

Annual Forage Species for Irrigated Pastures and Hay in New Mexico

Mark Marsalis and Leonard Lauriault¹

aces.nmsu.edu/pubs • Cooperative Extension Service • Circular 697

The College of
Agricultural,
Consumer and
Environmental
Sciences is an
engine for economic
and community
development in New
Mexico, improving
the lives of New
Mexicans through
academic, research,
and Extension
programs.

INTRODUCTION

Selection criteria and establishment methods for forage crops are described in NMSU Extension Circular 695, *Forage Selection and Establishment for Irrigated Pastures and Hay in New Mexico* (https://aces.nmsu.edu/pubs/_circulars/CR695.pdf). Most of the annual forage crop species listed in this publication have demonstrated adaptation and are prominently used in irrigated pastures and hay fields in New Mexico. A few are included that have not yet been widely used but show promise. Other species might be well adapted, but are not included because of low productivity or insurmountable antiquity factors, or they simply might not be as well adapted as the species listed in this publication. For most species described here, specific varieties are not listed because of differences in seed availability and local adaptation. This publication describes **annual** forage species options. For more information on **perennial** forage options, see Circular 696, *Perennial Forage Species for Irrigated Pastures and Hay in New Mexico* (https://aces.nmsu.edu/pubs/_circulars/CR696.pdf).



COOL-SEASON ANNUAL LEGUMES

Berseem clover

Berseem clover (*Trifolium alexandrinum*) is a winter annual that resembles alfalfa in appearance. Flowers resemble those of white clover. Cold tolerance is questionable with this species, and it often winterkills in other states at latitudes comparable to north-central New Mexico. It has been grown at



New Mexico State University
aces.nmsu.edu

¹Respectively, Extension Forage Specialist, Department of Extension Plant Sciences/Agricultural Science Center at Los Lunas; and Forage Crop Management Scientist, Department of Plant and Environmental Sciences/Agricultural Science Center at Tucumcari, New Mexico State University.

Tucumcari, even though it was originally not known to be a winter-hardy species and had not been previously used in New Mexico. Newer varieties have been bred for more cold tolerance. It has an erect growth habit, making it suitable for hay production. It is very tolerant of alkalinity, salinity, and poor drainage, but it also grows fine in well-drained soils.

Berseem clover produces high-quality forage that is non-bloating. It can be grazed when it reaches 10 inches and will continue producing new growth if a 3- to 4-inch stubble is maintained. Although berseem clover is known as a poor reseeder and it did not produce viable seed in the planting at Tucumcari, newer varieties have been managed for natural reseeding in other areas by removing animals during the bud stage. Once seed is produced, grazing can resume to remove standing residue and to trample seed to obtain good seed-to-soil contact for late-summer germination. Berseem clover can be used to temporarily complement or thicken up weakening stands of alfalfa since its appearance and hay management are similar. Alfalfa allelopathy is not an issue with this clover. The seeding rate for berseem clover is 10–20 lb/acre.

Hairy vetch

Hairy vetch (*Vicia villosa*) is a winter-hardy annual legume that is widely adapted to New Mexico's climate. It has a vine-like growth habit and can be grown as a monoculture or overseeded into dormant, perennial warm-season grasses. Hairy vetch does not yield well in the fall, but it can provide four to six weeks of grazing in the early spring before warm-season grasses break dormancy. This crop also does well when grown in mixtures with cool-season annuals, such as small grains, or as a green manure or smother crop prior to a summer crop. Hairy vetch has a large seed and will reseed naturally if cattle are removed prior to the bud stage or if hay cutting is terminated early enough to allow plants to mature. As with berseem clover, once the seed is produced, grazing can begin on new growth of the warm-season companion grass or residue from the hairy vetch. Hairy vetch should be cut in the early bloom stage if grown for hay.

While hairy vetch has lower bloat potential than other legumes, it has been linked to a toxicosis or poisoning condition in cattle and horses that can result in dermatitis (due to hypersensitivity to sunlight), hair matting, diarrhea, coughing, kidney failure, body wasting, and even death. This condition is not well understood, and it appears to affect certain dark-skinned breeds (e.g., Angus and Holstein cattle) more than others, is more common in older animals, and may be worse in some years than in others. The greater the proportion of vetch in the diet, the longer the exposure, and the more mature the plants are (seed forming) when consumed will also increase the potential toxicity. Growing vetch mixed

with a grass will reduce risk. However, poisoning is not reported as a consistent problem, and vetch has been used successfully as a forage for many years. Animals grazing hairy vetch pastures should be monitored closely throughout the grazing period and removed at the earliest sign of symptoms.

Thick stands of hairy vetch may be difficult for some hay mowing equipment due to the viney nature of the plant, but disc mowers tend to work fine. Heavy windrows of vetch can be hard to dry quickly for baling. Seeding rates for hairy vetch range from 15–30 lb/acre, with the higher rates used for broadcast seeding.

