Irrigated Pastures for New Mexico

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Irrigated Pastures for New Mexico

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Irrigated pastures in New Mexico have changed drastically in recent years, mostly in patterns of pasture use. Many pastures are now used as a convenience rather than a cash crop. Small tracts are used to pasture saddle horses or other livestock as a hobby by nonfarmers. Still other pastures are used by ranchers as holding sites, calving pastures, horse pastures, as a source of hay, or to supplement rangeland grazing. Farmers with irrigated land have been primarily concerned with producing conventional cash crops. Irrigated pastures can compete with these cash crops, if enough water is available and the pasture is well managed.

Irrigated pastures require only a small labor force. For good production, irrigated pastures need as much management as most cash crops, or more. Successful pastures must be properly established, fertilized, irrigated, and grazed for the best yields of grain, wool, milk, or dry matter per acre.

In New Mexico, the Agricultural Experiment Station has accumulated some research information regarding desirable species, establishment, and management of pastures in the state. Additional information was obtained from other agricultural experiment stations and by observation of actual practices on New Mexico farms and ranches. This information is presented here as a guide to the development of productive irrigated pastures in New Mexico. The recommendations will likely change as more data and improved species become available.

TYPES OF PASTURES

There are three general types of pastures—permanent, rotational, and annual. Permanent pastures are usually composed of perennial species planted on marginal cropland, and will remain on the site indefinitely. Irrigated pastures planted to perennial species that will be rotated with row crops every few years are called rotational pastures. Annual pastures are planted to annual species for seasonal use. Annual pastures can be used to supplement other pastures, or they may constitute the entire forage program.

Annual pastures normally are more productive than permanent pastures, but they are more expensive to establish and maintain. The additional cost of land preparation, seed, and planting each year may more than offset the differences in production. Productivity of permanent or rotational pastures tends to decrease after the second or third year, because plants are weakened by grazing pressure, diseases, weeds, and insects.

Permanent pastures cost less to establish and maintain. Permanent pastures also improve soil structure and add organic matter, which benefits the following crop. Permanent pasture also reduces soil erosion. These characteristics make permanent pastures important on marginal cropland.

SELECTING SPECIES AND MIXTURES

Selection of the species to be used, whether in pure stands or in mixtures, is of major importance in establishing irrigated pastures. Each producer must determine which species best fits his forage program. Some factors to look for in selecting pasture species are:

- Adaptability to the climate and soil of the area.
- Inherent ability to produce under proper management.
- Reasonably long life (for permanent pastures).

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- Nutritional value.
- Palatability.
- Tolerance to grazing and ability to recover.
- Compatibility with other species (if used in mixtures).
- Disease and insect resistance (when available).

These factors are essential if a pasture is to remain productive for a reasonably long period. For information about particular species, consult the county extension agent or a forage production specialist.

Simple mixtures of one grass and one legume are more desirable than complex mixtures of several grasses and legumes. A legume in the mixture or in pure stands provides higher yields of better quality forage than grass alone. Many legumes, however, cause bloat in ruminant animals, and some producers prefer a pure grass pasture, which sacrifices some yield and quality to safety. Complex mixtures present several problems. No two species require identical management of water, fertilizer, and grazing. This makes it impossible to maintain all species in the stand. More palatable species can be overgrazed and eliminated from the stand. Species differ in their ability to compete for light, water, nutrients, and space. It is best to grow simple mixtures of two species that complement each other.

Use of both cool and warm-season species in a mixture has not been successful in most irrigated areas. If both cool and warm-season species are desired, they should be maintained in separate stands and managed according to their respective requirements.

KINDS OF PLANTS

Pasture species are usually classified by their growth habits—when they grow, how long they live, and how they spread. Cool-season species grow best between 60°F and 80°F and warm-season species grow best between 80°F and 95°F. Most warm-season species are killed when winter temperatures go consistently below 10°F.

Annual species complete their life cycle in one year or one growing season. Those species that need two growing seasons, or years, to complete their life cycle are biennials. Species that live for three or more years are perennial. The life span of perennial species can be shortened by diseases, insects, soil, and climatic conditions.

Species classified as bunch type have a crown and spread by tillering. They do not, generally, have rhizomes or stolons. Species that spread by lateral shoots such as rhizomes and stolons are classified as creeping.

DESCRIPTION OF PASTURE SPECIES

Legumes and grasses that show promise as pasture species in New Mexico are listed here. Because recommended varieties may vary with area, availability, and new varieties that are continually being released, specific varieties are not listed.

Legumes

Alfalfa (*Medicago sativa*) is a cool-season, long-lived, herbaceous perennial. The plant grows erect with shoots rising from the crown. Grazing may sometimes damage the crown, providing an entry for disease organisms. Alfalfa is a high-yielding, nutritious, palatable species, but it does cause bloating in ruminant animals. Adapted to most regions of New Mexico, alfalfa grows best on loamy soils that are fertile and well drained, but it can be grown on most soil types. Once established, it can tolerate a considerable amount of salt. Alfalfa probably has more heat tolerance than most cool-season forage legumes, except the white clovers. Alfalfa is compatible in mixture with most cool-season grasses.

White clover (*Trifolium repens* var. giganteum) is a cool-season, long-lived perennial with a creeping, stoloniferous growth habit. White clover tolerates frequent close grazing and trampling by livestock. It is adapted to a wide variety of soil types and will grow on poorly drained soils, but it does not tolerate salty soils. Like alfalfa, it causes bloat. It can be grown in most areas of New Mexico, except the colder regions. The various types of white clover are well adapted to grazing, but because of their prostrate growth habit, they are not well suited for hay. White clover is compatible with most cool-season bunch grasses.

Birdsfoot trefoil (*Lotus corniculatus*) is a cool-season, long-lived perennial with a semi-erect to prostrate growth habit. It is adapted only to the cooler regions of the state because it lacks heat tolerance. Adapted to most soil types, it can be grown on heavy, poorly drained, or swampy soils that are unsuited for most other legumes. Birdsfoot trefoil has good tolerance to flooding and salinity. It rarely causes bloat, but it does not have the yield potential of alfalfa and other legumes. It is compatible in mixtures with most cool-season grasses.

