with a high percentage of grass should receive about 100 pounds of nitrogen per acre each year. A split application of half in the fall and half in early summer is more beneficial than a single application. An application of 20 to 30 pounds of nitrogen per acre to rotation pastures each time the livestock are moved promotes even growth of pasture throughout the summer.
2. **Phosphorus** — Alfalfa is a heavy feeder on phosphorus. Thus, phosphorus needs should be checked periodically with a soil test. An average annual application would be 80 pounds of P_2O_5 per acre. Phosphorus used on legumes has a beneficial effect on the row crops that follow. Phosphorus may be applied at any time during the year except when the ground is frozen.
3. **Potash** — Use a soil test to determine needs. Current experiments indicate that there is sufficient potash in most soils for forage crops.
4. **Manure** — In general, where there is a limited supply of barnyard manure, it should first be applied to the cash crops. If more is available then it should be applied to the pasture and new forage seedings. Manure favors late summer growth.

C. New Forage Seedings

New forage seedings on low-fertility soils are favored by low rates of nitrogen and phosphorus. About 30 pounds of nitrogen and 80 pounds of available P_2O_5 (or based on soil test) are adequate.

D. Mountain Meadows

1. **Nitrogen** — Recent trials on improved species of forages have shown that 80 to 100 pounds of nitrogen per acre increased both the yield and protein content of the forage. Invasion of sedges was retarded by nitrogen fertilization; the result of increased vigor of the grasses. Best returns have occurred where water control was practiced. Wild flooding does not result in maximum response from fertilizers.
2. **Phosphorus** — Phosphorus is of maximum benefit in meadows that have a good legume stand. Phosphorus will also increase

the percent legume in the stand. Apply 80 pounds of P_2O_5 per acre (or rate based on soil test).

E. Supplemental Information

1. The proportion of grass to legume in a forage mixture can be modified by fertilizer treatment. Grasses are favored by high nitrogen levels and legumes are favored by high phosphorus and sulfur levels plus low nitrogen.
2. Table 3 presents the plant nutrients contained in some of the common fertilizers.

SECTION IV
Irrigation

A. General

Over 50 percent of the acres irrigated in Idaho are devoted to forage crop production. Hay and pasture use more water than any other crop—about 30 inches per season. Since irrigation management is quite different for alfalfa and grasses, they will be treated separately.

B. Crop Needs

1. **Alfalfa**

Alfalfa has the ability to compete for moisture without hurting yield. Tests have shown that alfalfa fields can dry down to 30 percent available moisture before irrigation. It is a deep-rooted plant using moisture from 5 to 6 feet deep.

This terrific root-zone reservoir allows it to go much longer between irrigations than shallow-rooted grass, although both use about the same amount of water to produce dry matter. Since it is a constant feeder, moisture is required in varying amounts all year around. This is why a good response is noted in early deep irrigation of alfalfa, especially if it has been allowed to go into the winter dry.

Alfalfa can take punishment and recover fairly well. If water is short or demanded elsewhere, the alfalfa is the crop to let go. When water is applied alfalfa seems to snap back and the only thing lost is the growth interval when it was dry. If grass is included in the mixture, the needs of each must be satisfied. The crop will have to be irrigated more often with light, frequent irrigations for the grass. Twice a year put on a heavy application to wet down the root zone of the alfalfa. Either early and midseason or midseason and late will fill the bill.

2. **Pasture**

Most grasses are shallow-rooted—about 2 feet. The root zone of Ladino clover is about 1.5 feet. A frequent light application wetting down 2 feet is all that is required.

Grass is a constant feeder requiring an even supply of moisture. Once grass is allowed to get too dry, production is severely reduced and it will take a long time to bring the pasture back to good production.

Tests indicate that Ladino clover will produce more if it is kept fairly wet. For average conditions, pastures should be irrigated at about 50 percent available moisture. Early season moisture is important to get the grass off to a good start.

C. Irrigation Methods

Border, corrugation, controlled flooding, and sprinkler irrigation can be used on forage crops. Choose the method best adapted to the slope, soil, water supply, and labor supply. An irrigation system should be tailor-made for good water management. Border irrigation is one of the best methods. It should be used a lot more in Idaho on forage crops.

D. Water Management

1. **When to Irrigate?**

The best way to tell when to irrigate is to watch soil moisture. Dig one-third of the way into the root zone. When moisture levels fall to their minimum, irrigate. Be sure to start early enough to be over the field by the time the last set needs irrigating.

2. **When to Stop the Irrigation?**

Wet down to the effective root-zone depth and stop — 2 feet in pasture and 5 feet in alfalfa. Water going deeper is lost, taking plant food with it. Table 4 shows the amounts of available moisture the soil holds for plant use.

TABLE 4. — Available Water-holding Capacity of Various Soil Textural Classes.

Soil texture	Available moisture in inches per foot of soil
Very coarse	.75 — 1.00
Coarse	1.00 — 1.5
Medium	1.5 — 2.3
Fine	1.75 — 2.5

Generally on a deep silt loam soil a 2-inch application on pasture and a 6-inch application on alfalfa will do the job. Dig in the soil to tell wetting front, with an auger or a probe. A probe will tell the depth of the wetting front. The soil will offer greater resistance to penetration just below the wetted zone.

3. **Mature Crop**

At the beginning of the growing season, the soil should be thoroughly wet 5 feet down in deep soils or to the restrict-

ing layer, whichever comes first. This can be done in the fall or spring.

Fall irrigation is an important management practice that will give valuable returns if good drainage exists. Forage crops should be irrigated in the fall so that 6 to 8 inches of top growth occurs before the first killing frost. This results in a build-up of root reserves which are available for the production of a vigorous, high-yielding crop the next spring. In addition, a high level of root reserves means the plants will be more winter hardy. If fall irrigation is impossible, plan an early spring application. A common mistake is to overwater early just because water is available and cannot be used elsewhere. Fill the soil by wetting down 5 feet and stop.

Forage crops should be irrigated immediately after removal of the hay crop so that rapid regrowth may occur. In many areas it is a practice to irrigate each alfalfa crop twice, except possibly the first crop.

4. New Seedings

To establish a good stand, have enough moisture in the soil at planting time to germinate the seed. This requires a well-prepared, firm seedbed.

If irrigating-up is necessary, do it before planting. Irrigating before seedlings emerge frequently causes crusting. After the plants have emerged, light, frequent irrigations should be practiced to prevent surface drying of the soil. Withholding water will not force deeper root development. A young stand that is irrigated early and often enough to maintain a normal rate of growth will produce a greater yield the first year.

The use of companion crops in the establishment of forage crops is an acceptable practice on fertile soils where adequate moisture is available. **Irrigation water should be applied in light, frequent applications.** This keeps the forage plants moist, and the companion crop will also receive adequate moisture. After the companion crop is harvested in late summer, irrigation should continue into the fall to provide moisture for maximum vigor and growth of the forage crop.

