Irrigated Forages for Northern Nevada-Type Climate

Joint Recommendations by Nevada Cooperative Extension University of Nevada, Reno and the Soil Conservation Service

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Summary

A series of publications regarding plant materials adapted for various uses and soils in the different climatic regions of Nevada has been developed by Nevada Cooperative Extension, University of Nevada, Reno and the Soil Conservation Service, United States Department of Agriculture. This series includes four publications: Irrigated Forages for Northern Nevada-Type Climate; Irrigated Forages for Western Nevada-Type Climate; Irrigated Forages for Southern Nevada-Type Climate; and, Conservation Plantings for: Rangeland, Windbreaks, Wildlife and Soil Conservation Cover.

The recommendations were developed to serve as a common source of information and recommendations regarding plant materials. Their use is encouraged by agricultural workers in the state to aid individuals/agencies in arriving at proper decisions regarding use of plant materials for agricultural and nonagricultural use such as mining reclamation, highway beautification and recreation.

Acknowledgments

The joint recommendations have been developed with the assistance of many workers. Special recognition is accorded to E. A. Naphan (Retired), Norman R. Ritter (Retired), J. E. Garrison (Retired) of the SCS; and to D. E. Gilbert (Retired), F. F. Peterson (Retired), and R. O. Gifford (Deceased) of the University of Nevada for their contributions.

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Irrigated Forages for Northern Nevada-Type Climate

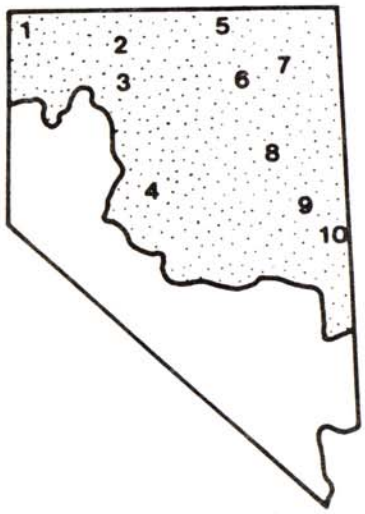
Introduction

This publication focuses on irrigated forages that are adapted to different soils in Northern Nevada. These recommendations have been developed jointly by the Nevada Cooperative Extension and Soil Conservation Service. Climatic conditions and availability of plant materials also have been considered. These recommendations may require adjustments for any individual farm or ranch, as dictated by particular needs, or conditions within such small areas.

When grasses are planted with legumes, alternate row seeding is recommended. Suggested seeding rates are given for pure live seed (PLS). Legume seed should be inoculated with the proper inoculant.

Environmental Features of Northern Nevada

The geographical section of Nevada for which these recommendations are intended is shown by the shaded area on the map. It has generally similar environments for irrigated forages and includes Land Resource Areas 23, 24, 25, 28 and defined in Agriculture Handbook 296, USDA, SCS, 1981, "Land Resource Regions and Major Land Resource Areas of the United States."



1. Sheldon Headquarters
2. Orovada
3. Winnemucca
4. Austin
5. Owyhee
6. Elko
7. Wells
8. Ruby Lake
9. Ely
10. Lehman Caves

Most of the area is above 4500 feet elevation and includes all of the north section and most of the east-central portions of the state. All or most of Elko, Eureka, Humboldt, Lander and White Pine Counties are in the area. Also included are portions of Churchill, Lincoln, Nye and Pershing Counties.

The area is mostly in the Great Basin and contains numerous basins and some river valleys, between north-south oriented mountain ranges. In its northern part, the typical basin and range physiography grades to volcanic plateaus with intervening valleys that are typical of the transition zone from the Great Basin to the Columbia Plateau. Mountains in the area are high and are composed predominantly of igneous and metamorphic rocks in the northern section, and well consolidated sedimentary rock in the eastern and southern sections. Stream flood plains, playas, lake plains, alluvial flats, fan piedmonts, and alluvial fans are common landforms between the mountains in the valleys. Old lake sediments and fan alluvium make up most of the valley fills. The area ranges in elevation from about 4000 feet, at the lowest point, to well over 10,000 feet on some mountain peaks.