Alsike clover (*Trifolium hydridum*) is a short-lived, cool-season perennial with an erect growth habit. Not

tolerant to heat and drought, alsike clover is adapted only to the cooler regions of New Mexico. It is well adapted to wet, poorly drained soils and has good flood tolerance. It grows on a variety of soil types, but has a low tolerance to salt. Alsike clover is compatible with most cool-season grasses. Alsike clover is not generally recommended for permanent pastures in New Mexico because of its relatively short life.

Red clover (*Trifolium pratense*) is a short-lived, cool-season perennial; it may even be an annual in some areas. It has an erect growth habit. The leaves are usually covered with hair. Red clover does not tolerate frequent close grazing and is better suited for hay than pasturing. Adapted to the cooler regions of the state, it does best on fertile, well drained soils with a moderate pH range. Red clover is rather sensitive to diseases, which may contribute to its short life span. Bloat is a severe problem with red clover. Red clover is compatible with several cool-season grasses.

Strawberry clover (*Trifolium fragiferum)* is a cool-season, long-lived perennial with a creeping growth habit. Strawberry clover is well suited for grazing, but not for hay. It is adapted best to the cooler regions of the state, but it does have fair heat tolerance. It has good salt tolerance and is adapted to wet soils with high pH. To produce adequately, it requires an abundance of water. It is compatible with most cool-season grasses. Strawberry clover is not being used much in New Mexico, but has potential.

Sainfoin (*Onobrychis viciaefobia*) is a long-lived, cool-season perennial with a growth habit similar to that of alfalfa. The crown of sainfoin is weak and will not tolerate trampling by grazing animals. For this reason, sainfoin should be planted in rows or on beds to reduce the trampling. It requires a well-drained soil, but is well adapted to sandy or cobbly soils that may be unsuited to other forage legumes. Sainfoin is resistant to the alfalfa weevil, but is susceptible to root and crown diseases. It is nutritious, highly palatable and non-bloating. Its palatability makes sainfoin susceptible to overgrazing if not managed properly. It is compatible with many cool-season grasses and also makes an excellent pasture as a pure stand.

Sweetclovers (*Melilotus officinalis* and *M. alba*) are cool-season biennials or annuals with a very erect growth habit. They usually grow to heights of more than two feet with a high proportion of stems that are coarse and become woody toward maturity. Sweetclover not only causes bloat, but also contains a chemical, coumarin, that has an undesirable taste and may be converted to a toxic substance that reduces the clotting power of blood. Animals may bleed to death from slight wounds or internal hemorrhaging. Sweetclover is adapted to most soil and climatic conditions in the state, is an excellent green manure crop, but it is not generally recommended as a pasture species.

Grasses

Tall fescue (*Festuca arundinacea)* is a long-lived, cool-season perennial with a bunch-type growth habit. The most heat-tolerant of the cool-season grasses used in New Mexico, it is adapted to a wide variety of soil types and pH. It will tolerate wet, poorly drained soils and can survive flooding. Tall fescue has good shade tolerance and is adapted to most climatic conditions in New Mexico. It is quite tolerant to grazing and management stresses. It may be less palatable than some other cool-season grasses, but livestock eat it when fertilized properly and grazed frequently. Tall fescue is compatible with most cool-season legumes in mixtures.

Endophytes in Tall Fescue. Poor animal performance on tall fescue pasture has been linked to a seed-borne fungus, *Acremonium coenophialum*. This endophytic colonizer is found within the plants and is only transmitted through the seed. Therefore, endophyte-free seed should be used to establish a tall fescue pasture. If the seed is not certified endophyte-free, it can be sent to a laboratory for analysis.

Producers who see poor animal performance on tall fescue pasture can submit a sample of the plants for analysis. The correct procedure for sampling is to collect a single tiller from at least 50 plants. Plants with seed stalks are easier to analyze and should be collected when possible.

Contact the county agricultural agent for labs that can conduct analysis.

Orchardgrass (*Dactylis glomerata*) is a cool-season, long-lived perennial with a bunch-type growth habit. Adapted to the cooler regions of New Mexico, it tolerates a wide range of soil conditions, but prefers fertile, well-drained soils. Orchardgrass has good shade tolerance and good palatability when well fertilized and grazed frequently. It is one of the most important pasture grasses at the higher elevations in northern New Mexico. In mixtures, it is compatible with most cool-season legumes.

Smooth bromegrass (*Bromus inermis*) is a cool-season, long-lived perennial with an erect growth habit, and is sod forming with heavy rhizomes. Its area of adaptation is similar to that of orchardgrass. It is best adapted to fertile, well drained, medium to heavy-textured soils rich in organic matter. Smooth bromegrass tends to become sod-bound because of the heavy

rhizomes. It has moderate tolerance to salt. It is compatible with alfalfa and has given satisfactory results in mixtures with sainfoin.

Tall wheatgrass (*Agropyron elongatum)* is a cool-season, long-lived perennial with a bunch-type growth habit, although it has rhizomes. It grows tall and becomes coarse-textured at maturity. Tall wheatgrass is somewhat sensitive to high temperatures. It is adapted to a wide range of soil types and has good tolerance to salt. Because of the rhizomes, it tends to become sod-bound. It is best to plant tall wheatgrass in rows and graze it frequently to maintain palatability. It is normally grown in pure stands, but appears compatible with alfalfa or sainfoin.

Annual ryegrass (*Lolium multiflorum*) is similar to perennial ryegrass, except it completes its life cycle in one season. Annual ryegrass has been used successfully as a winter annual pasture in the southern part of the state.

Perennial ryegrass (*Lolium perenne*) is a cool-season, short-lived perennial with a bunch-type growth habit. Of all the cool season grasses used in New Mexico, perennial ryegrass appears to be the most sensitive to cold, heat, or drought. Best adapted to the cooler regions of the state, it prefers fertile, well-drained, medium-textured soils with nearly neutral pH. It is not generally recommended for pastures in New Mexico.