Late summer or fall seeding of forage crops is frequently practiced, especially where noxious weed control is needed. Commonly, the forage crop is seeded immediately after the removal of an early grain crop or not later than August 15 in most areas. The new seeding should be irrigated immediately, followed by two additional light irrigations not more than three days apart. In most cases this practice assures establishment of a good, vigorous forage stand.

5. **Irrigation of Mountain Meadows**

Water management is the first step toward greater efficiency in the production of beef on mountain meadows. All too often poor water management spoils a good chance for improvement brought about by adoption of good fertility or other management practices.

Continuous irrigation with flood water just because it is available usually damages the meadow. Wet beyond endurance, good plants give away to sedges and rushes with considerably less production.

If the soil is not full from snow melt, an early irrigation is necessary. Fill the soil, wetting down 3 feet, and stop. Irrigate intermittently as needed throughout the season.

Recommended irrigation practices will help maintain the high-producing clovers and grasses.

SECTION V

Weed Control

A. Weed Control in Seedling Forages

1. **Severity of the Problem** — The severity of the weed problem in forage crops will be determined by:
   a. The quantity of weed seeds present in the soil.
   b. The kinds of weed seed present in the soil.
   c. The rate of forage crop emergence and establishment.
   d. The inherent competitive ability of the forage crop.

2. **Seed Quality**
   a. Use plump, well-matured forage seed. Plump seed produces strong seedlings. Their greater food supply permits them to emerge from greater soil depths. This helps insure a uniform stand in spite of normal variations in planting depth.
   b. Use certified seed. The best quality seed contains a very low percent of weed seed.

3. **Effect of Seedbed Preparation and Time of Seeding**
   a. See seedbed preparation in Section I. Prepare seedbed far in advance when possible and give additional shallow cultivations to stimulate germination and destroy sprouting weed seeds located at or near the soil surface.
   b. Weed seeds vary in their season of germination; most lambsquarter and pigweed seeds germinate in early spring, the foxtails and tickle grasses germinate in early summer. An intermediate seeding date gives time for additional spring cultivations and permits the forage crop to become established before the summer annual grassy weeds emerge.

c. In long-season areas alfalfa and other legumes will survive weed competition better when seeded in early fall than when seeded in the spring.

4. **Mowing or Clipping**

The possible benefits from mowing new forage seedings have been underestimated. One of the major effects from mowing new forage seedings several times is that seed production of annual weeds is greatly reduced. Best results are obtained if clipping can be delayed until 8 to 10 weeks after seeding. Clip to a height of about 3 inches. This will result in reduced shading and a temporary reduction in competition for moisture, thus enabling weak forage seedlings to become better established. Earlier clipping may result in damage to seedlings and may make an additional later clipping necessary to prevent seed production of the annual weeds.

5. **Chemical Control**

a. Dinitro herbicides for weed control in grasses (use only the selective dinitros).

(1) Apply 2 weeks after emergence or when grasses are 2 to 4 inches tall. The weeds must be small, having not more than 2 to 3 true leaves. These materials work best during warm weather. At high temperatures, rates should be reduced to prevent injury to the grass. The average application rate of the 13-percent material is 3 quarts per acre in 50 gallons of water.

(2) Since applications can be made when the grass is much younger these materials frequently may be more satisfactory than 2, 4-D for early germinating annual weeds, but the dinotros are ineffective on perennial weeds.

b. Dinitro herbicides for weed control in legumes (use only the selective dinitros).

(1) Apply after true leaves have formed on legumes. Most legumes can be treated at 3 quarts in 50 gallons of water per acre without serious injury. (Alfalfa can stand higher rates.) Weeds must be small for effective control. Dinitros work best during warm weather. At high temperatures rates should be reduced to prevent excessive injury to the forage crop.

(2) These are the only chemicals which can be used on grass-legume mixtures.

c. 2, 4-D for weed control in grasses

(1) Grasses should not be treated until 6 weeks after emergence. Spray with 1 pound acid equivalent, in the amine form, per acre.

(2) In the second year, perennial grasses may be treated at 2 pounds acid equivalent per acre if noxious weeds are present. The bromes, fescues, and wheatgrasses are tolerant to these treatments; bluegrasses are less tolerant.

d. Other Chemicals

New chemicals or new uses for older chemicals are constantly appearing. Some chemicals under investigation at the present time are: Eptam, MCPA, chlorinated urea, dalapon, carbamates, and phenolated butyric acids. Additional time will be required to determine their exact place in forage crop weed control.

B. Weed Control in Established Forages

1. Control by Competition

A well-established, adequately fertilized forage crop is in itself one of the very best methods for controlling both annual and perennial weeds.

2. Supplemental Control Measures

Occasionally under dryland or partially irrigated conditions there is need for additional control measures. Many annual grasses may be controlled with applications of dalapon, CIPC, diuron, and others. These chemicals are applied in the early spring to control winter annual weeds. Contact herbicides such as oils and dinitro compounds may be used to destroy patches of dodder and other annual weeds. **Use according to the manufacturers recommendations on the label.**

PESTICIDE RESIDUES — These recommendations for use are based on the best information currently available for each chemical listed. If followed carefully, residues should not exceed the tolerance established for any particular chemical. To avoid excessive residues, follow recommendations carefully with respect to dosage levels, number of applications, and minimum interval between application and harvest.

THE GROWER IS RESPONSIBLE for residues on his crops as well as for problems caused by drift from his property to other properties or crops.

SECTION VI
Insect Control

A. Introduction to the Problem

Insects of varying habit are found in our forage crops. Many of these are parasites or predators of the pests; and, by thoughtless application of insecticides, more harm than good may be done. Therefore, the following steps are essential for effective insect control:

1. Determine what insect is doing the damage.
2. Apply control measures during that period or stage of the insect's development in which the greatest degree of control can be obtained.
3. Use the insecticide or other control measure which will give the best control without damaging the plants, affecting the soil adversely, or making the forage unfit for livestock consumption.
4. **Thorough coverage** is essential for effective control.