The climate of the area is as complex as its topography. Precipitation generally increases and temperature decreases up the mountain slopes. The annual precipitation varies from approximately 5 inches on the basin floors to more than 16 inches on some mountain peaks. Much of the precipitation falls in the winter as snow. The annual snowfall varies from 12 to 24 inches at lower elevations to 60 inches at higher elevations. The summer precipitation is limited and results largely from thunderstorms that are more frequent in the eastern part of the area. Abundant sunshine and clear nighttime skies cause a wide daily range of temperature. Summers are hot, winters moderately cold. Many basin floors are affected by cold air drainage, especially during critical spring and fall periods, so the occurrence of frost is extremely variable. The number of hot days (temperatures over 90 degrees Fahrenheit) varies from 50 or more, at Winnemucca, to fewer than five at Sheldon and higher elevations in the northeastern section. With warm, clear days, low humidity and frequent winds, evaporation is rapid. The estimated total annual pan evaporation varies from approximately 55 inches in the northeast part of the region to about 75 inches along the southwestern boundary of the area. Potential evapotranspiration, although not necessarily equal to pan evaporation, is large and varies in approximately the same fashion. Selected climatic data are given in Table 1.

Table 1
Climatic data for selected northern and eastern Nevada locations

Location	Elevation (feet)	Annual Precipitation (inches)	Mean Temperature		Mean Freeze-Free Period	
			Annual °F	July °F	32°F days	24°F days
Sheldon Hq.	6500	12	42	61	51	115
Orovada	4300	13	49	72	102	164
Winnemucca	4300	9	48	71	94	143
Austin	6600	12	48	70	109	168
Owyhee	5400	13	46	68	93	153
Elko	5100	9	45	70	81	143
Wells	5600	10	45	69	61	122
Ruby Lake	6000	12	45	68	103	159
Ely	6300	8	44	68	80	141
Lehman Caves	6800	13	48	71	123	175

The headwaters of the Humboldt River are in the northeastern portion of the area. These streams, and the numerous tributaries to the Snake River and small, isolated mountain creeks and springs comprise the major surface water resources. Ground water is available in variable quantities in the valleys and basins throughout the area but has been intensively developed only in the Quinn River and Kings River Valleys, along the Reese River, and in the vicinity of Winnemucca. Surface and ground water is generally good quality, however, some poor quality ground water has been encountered in several of the basins and valleys in the area. Land is used primarily for irrigated haylands, grazing, wildlife, recreation, woodland, and watershed.

Key
Soils for Irrigated Forages

Table 2

Irrigated Forage Plant Characteristics

Grass	Recomm. Varieties	Winter hardiness	Seedling vigor	Yield Potential	Longevity	Growth habit	Compata-bility	Palata-bility	Recovery Rate	Use	Stubble Height (inches)	Drought tolerance	Wetness and flood tolerance	Salt and alkali tolerance
Smooth bromegrass	Manchar Lincoln (1)	Excellent	Good	Medium	Long	Sod	Good	Excellent	Medium	Multiple	Three	Good	Fair	Fair
Turkish bromegrass	Regar	Excellent	Good	High	Long	Sod	Good	Excellent	Rapid	Multiple	Three	Fair	Fair	Fair
Creeping meadow foxtail (2)	Garrison	Excellent	Good	Medium	Long	Sod	Good	Excellent	Rapid	Multiple	Three	Fair	Excellent	Good
Orchardgrass (3)	Latar Potomac	Fair	Good	Medium	Medium	Bunch	Good	Excellent	Rapid	Multiple	Four	Fair	Poor	Fair
Tall Fescue (3)	Alta Fawn	Good	Good	High	Long	Bunch	Poor	Fair	Rapid	Multiple	Three	Fair	Good	Good
Timothy	Climax Drummond	Excellent	Good	Medium	Short	Bunch	Good	Good	Slow	Hay	Three	Poor	Good	Poor
Reed canarygrass (4)	Ioreed	Excellent	Poor	High	Long	Sod	Poor	Poor	Rapid	Multiple	Three	Good	Excellent	Fair
Desert wheatgrass	Nordan Hycrest Ephriam	Excellent	Excellent	Medium	Long	Bunch	Good	Good	Slow	Multiple	Three	Excellent	Poor	Good
Siberian wheatgrass	P27	Excellent	Excellent	Medium	Long	Bunch	Good	Good	Slow	Multiple	Three	Excellent	Poor	Good
Kentucky bluegrass (5)	Park	Excellent	Good	Medium	Long	Sod	Poor	Good	Rapid	Multiple	Three	Poor	Good	Poor
Tall wheatgrass (6)	Alkar	Excellent	Excellent	High	Medium	Bunch	Poor	Poor	Slow	Multiple	Eight	Excellent	Good	Excellent
Intermediate wheatgrass (7)	Greenar	Excellent	Good	High	Medium	Sod	Good	Good	Medium	Multiple	Three	Excellent	Poor	Fair
Pubescent wheatgrass (7)	Greenleaf Luna Topar	Excellent	Good	High	Long	Sod	Good	Good	Medium	Multiple	Three	Excellent	Poor	Fair
Basin wildrye	Magnar	Excellent	Poor/Fair	High	Long	Bunch	Poor	Poor	Slow	Multiple	Eight	Excellent	Good	Good