Reed canarygrass (*Phalaris arundinacea*) is a long-lived, cool-season perennial that tends to have a bunch-type growth habit, but spreads by rhizomes. Adapted to cooler regions of the state, it is tall and coarse textured at maturity. It is best adapted on fertile, moist soils and is especially suited to swampy areas that are unsuited for other crops. Reed canarygrass has good salt tolerance and is more palatable than most other wetland grasses when grazed closely. It is compatible with some cool-season legumes.

Bermudagrass (*Cynodon dactylon*) is a warm-season, long-lived perennial that forms a dense sod. It spreads both from rhizomes and stolons. Bermudagrass is sensitive to cold and grows little when night temperatures fall below 60 ˚F. Many varieties tend to winterkill rather badly in New Mexico. It favors medium- to light-textured soils but will tolerate rather salty soils. It has poor shade tolerance and is not compatible with many other grasses or legumes. Bermudagrass is not generally recommended for pasture use in New Mexico, but it can be used on soils too sandy or salty for most crops. When bermudagrass is used, the improved giant types are recommended.

Kleingrass (*Panicum coloratum*) is a warm season perennial bunchgrass introduced to the United States from Africa. It is fine-stemmed and leafy, and can grow to a height of 3 to 4 feet. Kleingrass spreads by tillering and short rhizomes. It will establish roots at nodes of the stems that are in contact with the soil. Kleingrass is adapted to a fairly wide range of soil and climatic conditions; however, there are some concerns as to its cold tolerance. Because it is susceptible to winter injury, it is recommended for use only in the southern part of the state. Kleingrass has yielded well in Texas, but has suffered winterkill in parts of New Mexico. It can cause photosensitization (swellhead) in sheep.

Several other warm-season grasses can be adapted to conditions in New Mexico. Success in using them in irrigated pastures depends on the management and other conditions. Few of these are used extensively in the state. These grasses include switchgrass (*Panicum virgatum*), blue panicum (*P. antidotale*) and the various lovegrasses (*Eragrostis* spp.) Most of these grasses do not yield as much as cool season grasses.

Temporary Pasture

Many producers prefer temporary pastures. They provide a valuable source of high yielding, nutritious forage. These consist mainly of annual species and can be used as supplemental forage for perennial pastures, or they can be the entire forage program. Both warm- and cool-season annual species may be used to provide almost year-round grazing, particularly for supplementing perennial pastures. Cool-season annuals provide good fall and early spring forage; warm-season annuals provide abundant forage during the summer. Little or no forage can be produced from December through February. The length of this dormant period varies with location.

Cool-Season Annuals

The cool-season annuals most frequently used in New Mexico are winter wheat, barley, oats, rye, and annual ryegrass. Barley and oats are somewhat more susceptible to cold temperatures, and are best adapted to the southern part of the state. Rye and wheat are more cold tolerant and are better adapted to the cooler regions.

Barley and rye generally produce more fall forage than wheat, oats, or annual ryegrass. Barley appears to be the most salt tolerant of these crops; rye generally does better than the others on sandy or poor land. Water requirements are lower for these winter annuals than for the warm-season forages, and forage production per unit of water can be higher.

Cool-season annuals can be seeded from the first of August to the first of September to produce abundant

fall grazing. They are planted earlier in the cooler areas than in the warmer areas.

Cool-season annuals should not be grazed until they are 5 to 6 inches tall, allowing the plants to establish a good root system. Grazing too soon or too close slows root development and can destroy the plant's ability to produce. Animals should be removed when the forage has been grazed to a height of 2 inches.

Small grains (rye, wheat, oats, and barley) can provide grazing in both the fall and the spring and still produce a grain crop. If a grain crop is desired, grazing should be halted sometime around March 15 or at the first sign of stooling. The spring grazing season can sometimes be extended into May if no grain crop is to be harvested.

There has been some interest in use of two man-made crops for grazing in recent years. Triticale, a cross between wheat and rye, has potential as a good forage and grain producer, although acceptance has been slow. Another crop, agrotriticum, has also shown promise as a good forage producer with potential for a grain crop. Agrotriticum is a cross between wheat and wheatgrass, and tends to be a weak perennial.

Warm-Season Annuals

Sorghums, most commonly sudangrass and sorghum x sudangrass hybrids, are often used for pasture. Millet is another choice. Adapted to most areas of the state except the cooler regions, they provide excellent, high-quality feed during summer. In the cooler areas, small grains or annual ryegrass can be used for summer grazing. Seeded in spring, these annuals provide good grazing through summer.

Sudangrass and sorghum x sudangrass hybrids are adapted to most soil types and conditions, and produce a large volume of dry matter per acre. They support a high carrying capacity. Sudangrass and the sorghum sudangrass hybrids respond well to fertilization, particularly nitrogen.

Sorghums are adapted to warmer temperatures and should not be seeded until soil temperature reaches 60˚F. This normally occurs between May 1 and May 15 in most areas of New Mexico. Fineness of the stems is greatly influenced by the seeding rate. Plants from higher seeding rates have finer stems than those seeded at lower rates.

Prussic acid and nitrate poisoning have both been associated with sorghum. Sudangrass is less likely to contain dangerous amounts of prussic acid than the larger sorghums. When sudangrass grows normally and is not stressed from drought or frost, it offers little danger of poisoning when pastured. There are virtually no problems with properly cured hay made from sudangrass. There is little danger from nitrate poisoning, except under stress conditions.

It is dangerous to graze horses on sorghums. Sorghums cause a disease in horses known as sorghum cystitis ateaxia syndrome. This is a urinary disease that can kill the animals. For this reason, sorghums are not recommended as pastures for horses.

ANNUAL SPECIES FOR TEMPORARY PASTURES

Legumes

Hairy vetch (*Vicia villosa*) is a cool-season, vinetype plant that is best suited for overseeding in bermudagrass pastures. It can provide spring grazing 4 to 6 weeks before the bermudagrass begins to produce ample forage. Few annual legumes are adapted to New Mexico conditions, but hairy vetch may be one.