B. Insects and Their Control

1. **Alfalfa Weevil**

   a. The most effective and practical method of control is to kill the overwintering females before they commence to lay eggs in the early spring. To kill overwintering females, apply 20 pounds of 1½ percent dieldrin or heptachlor dust per acre or spray 1/4 pound of actual dieldrin or heptachlor in 30 to 50 gallons of water per acre, using at least 100 pounds pressure. **Apply when alfalfa plants first start to grow and before they are 2 inches high.**

   b. If early control measures are not undertaken and significant damage occurs, the first hay crop may be cut in the bud stage to avoid excessive injury to the hay. Immediately after the first crop is removed, apply DDT, chlordane, aldrin, dieldrin or heptachlor as dust or spray to the alfalfa stubble. Use DDT or chlordane at 1 pound actual, aldrin at 2 ounces actual, and dieldrin or heptachlor at 1 ounce actual per acre. If this practice is followed, the second cutting should be allowed to go nearly to full bloom before cutting to allow for the rebuilding of ample root reserves.

   c. Where it is necessary to apply an insecticide to the foliage of the first crop use 1 to 1½ pounds of actual methoxychlor per acre just as soon as larval feeding is noticed.

d. **FORAGE MUST NOT BE TREATED WITH DDT, HEPTACHLOR, LINDANE, BENZENE HEXACHLORIDE, ALDRIN, TOXAPHENE, DIELDRIN OR CHLORDANE IF HAY CROP IS TO BE FED TO DAIRY ANIMALS OR BEEF ANIMALS BEING FATTENED FOR SLAUGHTER.**

2. **Clover Leaf Weevil**

Infestations of this insect are most likely to develop during years when the spring is cool and dry. Treat these early infestations before the plant growth is 2 inches high with 5 percent DDT or chlordane dust at 20 pounds per acre. Methoxychlor is also effective.

3. **Clover Root Borer and Clover Root Curculio**

No effective chemical control measures for these insects have been developed. Crop rotation and frequent watering in irrigated areas will prevent the development of serious infestations. The use of 1 pound of actual aldrin or heptachlor granules per acre applied as seedling plants emerge shows promise in reducing damage by these insects.

4. **Wireworms**

a. Alfalfa is not a favorable host for wireworms. Clean stands of pure alfalfa maintained for several years will reduce wireworm infestations. Wireworm infestations will build up in alfalfa-grass mixtures, clovers, or alfalfa stands containing weeds, particularly dandelions.

b. For effective control in all forage crops, apply 10 pounds of actual DDT per acre and mix it thoroughly with the top 6 to 8 inches of soil before seeding in wireworm-infested areas. DDT may not be effective the first year after application. However, this treatment will prevent reinfestation for at least 8 years.

c. Aldrin or dieldrin, used at 5 pounds per acre, mixed in the top 8 inches of soil, will give an immediate kill of wireworms and prevent reinfestation for at least 6 years. Work these insecticides into the soil as directed above.

d. Do not apply benzene hexachloride or lindane formulations to the soil for wireworm control. Off-flavors or flavor changes may occur in corn, peas, beans, potatoes, and other root crops grown in soils treated with these materials.

5. **Pea Aphids**

a. When pea aphid populations reach 300 per sweep or the plants are noticeably unthrifty because of aphid feeding, apply a control treatment. For contact treatment on hay and seed crops use either demeton, malathion or parathion. Follow the container label instructions closely for amounts of insecticide to use per acre and timing of applications.

b. The development of the aphid population is retarded by applying a small amount of a systemic insecticide. Beneficial insects, such as ladybird beetles and hover flies, are unaffected by the treatment and multiply and hold the aphids in check. Use 1 ounce of actual demeton in 30 to 50 gallons of water per acre if applied by ground equipment and 2 ounces in 10 gallons of water if applied by aircraft.

c. Preliminary research indicates that it may be possible to develop a pea aphid-resistant alfalfa variety.

6. **Spotted Alfalfa Aphid**

a. In 1960, the spotted alfalfa aphid was collected from alfalfa in Nez Perce County and along the Snake River in Elmore County west into Oregon. To date, the spotted alfalfa aphid populations have not been large enough to justify control.

b. Although many organic phosphate insecticides have been registered for use on alfalfa, they are generally contact poisons and kill the beneficial insects as well as the aphids. In California, where this aphid has been responsible for serious alfalfa losses, as many as 4 to 6 contact treatments per season have been necessary. Treatments are applied when developing spotted alfalfa aphid populations reach 20 to 40 aphids per stem. Demeton, used at the rate of 1 ounce actual material applied by ground equipment in 30 to 50 gallons of water per acre or 2 ounces actual material applied by aircraft in 10 gallons of water per acre, retards the development of the spotted alfalfa aphid population and permits the beneficial insects, such as ladybird beetles and hover flies, to multiply and hold the aphids in check. Occasionally, a second systemic insecticide application is necessary during a season.

c. Lahontan alfalfa, adapted to southern Idaho, inhibits the development of large spotted alfalfa aphid populations.

7. **Miscellaneous Insects**

On rare occasions numerous other insects may attack forage legume and grass crops in sufficient numbers to cause significant damage. Consult your county agent or the Extension Entomologist, University of Idaho, for identification and control measures.

C. Things to Remember in Insect Control

1. The use of proper control methods and proper timing of applications is essential for good control.
2. Drive less than 3 miles per hour when applying insecticides to insure thoroughness of application.

3. Have dusters equipped with a 20- to 30-foot canvas trailer.
4. Adjust the ground sprayer to use 30 to 50 gallons of finished spray per acre applied at a pressure of at least 100 pounds. For air application use 10 gallons of finished spray per acre.
5. Watch closely and avoid "skips" in application.
6. Treat the field when the wind is not blowing.
7. Follow the instructions on the pesticide container label as to the specific crop, specific dosage and the specific time of application in order to prevent excessive residues.

PESTICIDE RESIDUES — These recommendations for use are based on the best information currently available for each chemical listed. If followed carefully, residues should not exceed the tolerance established for any particular chemical. To avoid excessive residues, follow recommendations carefully with respect to dosage levels, number of applications, and minimum interval between application and harvest.

THE GROWER IS RESPONSIBLE for residues on his crops as well as for problems caused by drift from his property to other properties or crops.

SECTION VII

Disease Control

A. Bacterial Wilt of Alfalfa

This is the most important disease affecting forage crop production in Idaho. When alfalfa is included in a rotation longer than 3 years, wilt-resistant varieties such as Ranger or Lahontan should be used. Bacterial wilt is a severe problem in most irrigated areas of the state unless resistant varieties are used. It is of minor importance in most of the dryland areas of the state. The main symptom consists of a brownish discolorization of the outer woody tissue of the roots of affected plants. Infected plants start dying after the second or third year of the stand.

B. "Sick" Alfalfa on Northern Cut-over Timberlands

Much research has been done on this problem, but no definite preventive measures have been developed.

C. Other Diseases

Other diseases may on occasion do significant damage to forage crops. When this happens, consult the Plant Pathology Department, University of Idaho, for identification and control measures.

SECTION VIII

Grass-Legume Mixtures

A. Advantages

1. **Increased Erosion Control**
   a. Grass-legume mixtures provide surface protection by complete coverage. This is more evident if a sod-forming grass is used with the legume.
   b. Grass-legume mixtures provide a more stable type of organic matter.
   c. Grass-legume mixtures result in increased root production.
   d. The inclusion of a grass in the mixture further improves the soil structure. Improved soil structure makes the soil easier to work and increases the rate of water penetration, thus reducing soil erosion.