Austrian winter pea

Austrian winter pea (*Pisum sativum*) is another viney winter annual occasionally utilized as forage in New Mexico. It tends to do best when mixed with grasses, such as wheat, triticale, or oats. In pure stands, Austrian winter pea can be damaged by hoof traffic and close grazing. Quality of winter pea is very good (high crude protein, low fiber), and it complements lower-quality grasses well. Hay of Austrian winter pea can be difficult to dry properly due to its succulent nature. Regrowth is generally considered poor. It is often a preferred species that is common in wildlife and cover crop blends, and it makes a good green manure crop. While it is relatively cold-tolerant, extreme cold and/or large temperature swings can kill Austrian winter pea. A certain percentage of the seed may be "hard seed" and germination can be delayed, presenting a problem in subsequent years. Seeding rates are 30–40 lb/acre in monoculture, or 20–30 lb/acre if seeded in a mixture with a small grain. The large seed size lends itself to deeper seeding (1–1.5 inches).

COOL-SEASON ANNUAL GRASSES

Annual (Italian) ryegrass

Annual ryegrass (*Lolium multiflorum*) is a cool-season annual bunchgrass that has excellent palatability and forage quality. It is similar to perennial ryegrass, except it completes its life cycle in one season. Annual ryegrass has been used successfully for winter annual pasture in southern New Mexico. This species performs well in the southern U.S. when sown into dormant, warm-season grass pastures (e.g., bermudagrass). It is adapted to a wide range of soil types and is tolerant of low fertility and poor drainage. It does not perform well in hot and droughty conditions.

Annual ryegrass has been shown to yield over 4 tons/acre of hay (from three spring/early summer cuts) under well-irrigated and high-fertility conditions at the NMSU Agricultural Science Center at Los Lunas. When seeded in the fall, it provided much earlier establishment and subsequent spring growth

than either tall fescue or orchardgrass. However, yield decreased and the stand declined as the summer progressed, and plants were dead by the end of the growing season. Annual ryegrass responds very well to nitrogen fertilizer, and growth can be quite prolific in spring if adequately irrigated. If plants are allowed to mature, annual ryegrass will reseed naturally.

It is relatively easy to establish by drilling or broadcast- ing into prepared seedbeds. Use a no-till drill when over- seeding dormant, warm-season grass pastures to achieve good seed-to-soil contact, which promotes germination and establishment. If seeded into warm-season pasture or hay fields, ryegrass growth should be terminated by heavy grazing or cutting prior to greenup of the warm-season species. Seeding rates of 20–30 lb/acre should be used for monocultures or overseeding situations.

Small grains

Small grains are the predominant winter annual grasses grown throughout New Mexico. They include barley (*Hordeum vulgare*), oats (*Avena sativa*), rye (*Secale cereale*; different from annual or perennial ryegrass), wheat (*Triticum aestivum*), and triticale (\times *Triticose- cale*). The small grains are broadly adapted to a wide range of climatic and soil conditions. Barley and oats are somewhat more susceptible to cold temperatures and have been recommended historically only for the southern two-thirds of New Mexico. However, newer varieties of both have been grown successfully for pasture and hay in recent years at more northern loca- tions in the state. Rye, wheat, and triticale are more cold-tolerant and have consistently been used more in the cooler regions. Barley and rye generally produce more forage than wheat, triticale, or oats in the fall, but less in the spring. Barley is the most salt-tolerant of these crops, while rye generally performs better than the others on sandy or poor soils. Mixtures of small- grained species are not desirable because selective or spot grazing is likely to occur and maturity differences complicate hay and silage harvesting. In grazing prefer- ence trials at Tucumcari, oats were selected over other small-grained species (barley, rye, triticale, and wheat). Performance by animals grazing monocultures will likely be similar across small-grained species, although barley is well-known for its higher quality over the other small grains.

Spring-planted (or late winter) oats are commonly used in much of New Mexico and can make excellent pasture, hay, or silage. Some newer varieties of spring oats have also survived winters at Tucumcari and are very productive in the fall. Fall-planted wheat and triti- cale are also quite common and can be utilized for some early grazing in the fall; however, the bulk of forage pro- duction will occur in the spring. Triticale matures later than wheat and yields are typically higher. Barley is the

lowest yielding of all the small grains, but is the crop of choice for highly saline soil and water sites.

Small grains should not be grazed until they are at least 5–6 inches tall, allowing the plants to establish a good root system. Grazing too soon or too close to the ground slows root development and decreases the plant's ability to survive the winter and be produc- tive in the spring. Animals should be removed when the forage has been grazed to a height of 2–3 inches. Small grains can provide grazing in both the fall and the spring and still produce a hay, silage, or grain crop if grazing is halted in mid-March or at the first sign of reproductive growth (i.e., jointing/stem elongation). If the crop will not be harvested for these dual purposes, grazing can continue until forage becomes limiting, which can be well into May (graze out situation). Beardless (i.e., awnless or short-awned) varieties are available for both wheat and triticale.