Grasses

Winter wheat (*Triticum aestivum*), winter barley (*Hordeum vulgare*), rye (*Secale cereale*), winter oats (*Avena sativa* and *A. byzantina*) and annual ryegrass (*Lolium multiflora*) are the most common winter annuals used for pasture. Rye and winter wheat are more cold tolerant than barley, oats, or annual ryegrass, and can be grown in most areas of the state. Barley, oats, and annual ryegrass tend to perform better in the southern part of the state. Seeded in fall, these crops provide excellent fall and spring grazing. Small grains are usually planted in pure stands. When planted for forage production, they are seeded at 1–2 times the usual rate for a grain crop.

RECOMMENDED PASTURES AND SEEDING RATES

Many possible combinations of pasture species could be used in New Mexico. A mixture that is excellent for one particular climate, soil type, management system, and kind of livestock may not be good in other situations. The pasture compositions suggested earlier should be altered to fit the needs of each situation. Seeding rates are expressed as pounds of seed per acre.

High Altitudes and Cooler Regions
(6,000 to 8,000 feet)

Limited water supply (late winter and early spring)

1. Mixtures
   A. Alfalfa (5-8 lb) and smooth bromegrass (10-12 lb)

B. Sainfoin (10-20 lb) and smooth bromegrass (10-12 lb)

2. Pure stands
   A. Smooth bromegrass (15-20 lb)
   B. Sainfoin (30-40 lb)

Excellent water supply and good soils

1. Mixture
   A. Alfalfa (5-8 lb) and smooth bromegrass (10-12 lb)
   B. Alfalfa (5-8 lb) and orchardgrass (10-12 lb)
   C. Ladino clover (3-4 lb) or sainfoin (10-20 lb) could be substituted for alfalfa in the previous mixtures.
2. Pure stands
   A. Smooth bromegrass (15-20 lb)
   B. Orchardgrass (15-20 lb)
   C. Sainfoin (30-40 lb)

Poorly drained or swampy soils

1. Mixtures
   A. Birdsfoot trefoil (6-10 lb) and reed canarygrass (10-12 lb)
   B. Alsike clover (4-5 lb) and reed canarygrass (10-12 lb)
2. Pure stands
   A. Reed canarygrass (15-20 lb)
   B. Birdsfoot trefoil (15-20 lb)

Middle Altitudes and Intermediate Climates

(4,500 to 6,000 feet)

Excellent water supply and good soils

1. Mixtures
   A. Alfalfa (5-8 lb) and tall fescue (10-12 lb)
   B. Alfalfa (5-8 lb) and orchardgrass (10-12 lb)
   C. Ladino clover (3-4 lb) or sainfoin (10-12 lb) could be substituted for alfalfa in the previous mixtures.
2. Pure stands
   A. Tall fescue (15-20 lb)
   B. Orchardgrass (15-20 lb)
   C. Sainfoin (30-40 lb)

A good mixture of grass and legume.

Poorly drained or swampy soils

1. Mixtures
   A. Birdsfoot trefoil (6-10 lb) and reed canarygrass (10-12 lb)
   B. Alsike clover (4-5 lb) or strawberry clover (5-6 lb) could be substituted for birdfoot trefoil in the mixture

2. Pure stands
   A. Reed canarygrass (15-20 lb)
   B. Birdfoot trefoil (15-20 lb)

Alkaline soils

1. Mixtures
   A. Alfalfa, if it can be established, (5-8 lb) and tall wheatgrass (10-12 lb)
   B. Sainfoin, if it can established and soils are well drained (10-12 lb), and tall wheatgrass (10-20 lb)
2. Pure stands
   A. Tall wheatgrass (15-20 lb)
   B. Sainfoin, it soils are well drained (30-40 lb)
   C. Kleingrass (3/4-1 lb PLS rows, 2 lb PLS broadcast)

Lower Altitudes and Milder Climates

(Less than 4,500 feet)

Excellent water supply and good soils

1. Mixtures
   A. Alfalfa (5-8 lb) and tall fescue (10-12 lb)
   B. Ladino clover (3-4 lb) or sainfoin (10-12 lb) could be substituted for alfalfa.
2. Pure stands
   A. Tall fescue (15-20 lb)
   B. Sainfoin (30-40 lb)

Alkaline soils

1. Mixtures
   A. Alfalfa, if it can be established, (5-8 lb) and tall wheatgrass (10-12 lb)
   B. Sainfoin, if it can be established and soils are well drained, (10-20 lb) and tall wheat grass (10-12 lb)
2. Pure stands
   A. Tall wheatgrass (15-20 lb)
   B. Bermudagrass (25-35 bu sprigs per acre)
   C. Sainfoin if soils are well drained (30-40 lb)

Temporary or Annual Pastures

Temporary or annual pastures are usually planted in pure stands. They may be fall seeded or spring seeded.

Fall seeded

   A. Wheat (90-100 lb)
   B. Rye (60-100 lb)
   C. Barley (90-100 lb)
   D. Oats (60-90 lb)
   E. Annual ryegrass (15-20 lb)

Spring seeded

   A. Sudangrass (10 lb in rows, 25-30 lb broadcast)
   B. Sorghum x sudangrass (10-12 lb in rows, 30-50 lb broadcast)

LEGUME INOCULATION

Legumes live in cooperation (symbiosis) with certain nitrogen-fixing bacteria (rhizobia). These bacteria form nodules on the roots of legumes and convert atmospheric nitrogen into a form the plant can use. For this reason, little or no nitrogen fertilization is necessary for legumes. Legumes, however, must be inoculated with the proper bacteria.

Improperly inoculated legumes produce stunted, yellow plants. This is the symptom of nitrogen deficiency, and must be corrected to maintain the stand. Legumes must be inoculated if there is no native bacteria in the soil. The best method is to inoculate the seed just before planting.

The most frequently asked question is whether to inoculate. Unless the particular legume has been grown in the field before, the chances of natural inoculation are small. If there is a doubt, it is best to inoculate. The cost of inoculum is relatively low, and inoculating is insurance that the legume will be exposed to an efficient nitrogen-fixing bacteria.

Each different legume needs a specific bacteria to form nodules and fix the atmospheric nitrogen. A bacteria specific to one legume will not be effective for a different legume. Good inoculation of legumes prevents nitrogen starvation, puts less demand on the soil nitrogen, increases yields and improves forage quality.