2. **Improved Weed Control**
   a. If a vigorous forage grass is not present with the legume, weedy grasses and other weeds may invade the stand and reduce hay quality. Competition by the forage grass will reduce the rate and severity of weed infestation.
   b. When a grass is planted with a legume, spot treatment with 2, 4-D can be made for the control of perennial weeds without leaving bare spots in the field. Even though the legume is killed in the treated areas, the grass will survive and produce good yields.

3. **Improved Utilization**
   a. Grass-legume mixtures are more suitable for silage than legumes alone.
   b. Grass-legume mixtures give the operator a chance to use the field for hay, pasture or silage, depending upon his specific needs.
   c. Grass-legume mixtures present less of a bloat hazard when pastured than do straight legumes.
   d. Many feeding trials have shown that grass-legume mixtures are about equal in feeding value to straight legume. In addition, the palatability may be increased with the use of a grass-legume mixture. Increased palatability in combination with the better balanced nutrient status of grass-legume forage means increased gains or milk production.
   e. Forage yields from grass-legume mixtures are usually not significantly different from those of straight legume, pro-

viding the grass does not constitute more than about 30 percent of the total dry weight. Forage yields of grass-legume mixtures are practically always higher than straight grass.

f. The growth, vigor, and protein content of the grass is often increased when it is grown with a legume.

g. The presence of grass in a mixture with a legume hastens the drying of the hay. This may be important in areas where inclement weather occurs during the haying season.

4. **Improved Stand Maintenance**

a. In certain problem areas the use of a grass-legume mixture may result in better stand establishment. Perhaps the legume grows poorly or is heaved out; then the grass is still present to provide a forage stand.

b. A grass-legume mixture may result in a prolonged productive life of the stand. This is particularly true when some of the short-lived perennial legumes are used. Often, after the second or third year the stand of these legumes is reduced. The presence of the grass allows a reasonable forage harvest for an additional period of time if an adequate supply of nitrogen is provided.

c. The grass in a grass-legume mixture provides a protective vegetative mulch which reduces heaving of legumes during late winter and early spring.

B. Disadvantages

1. **Lower Selling Price**

Generally, straight legume hay demands a slight premium over grass-legume hay. The primary reason for this is the emphasis on the protein content of legume hay. Hay buyers prefer the higher protein content of straight legume hay which is supplemented with a cheap source of carbohydrates to balance the ration.

2. **Increased Wireworm Infestations**

Good stands of straight alfalfa reduce wireworm infestations, but the use of grass-legume mixtures may result in an increase in the number of wireworms. See Section VI for wireworm control measures.

SECTION IX

Hay and Silage Mixtures

Alfalfa is recommended in preference to all other legumes for forage production in areas where it is well adapted.

A. Perennial Forages on Irrigated Land

1. **Adequate Irrigation Water Areas**
   a. Upper Snake—Manchar smooth bromegrass (6)* or Latar orchardgrass (3) and Ranger or Lahontan alfalfa (6).
   b. Boise Valley, Magic Valley and Lower Snake—Latar orchardgrass (3) and Ranger or Lahontan alfalfa (6).
   or
   Alta fescue (4) and Ranger or Lahontan alfalfa (6) in areas of light salt concentrations.
   c. Sprinkler irrigated sections of northern Idaho — Latar orchardgrass (3) or Manchar smooth bromegrass (6) and Ladak or Grimm alfalfa (6).

2. **Short Irrigation Water Areas**
   Greenar intermediate wheatgrass (6) and Ranger or Lahontan alfalfa (6).

3. **Mountain Meadows**
   Alsike clover (2) and Manchar smooth bromegrass (6) or timothy (3) or meadow foxtail (4).

4. **Wet Areas Not Suited to Alfalfa**
   a. Non-salty areas—Meadow foxtail (4) or timothy (3) and alsike clover (2) or red clover (5) or broadleaf birdsfoot trefoil (4). Reed canarygrass (4) may also be used in areas where it will not be a problem.
   b. Light salty areas—Alta fescue (4) and alsike clover (2) or red clover (5) or broadleaf birdsfoot trefoil (4).
   c. Medium to heavy salt areas—Alkar tall wheatgrass (10) and biennial sweetclover (5) or strawberry clover (4).

B. Perennial Forages on Non-irrigated Lands

1. **Limited Moisture Areas —** (10 to 15 inches annual precipitation).
   a. Soils with low moisture holding capacity or 10 to 12 inches annual precipitation—Nordan desert wheatgrass (6) or Whitmar beardless wheatgrass (8) and Ladak alfalfa (1).

*Numbers in parentheses refer to seeding rate in pounds per acre. Additional information on seeding rates is presented in Table I.

b. Soils with high moisture holding capacity or 12 to 15 inches annual precipitation—Greenar intermediate wheatgrass (6) and Ladak alfalfa (3).

2. **Moderate Moisture Areas** — (15 to 19 inches annual precipitation).

Greenar intermediate wheatgrass (6) and Ladak alfalfa (6).
or
Manchar smooth bromegrass (6) and Ladak alfalfa (6) on the better sites.

3. **Adequate Moisture Areas** — (over 19 inches annual precipitation).

3. a. Well drained—Greenar intermediate wheatgrass (6) or Manchar smooth bromegrass (6) or Latar orchardgrass (3) or Alta fescue (3) and Ladak or Vernal alfalfa (6).

b. "Sick" alfalfa areas—Any one of the above grasses with red clover (3) and Ladak or Vernal alfalfa (3).

c. Poorly drained—Meadow foxtail (4) or timothy (3) and alsike clover (2) or red clover (5) or broadleaf birdsfoot trefoil (4). Reed canarygrass (4) may also be used in areas where it will not become a problem.

C. Annual Forages

Annual forage crops, with the exception of corn and possibly sorghum, are not as desirable as perennial forages, but sometimes they are used as emergency forage crops.

1. **Corn**—Corn will produce more feed per acre than any other crop in areas where it is well adapted. It will make high quality silage and should be ensiled at the early dent stage.

2. **Sorghums**—Sorghums also make high quality silage and should be ensiled at the late dough stage. Sorghum is presently being grown on a limited acreage in the Boise Valley, but will probably not replace much of the corn acreage.

3. **Small Grains**

a. Oats are superior to the other small grains for both hay and pasture. They should be harvested between the milk and soft dough stage for best quality hay and silage.

b. Pea-oat mixtures also make high-quality silage. Seed 30 to 40 pounds of Marida, Park or Swedish Select oats and 50 to 60 pounds of Canadian field peas per acre. Austrian winter peas also make satisfactory growth if spring-seeded with oats. The pea-oat mixtures should be harvested for silage when the oats are between the milk and soft dough stage since the oats are the highest yielding component of the mixture.

4. **Sudangrass**—A warm-season annual that may find some use as an emergency hay pasture or silage crop. Piper is one of the higher yielding varieties.