(1) Other southern types also adapted.
(2) Well adapted to wet moderately saline and non-saline areas.
(3) Use in simple mixtures. May winterkill in seedling year. Use Paiute on droughty sites.
(4) Well adapted to wet non-saline areas. Harvest before sign of heading. Plant high germination seed.
(5) Pasture invader. Special use.
(6) Use in saline-sodic soils.
(7) Use where short season water prevails.

Table 2

Irrigated Forage Plant Characteristics (continued)

Grass or Legume	Recomm. Varieties	Winter hardiness	Seedling vigor	Yield Potential	Longevity	Growth habit	Compa-tability	Palata-bility	Recovery Rate	Use	Stubble Height (inches)	Drought tolerance	Wetness and flood tolerance	Salt and alkali tolerance
Streambank wheatgrass (1)	Sodar	Excellent	Good	--	Long	Sod	--	--	--	Erosion	--	Excellent	Poor	Good
Alfalfa (2)		Excellent	Excellent	High	Long	Tap Root	Good	Excellent	Rapid	Multiple	Three	Good	Poor	Good
Sweet clover (3)		Excellent	Excellent	High	Biennial	Tap root	Fair	Poor	Medium	Pasture or green chop	Six	Good	Fair	Good
Red clover (4)	Arlington Kenland	Excellent	Good	Medium	Short	Branch Tap root	Good	Good	Slow	Multiple	Three	Poor	Poor	Poor
White Dutch clover (5)		Fair	Good	Low	Long	Stolons	Good	Excellent	Rapid	Pasture	Two	Poor	Fair	Poor
Ladino clover (4,5,6)		Poor	Good	Medium	Medium	Stolons	Good	Excellent	Rapid	Pasture	Two	Poor	Fair	Poor
Strawberry clover (7)	Salina	Poor	Good	Low	Medium	Stolons	Good	Good	Medium	Pasture	Two	Poor	Excellent	Good
Narrowleaf birdsfoot trefoil (8,10,11)		Poor	Poor	Low	Medium	Branch Tap root	Good	Excellent	Medium	Pasture	Three	Fair	Good	Good
Broadleaf birdsfoot trefoil (8,10,11)	Viking Leo	Poor	Poor	Medium	Medium	Branch Tap root	Good	Excellent	Medium	Multiple	Three	Fair	Good	Fair
Alsike clover (9)		Excellent	Excellent	Medium	Medium	Branch Tap Root	Good	Good	Medium	Multiple	Three	Poor	Good	Poor
Sanfoin (8,10,12)	Remont	Excellent	Excellent	Medium	Short	Branch Tap Root	Good	Good	Slow	Multiple	Four	Good	Poor	Good
Cicer milkvetch (12)	Lutana Monarch	Excellent	Poor	Medium	Long	Rhi-zomes	Good	Good	Rapid	Multiple	Three	Fair	Good	Good

(1) Streambank and critical areas, not for grazing.
(2) Many varieties are adapted to the area. See your Extension agent or district conservationist for current recommendations and variety characteristics.
(3) Spoiled hay or silage may cause animal bleeding (Courmarin).
(4) May winterkill in seedling year.
(5) Frequent irrigation is needed.
(6) Danger of winterkilling.
(7) Well adapted to wet non-saline and saline-sodic soils.
(8) Plant in alternate rows to aid in establishment.
(9) Well adapted to wet non-saline areas.
(10) Non-bloat.
(11) Molybdenum accumulator.
(12) Use where only one cutting of alfalfa is obtained. Seed in alternate rows with grass.