Several things need to be done to ensure good inoculation. These include:

- Always use the specific strain for the legume to be planted.
- Make sure the inoculum is not outdated. The packing date is stamped on the container and should be checked carefully.
- Apply the inoculum evenly to the seed. Follow the instructions on the inoculum package.
- Plant immediately after inoculating to prevent drying and death of the bacteria.

- Plant in a moist soil with a desirable soil temperature for germination of the seed.
- Maintain good soil moisture after planting.
- Always inoculate when there is a question of proper and adequate bacteria in the soil.

PRODUCTION PRACTICES FOR IRRIGATED PASTURES

Certain cultural and management practices are essential for good pasture production. Proper care must be given to the preparation, establishment, and maintenance of the pasture.

Land Preparation

Proper land preparation is important for the establishment and maintenance of an irrigated pasture. The field should be prepared so it provides for the best use and uniform distribution of water.

The type of irrigation system determines how much land preparation is necessary. With sprinkler systems, the land need only be smooth enough to allow easy operation of the sprinklers and the planting and maintenance equipment.

Flood irrigation, on the other hand, requires the land be level across the flow pattern, with the proper slope for water to flow freely, yet allow sufficient time for desirable penetration. High and low spots prevent uniform water distribution, resulting in poor, uneven stands. High spots do not get enough water for good plant growth and development; low spots become flooded, and plants are killed by a lack of oxygen. When desirable plants die out, weeds begin to invade the area.

Seed and Plant Stock Selection

When establishing an irrigated pasture, use the best quality seed or planting stocks available. It improves chances of obtaining a good stand and high productivity. When possible, use certified seed stocks.

Several factors involved with seed quality directly affect the performance of any pasture species. First is the purity of the seed. Purity as to the cultivar and species could affect yield, stand loss, diseases, and insects.

Germination is important for obtaining a stand and determining the seeding rate. Germination is affected by seed damage, weathering, age, kind of seed, and the storage. Germination percentage defines how much seed is needed to obtain a good stand, and it may also influence the seedling vigor. Many times, the label that shows the germination percentage also is marked as to seedling vigor.

The kind and amount of weed seeds present may be critical to the pasture quality. Weeds are objectionable for a number of reasons, particularly because they compete for water, space, and nutrients. Weeds reduce the quality of the forage as well as forage production. A relatively weed-free field can be contaminated with weeds if seed containing weed seeds is used. It is also desirable to use treated planting seed, as protection against fungus infections.

Another factor that can cause problems in seeding rate and seed distribution is inert matter, which includes stems, chaff, dirt, and rocks. This material has no life and will not germinate, but it can plug planting equipment or restrict the seed flow in some way.

Seed damage also influences germination and seed distribution. Seeds can be cracked or broken mechanically, or they can be damaged by insects, diseases, or weathering. Seed infested with insects or infected with disease can carry these pests into the new pasture.

When selecting seed or planting stock, follow these general rules.

- Get pure seed of the type needed and be sure it is adapted to the area.
- Get seed with a high germination percentage.
- Make sure the seed is free of undesirable weeds.
- Use clean seed that is free of inert matter.
- Use undamaged seed.
- Use recently produced seed with good color.
- Use treated seed when possible.

Seedbed Preparation

Seedbed preparation strongly influences stand establishment. Important to all crops, it is more critical for pasture species. Most grass and legume seeds used for pastures are small and produce delicate seedlings. Many cannot emerge from great depths and are not satisfactorily established in cloddy seedbeds.

Provide a fine, fairly compact seedbed, free of clods and excessive vegetation. In such a seedbed, there is close contact between the seed and soil particles, and water absorption is favorable for germination. The seedbed also allows good root penetration, which favors rapid establishment. Generally, pasture establishment is more successful when seeds are planted in moist soil rather than in dry soil and irrigated. Irrigating dry-

planted seed often causes seed movement, soil erosion, and crusting. The soil should be moist enough for germination and establishment, but dry enough for planting equipment to go over the field with a minimum of compaction.

Time of Seeding

Time of seeding is determined largely by the soil temperature. Use soil temperature rather than the calendar date as a guide for planting time, particularly when seeding in the spring. Warm-season plants germinate and emerge most rapidly when the soil temperature is 55˚F or above; cool-season plants germinate and emerge when the soil temperature reaches 45˚F.

Warm-season species should be planted only in spring and up to mid-summer. This type of crop requires sufficient time to establish a good root system and top growth before freezing temperatures set in.

Normally, cool-season species can be planted either in spring or fall in New Mexico. They are usually seeded early in spring or in fall when the temperatures are beginning to be lower. Fall plantings of cool-season species are generally more advantageous for several reasons.

Fall planting gives the plants time to become fully established and ready to graze the following spring. Generally, there is less weed competition in fall than in spring. Water requirements are lower in fall because there is less evaporation and transpiration losses than in spring. Normally, there are fewer wind problems in fall and fewer disease and insect problems.

Fall planting are subject to loss to winter freezing if planting time is too near the first killing frost. Nevertheless, it is best to seed cool-season species in fall in most areas of the state.

Poor stand on a cloddy seedbed.

Planting Methods

Most pasture species are established by seeding, but certain crops, such as the improved bermudagrasses, must be established vegetatively. These are hybrids and do not produce seed, or seed that may be produced do not become the desired plants. Seeding pastures is usually much less difficult than vegetative plantings because of availability of equipment and planting material.

Pastures can be seeded by drilling or by broadcasting, depending on the available equipment and the crop to be planted. A drill provides more uniform seed distribution and good seed coverage. In fact, care must be taken to avoid planting the seed too deep. If there is a fertilizer attachment on the drill planter, fertilizer can be applied at planting, which saves an extra operation.

Seed is often broadcast with a cyclone seeder, then covered. Fertilizer can also be applied as seed is broadcast. Seed can be covered with a harrow or with a roller, but neither provides thorough covering. Seed left on the surface can be displaced by wind and water, or removed by birds or rodents. The main advantage to broadcasting is that it is easier and takes less time than drilling. This advantage may be more than offset by uneven seed distribution, loss of seed by displacement, and the necessity of secondary operations.