D. Special Purpose Forages

1. **Green Manure**—Manchar smooth bromegrass (6), or Greenar intermediate wheatgrass (6) or Alta fescue (4) and Ladak (N. Idaho) or Ranger (S. Idaho) alfalfa (6) or red clover (5).

2. **Burned-over Timberland Seedings** — Timothy (2), Manchar smooth bromegrass (3) and alsike clover (2).

SECTION X

Pasture Mixtures

Any of the hay and silage mixtures discussed in Section IX will make satisfactory pasture mixtures. If an alfalfa-grass mixture is used, reduce the seeding rate of alfalfa to 2 pounds per acre to help reduce the bloat hazard.

A. Irrigated Land

(See Perennial Forages for Irrigated Land under Section IX.) Ladino clover (2) may be substituted for alfalfa in these mixtures if a plentiful supply of water is available throughout the entire growing season. Ladino is superior to alfalfa in rate of regrowth and thus is well adapted to pasture use. If Ladino clover is used as the legume, either orchardgrass (3) or Alta fescue (4) will give the best pasture mixture. Under pasture conditions, an adapted variety of orchardgrass earlier than Latar will be more productive. Latar is a late-maturing variety and performs better as a component of a hay or silage mixture.

B. Non-irrigated Land

(See Perennial Forages for Non-irrigated Land, under Section IX.)

SECTION XI

Pasture Management

The goals of pasture management are to (1) produce high yields of palatable and nutritious forage, (2) extend the grazing season from as early in the spring to as late in the fall as feasible, and (3) provide a fairly uniform supply of feed throughout the entire grazing season.

A. New Pasture Seedings

1. Harvest the first crop of a newly established pasture as hay or silage. This allows the plants to become well-established before they are subject to trampling and pulling by livestock.
2. Spring seedings under irrigation may be lightly grazed in late summer or early fall if a dense, vigorous stand is present.
3. Dry land pasture seedings should never be grazed the first year. Two or three years may be required to develop a vigorous stand in the drier areas. If a pasture is grazed before the forage plants are well established, it may never reach its maximum production level.

B. Established Pasture Stands

1. **Deferred Spring Grazing** — Allow at least 8 inches of top growth to develop before turning livestock on the pasture in the spring.
2. **Avoid Overgrazing**—Never graze the topgrowth closer than 3 to 4 inches from the ground since it reduces yield, weakens the plants, increases erosion and allows weed invasion. Irrigated and humid area pastures subject to continuous overgrazing generally end up as a low-producing bluegrass pasture.
3. **Avoid Undergrazing**—Mature forage is unpalatable and of low nutritive value. Tall-growing plants may drive out such desirable low-growing plants as Ladino clover due to excess shading.
4. **Clipping**—At the end of a rotation grazing period, the pasture should be clipped to remove weeds and the unpalatable portions the livestock refused. This encourages new palatable regrowth from the crown.
5. **Scatter Droppings**—Droppings should be scattered at regular intervals with a drag-type implement such as a harrow. This reduces the formation of ungrazed clumps of forage around piles of droppings.

6. **Fertilization**—The vigor and yield are increased by proper fertilization. See Sections II and III on types, rates and frequency of application of fertilizers.
7. **Irrigation**—Irrigate pastures if possible. This results in increased yield and provides grazing during late summer when most dryland pastures are dormant.
8. **Avoid Late Fall Grazing**—Late fall grazing depletes root reserves and results in reduced vigor and loss of stand. Leave 6 to 8 inches of fall growth. This may be grazed off after the ground freezes.

C. Grazing Systems for Irrigated or Sub-humid Area Pastures

1. **Continuous Grazing**—A continously grazed pasture is poor management. In a short time an irrigated or sub-humid area pasture subjected to continuous grazing will consist of a low-producing stand of Kentucky bluegrass and some white clover since they are the only grass and legume that can survive intense continuous grazing. Continuous grazing consistently results in poor production.
2. **Rotation Grazing**—Under rotation grazing, the pasture is subdivided into three or more units. As soon as the forage is about 8 inches tall in the spring, the livestock are turned into the first unit. They graze the first unit for 6 to 9 days and then are turned into the second unit. The remaining units are grazed in turn and then the cycle is repeated starting with the first unit again. A complete grazing cycle of the entire series of grazing units should last about 21 days with a Ladino-grass pasture. About 30 to 35 days are required with alfalfa since a larger proportion of the stems are consumed and a certain amount of regrowth is essential for the replenishing of root reserves so that the vigor, productivity and density of the stand are maintained.

   Rotation grazing is more profitable with high-producing pastures than with Kentucky bluegrass pastures. Also, it is more productive with high-producing dairy cows than with other types of livestock.

   Advantages of rotation grazing are:

   a. Irrigation can be done while livestock are not in the field; pasturing can be delayed until the field is sufficiently dry to prevent trampling damage to the plant crowns and the soil.

   b. Proper rotation grazing prevents overgrazing. This allows plants to maintain ample root reserves and vigorous growth.

c. Pasturage is maintained in a relatively young, rapidly growing state. In this condition it is more palatable and nutritious than at later stages of growth.

d. High-yielding plants such as Ladino clover, which are susceptible to trampling damage, can be more successfully maintained under rotation grazing than under continuous grazing.

3. **Daily Ration, Ration-a-day, or Strip Grazing**—This method involves the use of an electric fence and fencing off only enough pasture for one day's use by the livestock. The livestock are moved to a new pasture each day.

4. **Green Chop, Soiling, Zero Grazing, or Green Feeding**—This method involves the daily or semi-daily chopping of fresh forages which are hauled and fed to the livestock in a feedlot.

5. **Storage Feeding**—This method involves the year-around feeding of hay and silage in a dry lot.

D. Grazing Systems for Arid Pastures

1. **Continuous Grazing**—This has the disadvantage of resulting in rapid depletion of the more desirable perennial forages.

2. **Deferred Rotational Grazing**—This method involves the subdivision of the arid pasture land into three or four pasture units. A different unit is grazed each successive spring, allowing the other units to attain full growth. The last unit is usually allowed to set seed. Each unit then receives a complete series of such treatments by the end of the third or fourth year, depending upon the number of units.

   Not more than 50 percent of the season's available vegetative growth should be removed by early spring grazing. Fall grazing often results in more complete utilization. These practices allow the more desirable forage plants to maintain vigor for continued high production and maintenance of stand under low moisture conditions.

   A modification of this system is to seed several species in different pastures, using rapidly developing plants for early spring use only and later maturing plants for late spring and summer use.

E. Temporary or Supplementary Pastures

Supplementary pastures are important in that they provide good, succulent pasturage during the hotter portions of the grazing season when sufficient permanent pasture is generally not available. Crops that provide good supplementary pasture are the spring and winter cereals, pea-oat mixtures and, in the lower Snake River Valley, sudangrass.