Table 3

Mixtures and Seeding Rates for Soil Group A

Soils with no problem other than some slight to moderate wetness

Full Season Water				Short Season Water			
Hay	lb/A	Pasture	lb/A	Hay	lb/A	Pasture	lb/A
Alfalfa (1)	10	Alfalfa (1)	2	Alfalfa (1)	10	Alfalfa (1)	2
or Alfalfa (1) with Smooth Bromegrass	5 8	or White Dutch Clover (5)	2	or Alfalfa (1) with Intermediate Wheatgrass	5 8	or Cicer Milkvetch (4) with Intermediate Wheatgrass	20 8
or Orchardgrass (3)	5	or Ladino Clover (3,5)	2	or Pubescent	8	or Pubescent Wheatgrass	8
or Turkish Bromegrass	8	with Orchardgrass (2,3)	5				
		or Smooth Bromegrass	8				
		or Tall Fescue (3)	8				
		or Turkish Bromegrass	8				

(1) See your Extension agent or district conservationist for current recommendations and variety characteristics.
(2) Seed Potomac orchardgrass with clover and seed Latar orchardgrass with alfalfa.
(3) Orchardgrass, tall fescue and Ladino clover are susceptible to winterkill during the establishment year and under extreme conditions and close fall grazing.
(4) Seed in alternate rows. Will yield less than alfalfa--non-bloat.
(5) Frequent irrigation needed.
(6) See Table 2 for recommended varieties.

Table 4

Mixtures and Seeding Rates for Soil Group B

Soils with only some moderate salinity hazard

Full Season Water				Short Season Water			
Hay	lb/A	Pasture	lb/A	Hay	lb/A	Pasture	lb/A
Alfalfa (1)	10	Alfalfa (1)	2	Alfalfa (1)	10	Alfalfa (1)	2
or Alfalfa (1) with Tall Fescue (2)	5 8	with Tall Fescue (2)	8	or Alfalfa (1) with Intermediate Wheatgrass	5 8	or Cicer Milkvetch (4) with Intermediate Wheatgrass	20 8
or Intermediate Wheatgrass	8	or Intermediate Wheatgrass	8	or Pubescent Wheatgrass	8	or Pubescent Wheatgrass	8
				or Siberian Wheatgrass	6	or Siberian Wheatgrass	6
				or Desert Wheatgrass	6	or Desert Wheatgrass	6

(1) See your Extension agent or district conservationist for current recommendations and variety characteristics.
(2) Tall Fescue is susceptible to winterkill during the establishment year and under extreme conditions and close fall grazing.
(3) Seed Siberian or desert wheatgrass on severely dry sites.
(4) Seed in alternate rows. Will yield less than alfalfa. Non-bloat.

Table 5

Mixtures and Seeding Rates for Soil Group C

Soils with claypans at less than 20 inch depth that restrict root and water penetration

Full Season Water				Short Season Water			
Hay	lb/A	Pasture	lb/A	Hay	lb/A	Pasture	lb/A
Alsike Clover	5	Alfalfa (1)	2	Alfalfa (1)	10	Alfalfa (1)	10
or Red Clover	5	or Broadleaf Birdsfoot Trefoil (2,3)	5	or Alfalfa (1) with Intermediate Wheatgrass	5 8	or Cicer Milkvetch (5) with Intermediate Wheatgrass	2 8
with Smooth Bromegrass	8	or White Dutch Clover (6)	2	or Pubescent Wheatgrass	8	or Pubescent Wheatgrass	8
or Orchardgrass (3)	5	or Ladino Clover (3,6)	2				
or Alfalfa (1) with Smooth Bromegrass	5 8	with Smooth Bromegrass	8				
or Orchardgrass (3)	5	or Orchardgrass (4)	5				
or Turkish Bromegrass	8	or Tall Fescue (3)	8				
		or Turkish Bromegrass	8				

(1) See your Extension agent or district conservationist for current recommendations and variety characteristics.
(2) Seed birdsfoot trefoil in alternate rows with grass. Non-bloat. Molybdenum accumulator.
(3) Orchardgrass, tall fescue, Ladino clover and birdsfoot trefoil are susceptible to winterkill during the establishment year and under extreme conditions and close fall grazing.
(4) Seed Potomac orchardgrass with clover and seed Latar orchardgrass with alfalfa.
(5) Will yield lower than alfalfa. Non-bloat.
(6) Frequent irrigations needed.
(7) See Table 2 for recommended varieties.