Vegetative planting requires special operations and equipment. The sprigs must be vigorous and healthy. They may be scattered and lightly disced or rototilled, or they can be planted with a sprigging machine. The sprigging machine provides surer sprig distribution and covering. Sprigging machines, however, may not be always readily available. Good stand establishment by sprigging depends on proper distribution and coverage of the sprigs.

A common practice is to seed or sprig in dry soil, then irrigate. There are some advantages to this method, but there are also disadvantages. Among the advantages are: it is generally easier to use the equipment; there is no problem with the right soil moisture; and you do not have to wait for the soil to dry enough for the equipment to get over the field. Some of the disadvantages are: it is easy to plant too deep; seed may be displaced by the irrigation water; the soil may crust; and germination and establishment are generally delayed.

Pre-irrigation and planting in moist soil generally takes care of those hazards, but this method also has disadvantages. Planting must be done before the soil has

dried too much for satisfactory germination. If the soil is too wet, there can be excessive soil compaction and crusting. Knowing when the soil is moist enough to plant, and yet dry enough for equipment to go over the field, is largely a matter of experience.

Sometimes an annual crop, called a nurse crop, is planted with a perennial pasture species, to protect it until it becomes established. Use of nurse crops is discouraged except under special circumstances. Where wind is a problem, spring seedings often include a small grain such as wheat, oats, or barley as a nurse crop. It may protect the pasture species from the wind and provide an early hay or grain crop, but the nurse crop competes directly with the pasture species for water, nutrients, light and space. This competition delays stand establishment drastically. A nurse crop should rarely be used with fall seeding, and at the producer's discretion with spring seeding.

Planting Depth

Most pasture species are small seeded and will not emerge easily when planted too deep. Depth of planting is determined by the seed size, the soil type, soil moisture and soil temperature. Generally, the smaller the seed, the shallower the planting depth. Seed can be planted deeper in sandy soils than in heavy soils. Colder soils usually require shallower planting. For most pasture species, the planting depth is between $^1/_4$ and $^3/_4$ inch.

For emergence of a good stand, the seed must be planted at the correct depth, soil must be moist, and it must not be crusted. If crusting occurs, it may be necessary to apply more water or physically break the crust.

Establishment

Once seedlings have emerged from the soil, they need special care to become established. Many stands are lost or depleted from poor care. Management during the first growing season determines the quality and longevity of the perennial pasture.

Adequate nutrients are essential. A good starting point for a sound fertilizer program is a soil test because it shows the existing fertility of the field. Nutrient requirements vary with species, so fertilizer applications should be based on soil test results and the requirements of the species.

Most pasture crops need abundant water. During establishment, there should be a constant moisture supply to allow rapid vegetative growth and good root development. Whenever possible, the soil moisture should remain at about 50% of the field capacity. When the soil moisture gets much below this, the plants experience a certain amount of stress. Over-irrigation can also be detrimental. It leaches nutrients and can saturate the soil. Water standing too long in the field may also encourage diseases to become established.

Weeds should be controlled because they compete for nutrients, water, light, and space. The best weed control is a good thick stand of the pasture plants. It may be necessary, however, to mow weeds or control them with a herbicide in some cases.

When possible, use plant varieties that are tolerant to the common diseases and insects of that area. If such varieties are not available, pesticides can help control disease and insect pests.

Winterkill can be a problem with new pastures. If the pasture is seeded too late for the plants to develop food reserves in the roots, they may not withstand the cold. Grazing pastures too soon can prevent good establishment and subject the plants to winterkill. Use of adapted varieties should also help prevent winterkill.

FERTILIZATION

One key to good pasture productivity is adequate fertility. Proper fertilization of a good stand of perennial pasture improves the yield, palatability, and nutritive value of the forage. In addition, proper fertilization can enhance length of stand life, weed control, disease tolerance and water-use efficiency.

Pastures, like all other crops, require relatively large amounts of the three major nutrients nitrogen, phosphorus, and potassium. New Mexico soils normally have adequate supplies of potassium, and rarely are additions beneficial. The other two nutrients are usually quite low in most soils in the state. Occasionally iron and zinc deficiencies occur. It is impossible to provide a blanket fertilizer recommendation because of the variability in pasture composition, soils, climate, and water. The kind and amount of fertilizer required are influenced by the kind of plants in the pasture, the soil fertility, the soil type, the climate of the area, and the available water supply.

Nitrogen is the nutrient most often deficient in the soil and essential for vegetative growth. Deficiency symptoms include poor growth and yellowing (chlorosis) of the leaves. Nitrogen is a mobile nutrient and can be leached out of the root zone. It is best to apply nitrogen in split applications rather than a single application. Split applications of nitrogen not only reduces the chance of injury to the plants from fertilizer (salt) burn, it also allows more efficient use of the nutrient. An added benefit is the reduction of leaching which may result in reducing the potential nitrate contamination of the ground water. Phosphorus is commonly deficient in New Mexico soils. It is rapidly tied up in calcareous soils becoming unavailable to plants. Unlike nitrogen, phosphorus is not readily lost from the soil, and a single

spring application is generally sufficient. Phosphorus is essential for both legumes and grasses. Legumes are more sensitive to phosphorus deficiency because they require more phosphorus than grasses. Deficiency symptoms include stunted growth and purpling of the leaves.

Legumes are also more sensitive to potassium deficiencies than grasses. New Mexico soils are generally high in potassium, and its application to crops has not been beneficial in the past. When deficiencies occur, the symptoms are excessive wilting and top or marginal burn of the older leaves.

The botanical composition of grass-legume pastures can be altered by fertilization. When nitrogen is reduced and phosphorus is increased, the legume tends to become the dominant species. The composition tends to remain stable in a cool-season grass and legume mixture when 150 to 200 pounds of nitrogen along with 90 to 100 pounds of phosphate (P_2O_5) are used.