F. Bloat

Bloat may occur anytime when legumes other than birdsfoot trefoil are pastured. Neither the exact cause nor a sure-fire preventive measure are known. However, the bloat hazard may be reduced in several ways:

1. Seed a grass-legume mixture, but keep the seeding rate of the legume low (1 to 2 pounds per acre of alfalfa).
2. Watch the pastures during the spring when there is a rapid change from cool to warm growing temperatures. Under these conditions legumes often make a sudden flush of growth and outgrow the grass.
3. Keep grasses and legumes in proper balance with an adequate fertilization program. See Sections II and III.
4. Do not turn hungry livestock into a legume pasture. Fill them up with dry roughage and water first. Keep dry roughage available at all times. Dry roughage may be provided by mowing strips through the pasture and allowing the clippings to cure before turning in the livestock.
5. Watch livestock closely, especially the first 2 or 3 days. Some animals bloat more easily than others.
6. Have salt and water available at all times.
7. Feed a supplementary ration of grain to livestock on legume pasture.
8. Turn livestock into a new pasture during the heat of the day.
9. Allow legumes to reach a more mature stage of growth before pasturing.
10. Recent work with antibiotics and oil-sprayed legumes has shown reduced bloat incidence.

SECTION XII

Production of Quality Hay

High quality hay may be defined as properly-managed, weed-free hay cut at the proper time, properly cured and stored so there is a minimal loss of palatability and feeding value from that of the original crop when cut.

No other crop suffers such a high loss of nutrients from the time it is cut to the time it is fed. It has been conservatively estimated that 20 percent of the nutrients in the hay crop is lost. Any method of reducing nutrient losses is of great importance to the hay producer and the livestock feeder.

A. Physical Characteristics of High Quality Alfalfa Hay

1. **Leafiness**—High-quality alfalfa hay contains about 50 percent leaves. These leaves provide 50 percent of the feed value, 70 percent of the protein and 90 percent of the carotene found in alfalfa hay. Any leaf loss results in serious losses of nutritive value of the hay.
2. **Natural Green Color**—Bright green hay indicates a high level of carotene or provitamin A.
3. **Foreign Material**—Weeds, etc., result in decreased palatability and feeding value.
4. **Other Characteristics**—Texture, aroma and stage of maturity are also important in high quality hay.

B. Quality and Dry Matter Losses in Producing Alfalfa Hay

1. **Failure to Harvest**—This includes mower skips and clipped hay not picked up by other harvesting machines.
2. **Respiration Losses**—Harvested plants continue to respire for some time until the individual cells die. Rapid drying is essential if respiration losses are to be kept to a minimum.
3. **Mechanical Losses**—This refers primarily to the loss by leaf shattering. Overcuring results in excessive brittleness and increasing loss of leaves and fine stems. Some farmers bale in the evening when the dew is present to reduce leaf loss, especially if the hay is slightly overcured.
4. **Leaching Losses**—Rain leaches out the more water-soluble and highly digestible nutrients. The sun bleaches out the natural green color associated with carotene content.
5. **Fermentation Losses**—These losses occur as the result of the destructive action of bacteria and fungi in wet, moldy hay. This loss is increased by storing hay with too high a moisture content.

C. Producing High Quality Hay

Use certified seed of adapted varieties along with proper seeding practices on adequately fertilized soil. These practices promote the development of a vigorous, weed-free, high-yielding stand of a forage crop.

1. **Stage of Cutting**—A relatively early stage of maturity is best. The recommended harvest stages are given in Table 5 for the common forage crops.

TABLE 5. — Recommended Harvest Stage of Forage Crops

Crop	Recommended Harvest Stage
Alfalfa (all except last crop)	1/10 bloom stage* or when new shoots start growth, whichever occurs first.
Alfalfa (last crop)**	4-5 weeks prior to average date of first killing frost.
Red and Alsike Clover	Early bloom to 1/2 bloom.
Grasses	Between heading and flowering.
Small Grains	Late milk to soft dough stage.
Grass-legume mixtures	When the legume is ready as noted above.

*The 1/10 bloom stage is when 1/10 of the stems in a field have one or more blossoms on them. The farmer may grab a handful of stems from various places in the field and count the ones that have blossoms on to determine the bloom stage.

**The last crop must be cut sufficiently long before the first killing frost so that enough growth occurs to rebuild the root reserves and thus insure a high level of winter hardiness.

2. **Harvesting** — Cut only the amount of forage that can be handled with available equipment by the time it is cured sufficiently for storage.

3. **Hay Crushing, Crimping or Conditioning** — Tests in Idaho have shown that the use of a hay crusher will reduce hay drying time by about 1 full day. This is very important if it means the difference between getting the hay in before a heavy rain. It is of no value for grass or cereal hay.

4. **Windrowing**—Windrowing reduces leaf loss. The side-delivery rake is satisfactory for this and leaf loss is kept to a minimum if the hay is windrowed as soon as it is well wilted but before the leaves start to shatter.

5. **Processing Hay**

   a. **Maximum Moisture Content**

Treatment of Forage	Maximum Percent Moisture	
Loose Hay	25-28	
Baling	20-25	
Chopping	18-22	
Barn dried	25-50	(depending on weather conditions)

Hay of a higher moisture content than indicated should not be stored because of the danger of molding the hay and spontaneous combusion resulting in a costly fire.

b. **Estimation of Moisture Content** — A rough estimation of moisture content may be obtained by using the following criteria:

(1) Freshly cut forage ..... 75-80 percent

(2) When material is well wilted ..... 60 percent

(3) When stems are tough but leaves are dry and just beginning to shatter ..... 30 percent

(4) Twist a few stems until they break. If there is no evidence of moisture and the stems are slightly brittle ..... 25 percent

c. **Methods of Processing Hay** — Hay may be processed by baling, chopping or storing loose hay in stack or mow. Baling is the most common method.

6. **Hay Storage**—Hay may be stored in outdoor stacks and in barns with or without artificial drying. Preservatives such as salt and carbon dioxide generating compounds are sometimes used but they are ineffective and are not recommended. Preservation is not necessary if the proper moisture content is reached.