Table 6

Mixtures and Seeding Rates for Soil Group D

Soils with clayeyness throughout the soil profile

Full Season Water				Short Season Water			
Hay	lb/A	Pasture	lb/A	Hay	lb/A	Pasture	lb/A
Alfalfa (1)	10	Alfalfa (1)	2	Alfalfa (1)	10	Alfalfa (1)	2
or Alfalfa with Tall Fescue (2)	5 8	or Broadleaf Birdsfoot Trefoil (2,3) with Tall Fescue	5 8	or Alfalfa with Pubescent Wheatgrass	5 8	or Cicer Milkvetch (3,4) with Pubescent Wheatgrass	20 8
		or Intermediate Wheatgrass	8	or Intermediate Wheatgrass	8	or Intermediate Wheatgrass	8

(1) See your Extension agent or district conservationist for current recommendations and variety characteristics.
(2) Tall fescue and birdsfoot trefoil are susceptible to winterkill during the establishment year and under extreme conditions and close fall grazing.
(3) Seed in alternate rows with grass. Non-bloat.
(4) Will yield less than alfalfa.
(5) See Table 2 for recommended varieties.

Table 7

Mixtures and Seeding Rates for Soil Groups E and F

Soils with droughtiness due to gravel at less than 20 inch depth or sandiness throughout the profile

Full Season Water			
Hay	lb/A	Pasture	lb/A
Alfalfa (1)	10	Alfalfa (1)	2
or Alfalfa (1) with Intermediate Wheatgrass	5 8	with Intermediate Wheatgrass	8
or Pubescent Wheatgrass	8	or Pubescent Wheatgrass	8

Short Season Water			
Hay	lb/A	Pasture	lb/A
Alfalfa (1) with Desert Wheatgrass	5 6	Alfalfa (1) or Cicer Milkvetch (2)	2 20
or Siberian Wheatgrass	6	with Desert Wheatgrass	6
or Pubescent Wheatgrass	8	or Siberian Wheatgrass	6
		or Pubescent Wheatgrass	8

(1) See your Extension agent or district conservationist for current recommendations and variety characteristics.

(2) Seed in alternate rows with grass. Non-bloat. Will yield less than alfalfa.

(3) See Table 2 for recommended varieties.

Table 8

Mixtures and Seeding Rates for Soil Group G

Soils with droughtiness due to hardpan or bedrock at less than 20 inch depth

Full Season Water			
Hay	lb/A	Pasture	lb/A
Alfalfa (1)	10	White Dutch Clover (5)	2
or Red Clover (5)	5	or Ladino Clover (3,5)	2
Broadleaf Birdsfoot Trefoil (2,3)	5	with Intermediate Wheatgrass	8
with Intermediate Wheatgrasss	8	or Tall Fescue (3)	8

Short Season Water			
Hay	lb/A	Pasture	lb/A
Alfalfa (1) with Intermediate Wheatgrass	5 8	Alfalfa (1) or Cicer Milkvetch (4)	2 20
or Pubescent Wheatgrass	8	with Intermediate Wheatgrass	8
		or Pubescent Wheatgrass	

(1) See your Extension agent or district conservationist for current recommendations and variety characteristics.

(2) Seed birdsfoot trefoil in alternate rows with grass.

(3) Tall fescue, Ladino clover and birdsfoot trefoil are susceptible to winterkill during the establishment year and under extreme conditions and close fall grazing.

(4) Seed in alternate rows. Non-bloat. Will yield less than alfalfa.

(5) Frequent irrigation is needed under 'full season water' but care must be taken to prevent perched water table.

(6) See Table 2 for recommended varieties.

Table 9

Mixtures and Seeding Rates for Soil Group H

Poorly drained soils but without salinity hazard

Hay	Full Season Water lb/A	Pasture	lb/A
Creeping Meadow Foxtail (1)	5	Creeping Meadow Foxtail (1)	5
or Timothy	5	or Reed Canarygrass	6
or Reed Canarygrass	6	with Strawberry Clover (2)	3
or Basin Wildrye (3)	8	or Alsike Clover	3
with Alsike Clover	5		

(1) Garrison meadow foxtail is the preferred grass.
(2) Salina strawberry clover may winterkill under severe conditions.
(3) Poor palatability.
(4) See Table 2 for recommended varieties.