Grasses in a pure stand require large amounts of nitrogen. Bermudagrass responds favorably with 300 to 400 pounds of nitrogen and 60 to 80 pounds of P_2O_5. Tall fescue and other cool-season grasses normally require 200 to 250 pounds of nitrogen and 60 to 80 pounds of P_2O_5. Legumes generally do not require nitrogen, but they need 90 to 100 pounds of P_2O_5 per acre annually. Sainfoin does not fix nitrogen effectively and may suffer a mid-season slump if not fertilized with nitrogen. In tests in both Montana and New Mexico, sainfoin has not responded to phosphorus fertilization.

IRRIGATION

Water Requirements

Water requirements are generally higher for a productive irrigated pasture than for most other crops. A good productive pasture requires 40 to 60 acre-inches of water annually. The amount and application frequency

This pasture is flood irrigated between borders.

A pivot sprinkler waters the back section of this wheat pasture while cattle graze the front section.

vary with temperature, humidity, wind velocity, soil type, and the species grown.

High temperatures and high winds increase the water requirement. Sandy soils have less water-holding capacity than heavier soils, and require lighter but more frequent applications.

One measurement of water requirement is the consumptive use. Depending on the soil and the climate, the consumptive use of most plants range from 0.1 to 0.4 inch per day. Poor management of surface irrigation can lose one-third or more of the applied water to run off and percolation below the root zone.

Irrigation Systems

The two major types of irrigation systems are flood and sprinkler. Flood irrigation is most commonly used in river valleys and on land that has already been leveled for other crops. The common method of flood irrigating pastures is with borders. The size, length, and width of a border depend upon soil type, size of the available water head, amount of cover, and slope. A border should be no longer than will insure uniform water distribution and penetration over the entire border. Normally, lengths range from 400 to 1,000 feet and widths range from 30 to 90 feet.

Sprinklers are most commonly used on new land, sandy soils, land too rough or too steep for leveling, and when water is scarce or expensive. Many types of sprinkler systems are available, ranging from perforated pipe to the overhead circle or center pivot. The type that is used depends upon the producer and the amount of money there is to invest in the system.

Frequency and Amount

Depending on the temperature, soil, and species, the irrigation intervals can range from 7 days to 21 days. Usually pastures are irrigated once a month during winter.

In general, sandy soils need irrigating every 7 to 10 days, with 1 to 3 acre-inches each time. Medium-textured soils normally need 2 to 4 inches applied every 10 to 15 days. Heavy soils should be irrigated with 3 to 5 inches every 14 to 21 days.

Some rules for irrigating a pasture are:

- Do not allow soil moisture to drop below 50% of field capacity.
- Apply enough water to wet the soil through the root zone, but do not over-irrigate.
- Do not stress plants to the extent of wilting.
- Irrigate immediately after a grazing period, but never allow livestock on a pasture while it is being irrigated.

Weed Control

The best, safest, and most economical means of weed control in pastures is good management. A pasture that is properly fertilized, watered, and grazed produces a dense, vigorous stand of plants. Such a stand competes favorably with and effectively controls weeds.

It may be necessary to use chemicals to control weed infestations, particularly troublesome perennial weeds. Many herbicides are selective, so the weeds to be killed must be properly identified. The chemical must be applied at the proper rate and time to be effective. Anyone who uses pesticides must read the label carefully and follow the instructions on the label. Observe all restrictions and precautions printed on the label.

GRAZING MANAGEMENT

The forage yield of an irrigated pasture largely depends on the grazing system and the management. Management goals are to utilize the most forage possible, hold waste to a minimum, maintain the forage in the most nutritious and palatable condition, and keep the plants healthy and vigorous. These goals require strict management.

When To Start Grazing

Pastures should not be grazed when they first begin to grow. Most grasses and legumes should be 6 to 12 inches tall when the animals are turned into the pasture. Most legumes should be grazed at or near the early flowering stage. Species such as tall fescue, tall wheatgrass, and bermudagrass lose palatability rapidly and should be grazed when fairly young. Bunch-type or upright plants should be allowed to grow taller than the creeping plants.

Grazing Systems

The two grazing systems used most frequently are continuous and rotational. Under continuous grazing, livestock are allowed to graze an area continuously, without the plants having a rest or recovery period. With rotational grazing, a pasture is divided into several sections or lots, and the livestock are rotated from one section to another. Advantages and disadvantages are associated with both systems.

Continuous grazing requires less fencing and less handling and moving of the livestock. The system however, leads to overgrazing or selective grazing. Without a rest or recovery period, pasture plants normally do not have time to build up food reserves, so the stand is reduced. This usually leads to weed problems. Yield and quality of the forage are reduced. With continuous grazing, it is often difficult to apply water and fertilizer at the proper time.

Rotational grazing requires additional fencing and increased handling and moving of the livestock. With rotational grazing, however, the forage yield is increased and forage use is more complete. There is less selective grazing, and overgrazing can be prevented. This system provides a rest or recovery period for the plants to build up their food reserves. Stand loss is reduced, and weeds are less of a problem. Losses from trampling are reduced, which enhances stand life. Pastures need water and fertilizer after the forage has been grazed, and both are much easier to apply when animals are not present.

Rotational grazing is essential if irrigated pastures are to remain productive for several years. Pastures should be divided into enough sections for the livestock to graze the forage down in a relatively short time and then be moved, to allow adequate regrowth before the next grazing period.

Mowing

Mowing removes older, less palatable plants to make room for new, succulent growth that will be readily consumed by the livestock. With mowing, regrowth is more uniform. Mowing also helps control weeds.

Scattering the Droppings

Animal droppings should be scattered evenly over the pasture after each grazing period and before irrigation. Animals tend to avoid areas where droppings are concentrated, and failure to spread them can result in unused forage in that area. Concentrated droppings may also interfere with the water distribution pattern.

Fencing

Proper irrigated pasture management requires considerable fencing. To have the pasture divided and allow livestock access to water, supplemental feed, and shade may require different arrangements. Generally electric fencing is employed, especially for all interior fences and lanes. This is more economical and allows for easier movement of fences to accommodate necessary farming operations.

Cattle on this grass pasture are confined with a permanent outside fence (left) and an electric seasonal fence (right).