SECTION XIII

Silage Making

A. Crops Suitable for Silage

1. **Grass Silage**—Grass silage includes grasses, the small grains, legumes, and grass-legume mixtures. Coarse and weedy crops may be better utilized as silage than as hay. However, the quality of the silage will be no better than the quality of the crop ensiled.
2. **Corn Silage**—In areas where corn is well adapted, more nutrients per acre can be produced from corn silage than from any other crop.
3. **Miscellaneous Crop Silages**—Silage may also be made from sorghums, sunflowers, pea vines, beet tops and processing by-products such as beet pulp, fruit culls, potatoes, cannery refuse, etc. Most processing by-products make a high moisture silage and should be chopped into the silo along with 15 to 30 percent dry hay by weight. **Be sure these by-products are free of chemical residue.**

B. Advantages of Silage

1. Grass silage retains a higher proportion of nutrients than hay since shattering, leaching, and bleaching losses are virtually non-existent.
2. Grass silage may be made during inclement weather when quality losses in making hay would be the highest. Properly made grass silage will provide more food nutrients, especially protein and carotene, than the same crop made into field-cured hay, even during the best haying weather. Usually 80 to 85 percent of the original feeding value is preserved in silage, compared with 70 to 75 percent when the crop is made into field-cured hay.
3. Good silage is palatable. Livestock will usually eat more dry matter when fed both silage and hay than when fed hay as the only roughage.
4. Silage is a good supplement to dried-up pastures in the summer.
5. Corn has a higher feeding value per acre when fed as silage than as fodder, stover, or grain.
6. Silage requires less storage space per pound of dry matter than hay and there is no danger of spontaneous combusion.

C. Disadvantages of Silage

1. Extra equipment and labor required for making silage is costly. Almost three times as much tonnage must be handled as silage than as hay.
2. Silos are required. This is an important consideration with a small operator.

3. Extreme care is required to produce good silage, especially from high moisture, high protein crops.
4. Preservatives, if used, cost extra.
5. Silage contains less vitamin D than hay. However, vitamin D is seldom limiting in Idaho.
6. Silage is seldom suitable as a sole forage ration unless it has the right combination of high protein legumes along with low protein grass, corn or cereal crops.

D. Making High Quality Silage

1. **Stage of Cutting**
   a. **Grass Silage**—Harvest at the same stage as for hay. See Table 5.
   b. **Corn Silage**—Ensile corn in the early dent stage.
2. **Length of Cut**—Chop grass silage into 1/4 to ½-inch lengths to insure proper packing. Chop corn silage into ½ to 1½-inch lengths.
3. **Moisture Content**

   The optimum moisture content at time of ensiling is 65 to 70 percent if high-quality silage is to be produced.

   a. **Grass Silage**—Fresh-cut grass silage will usually have a moisture content of 75 to 80 percent. Ensiled at this time it will produce high-moisture silage which results in offensive odors and excess leakage with loss of soluble nutrients. High moisture silage may be prevented by:
      (1) **Wilting**—The green material is wilted in the field until a moisture content of 65 to 70 per cent is reached. The proper moisture level can be estimated by noting when the leaves and stems become limp. The "grab test" may also be used. Squeeze a handful of freshly chopped material and release it. If the material opens up slowly leaving slight moisture in the hand, then the moisture content is about right. If the material remains in a ball and the hand is moist, then the moisture content is too high. If the material falls apart readily leaving no moisture in the hand, then the moisture content is too low. Generally, grass silage need not be wilted more than about 2 hours.
      (2) **Use of Preservatives or Conditioners** — Preservatives need not be used if the material is ensiled at the proper moisture content. Recommended preservatives reduce the moisture content and add nutrients. About 90 percent of the nutrients in the preservatives are retained in the silage where they stimulate the growth of desirable bacteria. Conditioners are of maximum benefit when high protein, high moisture silage is made. See Table 6 for suggested preservatives and rates.
   b. **Corn Silage**—Wilting or the use of preservatives are not

needed in making corn silage since it is already at about the right moisture content if harvested at the proper stage.

4. **Packing the Silage**—As the silo is filled pack the silage well, especially near the outside wall since silage has a tendency to pull away from the outside wall as it settles. The top should be well packed and it is often desirable to pack the top daily for a week after the silo is filled.
5. **Covering the Silage**—The top of the silage should be covered with a silo cap or large sheet of plastic that is weighted down so as to exclude as much air as possible. The presence of air results in mold which often ruins the top foot or so of the silage. Thus, air exclusion is essential to good silage production.

E. Types of Silos

1. **Upright or Tower Silos**—These types of silos result in the least loss of silage, but they are also the most expensive to construct.
2. **Trench or Bunker Silos**—In this type the silage is put in a well-drained trench in the soil or between wood or concrete bunkers. The silage is then covered with plastic to exclude air.
3. **Miscellaneous Silos**—Various other types of silos are sometimes used. They include the stack silo which is merely a stack of silage covered with a large sheet of plastic to exclude air. With care this sheet of plastic may be used 2 or 3 years.

F. Feeding Silage

For all practical purposes, 3 tons of silage will replace 1 ton of hay of similar kind and quality. Most dairymen feed free access to both silage and alfalfa hay. Silage should be fed immediately after milking as off-flavored milk often results if silage is fed too soon before milking.

TABLE 6. — Suggested Quantities of Preservatives per Ton of Green Cut Material for the Ensiling of Various Crops (Lbs/Ton).

TYPE OF SILAGE	CHOICE OF PRESERVATIVE			
	Molasses	Ground grain	Dry molasses** beet pulp	Dry** hay
Legumes				
fresh, green	80	200	200-300	200-300
wilted*	60	150	100	-----
Grass-legume mixtures				
fresh, green	60	100	100	100
wilted*	---	-----	-----	-----
Grasses and cereals				
fresh, green	40	100	-----	-----
wilted*	---	-----	-----	-----

*Preservatives may be omitted when the silos are air tight and when good silo filling methods are carefully followed.

**It is recommended that when dried molasses beet pulp, or dry hay is used as a preservative that larger amounts be added at the bottom of the silo and decreasing amounts as the silo is filled.

SECTION XIV

Description of Common Grasses and Legumes

A. Grasses

1. Important Irrigated and Sub-humid Area Grasses

a. **Orchardgrass** (*Dactylis glomerata*)

Orchardgrass is a long-lived bunchgrass characterized by rapid regrowth after clipping or grazing. This characteristic makes it a valuable grass for pasture as well as hay use. Ladino-orchard is a widely used irrigated pasture mixture. Most varieties are early maturing; too early for use with alfalfa in a hay mixture. However, later maturing varieties have now been developed.

Varieties – Latar is a late maturing variety of orchardgrass developed specifically for use with alfalfa for hay. It is low in lignin and highly nutritious and palatable.

b. **Tall Fescue** (*Festuca arundinacea*)

Tall fescue is a long-lived bunchgrass characterized by stiff leaves that become rather unpalatable as the plant matures. It has an extremely wide range of adaptation and is a high yielding grass. Leaves remain green late in the summer and maintain growth on irrigated land during hot weather. It is acceptable to livestock in early stages of growth, but must be properly managed to present the development of mature foliage which is rather harsh and unpalatable.

Varieties – Alta tall fescue is the variety that is best adapted to Idaho. It is well adapted to heavy soils, slightly wet soils and slightly saline soils.

c. **Smooth Bromegrass** (*Bromus inermis*)

Smooth bromegrass is a long-lived, sod-forming grass that spreads by vigorous rhizomes. It is well adapted for use with alfalfa for hay, pasture or silage. It is easily established and if planted without a legume, it requires high rates of nitrogen fertilization for maximum growth.