Table 10

Mixtures and Seeding Rates for Soil Group I

Poorly drained soils with salinity hazard

Hay	Full Season Water lb/A	Pasture	lb/A
Tall Wheatgrass	10	Tall Wheatgrass	10
or Tall Fescue (1)	15	or Tall Fescue (1)	15
or Tall Wheatgrass	8	or Tall Wheatgrass	10
with		or Tall Fescue (1)	8
Broadleaf Birdsfoot Trefoil (1,2,3)	5	with	
		Strawberry Clover (1)	3
		or Narrowleaf Birdsfoot Trefoil (1,3)	5

(1) Tall fescue and birdsfoot trefoil and strawberry clover are susceptible to winterkill under severe conditions.
(2) On severe saline sites substitute Madrid sweet clover at 5 lb. per acre.
(3) Seed birdsfoot trefoil in alternate rows with grass.
(4) See Table 2 for recommended varieties.

Table 11

Mixtures and Seeding Rates for Soil Group J

Soils with excessive wetness (very poorly drained)

Possible species for seeding may include the following, but treatment, species and seeding rates will depend upon onsite investigation.

Hay	Full Season Water lb/A	Pasture	lb/A
Creeping Meadow Foxtail	12	Reed Canarygrass	12
or Tall Fescue (1)	12	or Tall Fescue (1)	12
or Reed Canarygrass	12	with	
with		Alsike Clover	3
Alsike Clover	3	or Red Clover	3
or Red Clover	3	or Strawberry Clover (1)	3

(1) Tall fescue and strawberry clover are susceptible to winterkill under severe conditions.

(2) See Table 2 for recommended varieties.

Table 12

Disturbed Soils

Soil stabilization, ditchbank and other non-crop seedings

The following species are recommended for stabilizing or protecting disturbed areas that receive more than 8 to 10 inches of rain or will receive some supplemental irrigation water.

For wildlife, follow recommendations for hay or pasture if supplemental irrigation water is available.

Drill Seeding	lb/A	Broadcast seeding	lb/A
Streambank Wheatgrass	6	Streambank Wheatgrass	12
or		or	
Crested Wheatgrass	6	Crested Wheatgrass	12
or Sheep Fescue	4	or Sheep Fescue	8
with		with	
Sweetclover	3	Sweetclover	2

Appendix 1
A grouping of soils for irrigated forages

Soil Group	Major Soil Limitations (1)	Usable Depth in. (2)	Surface Texture (3)	Subsoil Texture (3)	Drainage Class (4)	Salinity Hazard Ec, mmhos/cm (5)	Sodium Hazard (SAR) (6)	Available Water Holding Capacity in Surface Foot in. (7)
A	Soils with no problems other than some slight to moderate wetness	>20	sl,fsl,vfsl, l,sil,si,cl, scl,sicl	sl,fsl,vfsl, l,sil,si,cl, scl,sicl	well, mod. well, somewhat poorly drained	<4	<10	>1.25
B	Only some moderate salinity-sodium hazard	>20	sl,fsl,vfsl, l,sil,si,cl, scl,sicl	sl,fsl,vfsl, l,sil,si,cl, scl,sicl	well, mod. well, somewhat poorly drained	4-10	10-30	>1.25
C	Claypan at less than 20 inch depth that restricts root and water penetration	<20 to claypan	sl,fsl,vfsl, l,sil,si,cl scl,sicl	sc,sic,c	well, mod. well, somewhat poorly drained	<4	<10	>1.25
D	Clayeyness throughout the soil profile	>20	sc,sic,c	sc,sic,c	mod. well, somewhat poorly drained	<4	<10	>1.5
E	Droughtiness due to gravel at less than 20 inch depth	<20 to gravel	sl,fsl,vfsl, l,sil,si	s,ls,gravel, cobbles	well, mod. well drained	<4	<10	>1
F	Droughtiness due to sandiness throughout the soil profile	>20	s,ls	s,ls	excessively well, mod. well, somewhat poorly drained	<4	<10	<1
G	Droughtiness due to hardpan or bedrock at less than 20 inch depth	<20 to hardpan, bedrock	sl,fsl,vfsl, l,sil,si,cl, scl,sicl	sl,fsl,vfsl, l,sil,si,cl, scl,sicl	well, mod. well drained	<4	<10	>1.25
H	Poorly drained but without salinity-sodium hazard	<20	all textures	all textures	poorly drained	<4	<10	>1
I	Poorly drained with salinity-sodium hazard	<20	all textures	all textures	poorly drained	4-20	10-50	>1
J	Excessive wetness (very poorly drained)	<10	all textures peats	all textures	very poorly drained	<4	<10	--

< = less than > = more than

Appendix 1
A grouping of soils for irrigated forages (continued)

1. Only serious soil problems are considered. Gravel content <35 percent by volume is assumed. Climatic, irrigation, and fertility factors are assumed suitable. The drainage and salinity hazards are for the soil at the present time. In defining these soil groups, some major later crop management requirements have been considered in addition to mere species adaption.