In addition to division fences, it is recommended that travel lanes are provided to allow the cattle to drink or loaf in an area separate from the grazing area. Shade should be provided in the area if possible. With separate loafing areas, cattle will not damage as much pasture by laying on it.

LIVESTOCK MANAGEMENT

Determining Livestock Numbers

Livestock numbers are determined by estimating how much dry matter they consume or waste in a 1 month period. One animal unit month (AUM) is considered to be about 1000 pounds of air-dry forage. This is allowing about 25% waste due to trampling, etc. Animal units may be made up of different ages and classes as shown in the following chart:

Animal Unit Equivalents

Mature cow and calf	1.00AU
Bull	1.25AU
Yearling cattle	.60AU
Horse	1.25AU
Sheep	.20AU

Example

A 100–acre field will produce 6000 pounds (3 T/Ac) in a 6 month growing season.

100 x 6000 = 600,000 lb

600,000 ÷ 1000 lb/AUM = 600 AUM

600 AUM's ÷ 6 months = 100 AU

Because forage is not produced uniformly during the season, either the type of forage must be varied, or the cattle numbers must be adjusted to accommodate these differences.

Selecting the Livestock

The kind and class of livestock you intend to run on a pasture will have an influence on several other management decisions. For example, if you intend to run horses, then you can not plant sorghum pasture. Or, if you intend to plant alfalfa and graze it with cattle, then you must be prepared to prevent bloat in the cattle. Yearling steers may be purchased in the spring, grazed through the summer and sold in late fall without having to feed the animals through the winter. Whereas, a breeding herd of cows and calves will require keeping them through the winter, thus winter pasture or winter feed such as hay must be provided for the livestock.

Genetic differences must be recognized in livestock. Just as in people, some individuals grow faster than others. This potential for fast growth is inherited from both parents, which means a calf sired by a superior bull but from an "inferior" dam will not perform as well as the father, but better than the mother. Also of genetic importance, is whether the calf is cross-bred or straight bred. Crossbred meaning having parents of different breeds have "hybrid-vigor" which makes them grow faster than straight-bred calves (about 5%).

Previous management of livestock can effect the rate which they grow on irrigated pasture. The rate of gain from irrigated pastures can be expected to be from .75 to 2.0 pounds per day for growing steers. Steers which have grown fast and are fat are not expected to gain as well as thin steers that are put on pasture.

Animal health must be considered as part of the overall livestock program. Cattle, particularly raised or purchased calves must be vaccinated against certain diseases such as blackleg, malignant edema, and often several other diseases. Check with your local Veterinarian for the diseases that must be vaccinated for in your area. Concentrating livestock on pastures often compounds the disease problems requiring diligent observation and care of all livestock.

Internal parasites must also be controlled on irrigated pastures. Internal parasites have largely been ignored in most of New Mexico because of the dry climate. There is a low incidence of worms in cattle on native ranges. Irrigated pastures have livestock much more concentrated and moisture conditions due to irrigation are conducive for propagation of internal parasites. Livestock need to be treated for internal parasites in the spring before going on irrigated pastures, at least once more during the summer and possibly again in the fall. The fall treatment could be combined with lice treatment.

Water should be checked daily while livestock are on pastures. Adequate quantities of fresh, clean water should be available at all times. Even though the forage contain considerable amounts of moisture, livestock still need water. In the heat of New Mexico's summers, livestock can dehydrate and die within two or three days without water. Water is equally as important in the winter, although death is not quite as sudden. Limited water in winter is considered a significant contributor to water belly or urinary calculi in steers.

Shade although not mandatory, certainly helps livestock withstand the hot days of summer and will help them perform better. If trees are not present, a simple shade can be erected in the loafing area made of snow fence.

Salt should be available at all times. Since phosphorus is usually marginal, it is suggested that a salt-mineral mix be provided which contains salt, trace minerals and phosphorus. The phosphorus level should be 6% minimum in a free choice mineral.

Flies should be controlled throughout spring and summer. There are several methods to control flies, such as fly control ear tags, dust bags, back rubbers, and spraying. It is suggested that at least two different methods be employed to prevent a buildup of immunity to one method.

Bloat

Given the right conditions, there is always a chance of bloat in ruminant animals. The more legumes a pasture contains, the greater the chance for bloat. Alfalfa, white clover, sweetclover, and related legumes cause severe bloat problems: other species cause little or no bloat. Sainfoin, birdsfoot trefoil, and the grasses are considered non-bloating, although, they may occasionally produce some bloat.

Bloat results from a foam that forms in the rumen, and prevents the animal from expelling gas by belching. Gas pressure continues to build up, and unless it is relieved, it can kill the animal by suffocation. The exact cause of bloat is not well understood, but certain proteins are believed to cause the development of the stable foam.

The conditions of the animal and the microbiology of the rumen affect bloating. Some animals are more susceptible to bloat than others. Bloat seems more prevalent in the colder part of the year, when legumes are younger and succulent or when legume growth is rapid.

Grazing pure stands of legumes such as alfalfa is not recommended unless cattle are fed some sort of bloat preventative. Compounds such a poloxalene can prevent bloat in cattle only if they receive the required amount of the drug every day. Feed blocks, and other supplements will not prevent bloat totally because individual animals may not eat enough feed to get the required amount of the compound to prevent bloat. Adding a bloat preventative to the water does seem to give almost complete control provided the water has the proper amount of the bloat preventative and no other water is available to the animals. If rain water, tail water, irrigation water etc. is available, cattle must be removed from the pasture until the untreated water

Legume pasture provides plentiful forage but there is danger that grazing ruminants may develop bloat.

source is removed. The effect from bloat preventatives only lasts about 12 hours or so, thus a self fed supplement or water treatment is necessary.

A mixed pasture containing 60 percent grass and 40 percent legumes will allow many of the advantages of a legume pasture without the danger of bloat. Bloat is still possible in these pastures, but with proper management the incidence should be low. Any pasture with legumes poses a threat of bloat and care should be taken when turning animals into a fresh pasture. Animals should be fed dry roughage before they are turned into the pasture. Never turn hungry animals into pasture containing legumes without feeding them first. Dry roughage made available at all times will also help hold down the incidence of bloat.

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