Varieties – Manchar is the most important variety of smooth brome in Idaho. It is high-yielding, leafy, palatable, and provides good regrowth after clipping or grazing.

d. **Intermediate Wheatgrass** (*Agropyron intermedium*)

Intermediate wheatgrass is a long-lived, sod-forming grass characterized by little regrowth after clipping or grazing at the hay stage. Thus, its use under irrigation is limited specifically to early spring pasture since it does make a large amount of growth early in the season. Its primary adaptation is in areas where one crop of hay per year is produced. In these areas, similar to much of northern Idaho, a Ladak alfalfa-intermediate wheatgrass mixture cut for hay will generally outyield any other mixture. It is a late maturing grass and usually matures about 2 weeks later than alfalfa.

Intermediate wheatgrass is also adapted to dryland areas with an excess of 12 inches of annual precipitation. It has good seedling vigor.

Varieties – Greenar is the leading variety at the present time. However, some advanced selections are showing considerable promise and may be released soon.

e. **Miscellaneous Species**

1. **Pubescent Wheatgrass** (*Agropyron trichophorum*)

Pubescent wheatgrass is a long-lived sod-former adapted to the same general areas and uses as intermediate wheatgrass except that it is a lower forage yielder, especially in the moister sites. It apparently yields better than intermediate wheatgrass under lower rainfall conditions. Topar is the only variety presently available.

2. **Timothy** (*Phleum pratense*)

Timothy is a bunchgrass which is best adapted to the mountain meadows. It is also widely used to reseed burned-over and cut-over timberland because it is so easily established on these sites. It is very palatable but becomes woody if permitted to mature. The late maturing varieties, such as Drummond, are preferred.

3. **Tall Wheatgrass** (*Agropyron elongatum*)

Tall wheatgrass is a tall, coarse, late-maturing bunchgrass. Its outstanding characteristic is its ability to grow on alkaline soils, especially under irrigated or subirrigated conditions. It will not persist under close mowing. Alkar is the only variety presently available.

2. **Important Rangeland Grasses**

a. **Desert or Standard Crested Wheatgrass** (*Agropyron desertorum*)

Desert wheatgrass is a long-lived bunchgrass characterized

by extreme drought and cold tolerance. It is highly productive on the dry, rangeland sites. It has good seedling vigor and provides early spring grazing as well as some late fall grazing.

Varieties – Nordan is the best variety at this time. It has greater seedling vigor than the other varieties and thus is easier to establish under rangeland conditions.

b. **Siberian Wheatgrass** (*Agropyron sibiricum*)

Siberian wheatgrass is very similar to desert wheatgrass in most respects. Forage yields usually are less than for Nordan desert wheatgrass. Seed yields are commonly higher. It has a tendency to stay green longer than desert wheatgrass.

Varieties – P-27 is the only strain presently available.

c. **Beardless Wheatgrass** (*Agropyron inerme*)

Beardless wheatgrass is a selection from our native bunchgrass. It is a long-lived bunchgrass with good drought and frost tolerance. It is more difficult to establish than Nordan desert wheatgrass. However, once established, yields are equivalent to those of Nordan. It has the additional advantage that it can be used for late season pasture, while Nordan is primarily used as early season pasture.

Varieties – Whitmar is the only variety presently available.

3. **Wetland Grasses**

a. **Meadow Foxtail** (*Alopecurus pratensis and A. arundinaceus*)
Meadow foxtail is a long-lived, sod-forming grass adapted to areas of high moisture. It will tolerate repeated flooding. It is very palatable and maintains its quality longer than most grasses as maturity approaches. It makes early spring growth. Seedling vigor is low.
Varieties – No one variety is recommended over any other.

b. **Reed Canarygrass** (*Phalaris arundinaceus*)

Reed canarygrass is a long-lived, sod-forming grass adapted to areas of higher moisture. It will tolerate long periods of flooding. It is a tall, coarse grass but is fairly palatable if grazed or cut at an immature stage. Under high moisture conditions it sometimes is difficult to kill out since the roots can not dry out in moist soil. It should not be planted in ditches as the vigorous growth catches an abundance of the silt from run-off water and frequently results in filling in of the ditch channel and the forming of a different channel to one side.

Varieties – No one variety is recommended over any other.

B. Legumes

1. **Alfalfa** (*Medicago sativa*)

Alfalfa is a long-lived perennial legume with good drought tolerance. It is widely adapted and grows well throughout Idaho except on the dry range sites, poorly drained areas, and on some of the cut-over timberland of northern Idaho. It is the highest yielding of the perennial forages and should be grown wherever it is adapted.

Varieties –

a. Northern and Non-irrigated Southern Idaho — Ladak, Vernal and Grimm.

b. Irrigated Southern Idaho — Ranger and Lahontan.

2. **Red Clover** (*Trifolium pratense*)

Red clover is a short-lived perennial legume, but is usually managed as a biennial. It is adapted to shallow soils or well-drained soils with a medium-high water table. It is used to replace alfalfa on acid soils or the cut-over timber areas of northern Idaho where alfalfa does so poorly.

Varieties – Kenland, Dollard and Pennscott are the better adapted varieties.

3. **Ladino Clover** (*Trifolium repens*)

Ladino clover is a long-lived, stoloniferous legume widely used in irrigated pastures. It is a giant form of white clover but does not withstand as much close grazing or trampling as white clover. It can be crowded out of mixtures with tall growing grasses if they are allowed to mature, since Ladino can tolerate only a minimum amount of shading. It makes rapid regrowth after grazing.

Varieties – No one variety is recommended over any other variety.

4. **Alsike Clover** (*Trifolium hybridum*)

Alsike clover is a short-lived perennial legume, but is usually managed as a biennial. It is well adapted to acid, poorly drained areas, and grows well in many of the mountain meadows. It will reseed itself in the moister sites if allowed to go to seed.

Varieties – No one variety is recommended over any other variety.

5. **Broadleaf Birdsfoot Trefoil** (*Lotus corniculatus*)

Birdsfoot trefoil is a long-lived perennial legume. It does not cause bloat and so may have some use in pastures. It has some potential in the cut-over timberlands where alfalfa grows poorly. In these areas it may replace red clover for use in long-term forage stands. It does not have the extreme tolerance of alsike clover on acid, poorly-drained soils. It has rather poor seedling vigor and new seedings should be maintained in a vigorous condition.

Varieties – Cascade and Granger have provided the highest yields in tests to date.

Published and distributed in furtherance of the Acts of May 8 and June 30, 1914, by the University of Idaho Agricultural Extension Service, James E. Kraus, Director; and the U. S. Department of Agriculture, cooperating.