2. Usable depth refers to that depth exploited by large numbers of roots.

3. The surface soil is the 0 to 10 inch depth layer, or the plowed layers. The subsoil is the B horizon of soil survey reports if one is present, or else the 10 to 40 inch depth layer, or from 10 inches depth to bedrock or hardpan in shallow soils.

The following list of abbreviations for soil texture names are given by the generalized groups which are used to report soil texture on the soil test data sheets from the Nevada Soil and Water Testing Laboratory, University of Nevada, Reno:

1. Coarse Textures
   - s = sands
   - ls = loamy sand

2. Moderately Coarse Texture
   - sl = sandy loam
   - fsl = fine sandy loam

3. Medium Textured
   - vfsl = very fine sandy loam
   - l = loam
   - sil = silt loam
   - si = silt

4. Moderately Fine Textured
   - cl = clay loam
   - scl = sandy clay loam
   - sicl = silty clay loam

5. Fine Textured
   - sc = sandy clay
   - sic = silty clay
   - c = clay

4. The properties by which drainage classes can be identified in the field are given in Appendix 2.

5. Salinity hazard is defined in terms of electrical conductivity of a saturated paste extract (mmhos/cm) and for the plow layer. If the subsoil is more salt or sodium affected than the plow layer, it should be considered an additional hazard. Both layers should be tested. The upper salinity limit for some of the soil groups is higher than plants will actually grow at, and reflects the assumption that soil tests will be for conditions before the crop is planted, and that salinity will be reduced by irrigation. Soils with yet higher salinity need to be reclaimed before cropping.

6. Sodium hazard (i.e., alkali-affected) is estimated by the SAR value (Sodium Absorption Ratio) of a saturated paste extract. The SAR value is an estimate, and for all practical purposes is the same as the ESP (Exchangeable Sodium Percentage) value, which is also used as a measure of sodium hazard. A safe SAR upper limit for clayey soils is 10; loamy sands and sandy loams may be used with few problems up to values of about 15. Soils with yet higher SAR values should be reclaimed before or during cropping.

7. Values for estimating available water holding capacity (AWC) from textures and thickness of soil horizons are given in Appendix 3.

Appendix 2
Field evidence for identifying soil drainage classes

Class	Field Criteria
Very poorly drained	Water table remains at the surface or within 20 inches most of the year; the surface horizons are commonly dark colored and peaty or mucky; subsurface horizon colors are neutral greys, olive or bluish grey with or without dull mottling; grazing possible at least seasonally, hay can be harvested in drier years.
Poorly drained	Soil very wet much of time; water table seasonally at or near surface for several weeks; water table between 20 and 40 inches most of the year; surface horizon commonly dark colored; prominent soluble salt accumulation may occur at or near surface; subsurface horizon dull grey or olive, with or without mottling; grazing possible most of time, hay usually can be harvested.
Somewhat poorly drained	Soil seasonally very wet for several weeks because of an impermeable layer, or a water table at 40 to 60 inches; surface horizon commonly thick and dark colored; subsurface horizon dull grey and commonly mottled; prominent soluble salt accumulation may occur in upper 40 inches; drainage necessary for deep rooted crops.
Moderately well drained	Soil seasonally very wet for a week or so because of an impermeable layer or an intermittently high water table which is below 60 inches most of the year; or because of surface flooding from adjacent areas; surface horizon usually thicker and darker than adjacent well drained soils; indistinct mottling usually present in lower subsurface horizon.
Well drained	Soil is not very wet for more than a few days after protracted and heavy storms; no water table within 60 inches at any time; surface and subsurface horizons not greyed or mottled, but yellowish, brownish, or reddish colored.
Excessively drained	Soil moist for only few days after storms; soil porous throughout with no fine textured or impermeable layers; water does not run off surface except under most intense storms; no water table within 60 inches.
Altered drainage	Soils which have been artificially drained but retain the dark colored surface horizons, peaty or mucky surface horizon, or dull or mottled subsurface colors from former drainage status.

Appendix 3

Estimates of available water holding capacity based on soil texture

(After: Tech. Note-Soils-15, 1968, SCS, USDA, Berkeley, California)

Available water is that which plants can extract from the soil, and is roughly equivalent to that which is held between 1/10 and 15 bars suction in laboratory measurements, or between "field capacity" and the "permanent wilting" moisture contents. The 15 bar moisture content is quite closely related to the clayeyness of the soil, whereas the moisture content at field capacity is a more variable property affected by soil structure and very fine sand-silt content in addition to clay content. But since soil texture is so important in determining both, it can be used to estimate available water holding capacity (AWC). Volume content of available water is a more useful measure of AWC than weight percentage since we calculate irrigation water in inches, and since the actual amount of water in a soil for a given weight percentage varies with the available water ratio, that is, the decimal fraction of volume of water per unit volume of soil. This is the same as the decimal ratio of inches of water per inch of soil, or feet of water per foot of soil:

$$\text{Available water holding capacity ratio} = \frac{\text{Volume soil, cubic centimeter}}{\text{Volume water, cubic centimeter}} = \text{inches water / inches soil depth}$$

In the following table, the available water ratios for different textural groups are given. Total AWC can be calculated by multiplying the depth of a given soil by the water ratio for its particular texture. For soils with different textured layers, the AWC for each layer is calculated from its thickness and water ratio, and the values for the layers totaled.

Available Water Holding Capacity Ratio

Textural Classes	Low	Average	High
Gravelly sand Course sand Sand Fine sand	0.033	0.048	0.063
Loamy coarse sand Loamy fine sand Sandy loam Fine sandy loam	0.084	0.10	0.13
Very fine sandy loam Loam Silt loam Sandy clay Silty clay Clay	0.13	0.15	0.17
Sandy clay loam Clay loam Silty clay loam	0.17	0.18	0.19

Appendix 4

Common plant name	Scientific name
Alfalfa	*Medicago sativa L.*
Alsike Clover	*Trifolium hybridum L.*
Basin wildrye	*Elymus cinereus Scribn. and Merr.*
Broadleaf birdsfoot trefoil	*Lotus corniculatus L.*
Cicer milkvetch	*Astragalus cicer L.*
Creeping meadow foxtail	*Alopercurus arundinaceus Poir*
Crested wheatgrass	*Agropyron cristatum (L.) Gaertn.*
Desert wheatgrass	*Agropyron desertorum (Fisch.) J. A. Schultes*
Intermediate wheatgrass	*Agropyron intermedium (Host.) Beauv.*
Kentucky bluegrass	*Poa pratensis L.*
Ladino clover	*Trifolium repens latum L.*
Narrowleaf birdsfoot trefoil	*Lotus tenius Waldst. Kit. Ex Willd.*
Orchardgrass	*Dactylis glomerata L.*
Pubescent wheatgrass	*Agropyron intermedium trichophorum (Link) Halasy.*
Red clover	*Trifolium pratense L.*
Reed canarygrass	*Phalaris arundinacea L.*
Sainfoin	*Onobrychis viciaefolia Scop.*
Sheep fescue	*Festuca ovina L.*
Siberian wheatgrass	*Agropyron sibiricum (Willd.) Beauv.*
Smooth brome	*Bromus inermis Leyss*
Strawberry clover	*Trifolium fragiferum L.*
Streambank wheatgrass	*Agropyron dasystachum riparian (Scribn.) (J. G. Smith) and Bowden.*
Sweetclover - yellow	*Melilotus officinalis (L.) Lam.*
Tall fescue	*Festuca arundinacea Schreb.*
Tall wheatgrass	*Agropyron elongatum (Host.) Beauv.*
Timothy	*Phleum pratense L.*
Turkish bromegrass (meadowbrome)	*Bromus biebersteinii Roem. and J. A. Schultes*
White Dutch Clover	*Trifolium repens L.*

Appendix 5
Pure Live Seed Conversion Chart

To use chart:
Locate the percent purity and percent germination of the seed on lines A and B. Lay a straight edge between these two points. The point of the intersection with line C is the conversion factor for that seed.

Example:
Purity 95 - line A
Germination 35 - line B
Conversion Factor 3.00 - line C

It will take 3 pounds of this seed to equal 1 pound of pure live seed. Multiply this factor by the PLS seeding rate to obtain the seeding rate for this lot of seed.