Seeding rates for small-grained species in irrigated pastures should be 75–120 lb/acre. Typical planting depth is 1–1.5 inches. Nitrate toxicity, which will be discussed in more detail later, can be a problem when using small-grain pastures. Bloat is another concern, especially after a freeze or during rapid growth in the spring. Grass tetany can also be a problem during rapid spring growth (see Circular 586, *Irrigated Pasture Management in New Mexico* [https://aces.nmsu.edu/pubs/_circulars/CR586.pdf]). For more information on small grain forages, including species selection and management in New Mexico, see Circular 630, *Small Grain Forages for New Mexico* (https://aces.nmsu.edu/pubs/_circulars/CR630.pdf).

COOL-SEASON ANNUAL FORBS

Brassicas

Brassica species occasionally used for forage purposes include kale, rape (canola), swede, and turnip. Rad- ish (*Raphanus* spp.) is another multi-purpose winter annual within the Brassicaceae family. Swede has not been evaluated in New Mexico; however, all of these cool-season crops have the potential to make excellent late-season pastures by extending grazing late into the year when warm- and cool-season perennial pastures are declining in productivity. When planted in late summer, they are more productive than cool-season annual grasses leading into winter, with rape having the greatest yield, but turnip having the greatest nutri- tive value and regrowth potential.

In general, they are characterized by low fiber and high protein (>18%) and digestibility (70% or more), and animal performance is potentially very good. Bras- sicas produce leafy tops and some produce large tap- roots (turnip, swede, and radish), both of which can

be utilized by livestock. Much variation exists among the species with regard to forage yield, leaf-root proportions, length of grazing season, establishment, and adaptation. In general, these crops are planted in late summer or early fall. Forage-type brassicas can usually be grazed 60–90 days (species-dependent) after planting until freezing temperatures kill the plants. In some areas of New Mexico, these crops can survive winter and produce into the spring. In general, turnip and radish have the fastest growth, followed by swede, rape, and finally kale. Turnips have shown to be one of the higher-yielding brassicas, and may produce as much as 3–4 tons of dry matter per acre. While nutritive value is high, plant dry matter content is low (15% or less) and rate of passage is high. As such, it is recommended that brassicas do not constitute more than 60–75% of the diet and that animals have access to hay or another roughage source while on these pastures. Livestock will often dig out the plants or pull them out by their stems to get to the starchy roots late in the season. The large, deep-rooted species (e.g., tillage radish) have also been used to help break up hardpans in soils.

Several disorders have been associated with forage brassicas, including atypical pneumonia, hemolytic anemia, hypothyroidism, and polioencephalomalacia. In addition, bloat and high nitrates can be an issue. These problems can be largely avoided by limiting the amount of brassicas consumed, diluting the diet with other forages, and slowly introducing animals to pasture. While there are many varieties of each of the species, few have been extensively tested in New Mexico. Seeding rates range from 2–5 lb/acre for turnip and swede, 3–4 lb/acre for kale and rape, and 5–10 lb/acre for tillage radish.

WARM-SEASON ANNUAL LEGUMES

Warm-season annual legumes have not been utilized broadly in New Mexico in irrigated pastures or other forage systems. However a few, such as cowpea (*Vigna unguiculata*), lablab (*Lablab purpureus*), and tepary bean (*Phaseolus acutifolius*), have high heat and drought tolerance, and have been shown at Clovis and Tucumcari to improve forage nutritive value (crude protein) when mixed with a warm-season annual grass, such as forage sorghum. This complementary mixture (with sorghum or millet) is common in other parts of the country for hay or silage. Lablab is particularly suited for this due to its viney, climbing nature and higher yield potential.

Nutritive value is high, with these legumes being characterized by high protein and digestible dry matter. Hay quality can be excellent. These legumes can also be utilized in intensively, rotationally stocked pastures, which is necessary to maximize productivity and allow for adequate regrowth. Lablab exhibits greater palatability and regrowth potential, and tolerates trampling better

than cowpea. Of these species, cowpea seed is the most readily available in the region. Seeding rates for warm-season annual legumes range from 20–50 lb/acre for lablab to 50–90 lb/acre for cowpea, using the lower rates when drilling in rows and the higher rates for broadcast plantings. Seeding rates should be reduced in mixtures with warm-season grasses. Planting depth is 1–2 inches. Additional annual warm-season legumes continue to be evaluated for their potential in New Mexico.

WARM-SEASON ANNUAL GRASSES

Sorghums

Sorghums (*Sorghum bicolor*) include forage sorghum, grain sorghum, Johnsongrass, Sudangrass, and sorghum × Sudangrass hybrids. All of these sorghum types can provide valuable summer pasture, hay, and silage at lower elevations throughout New Mexico (below 6,500 feet). They are not tolerant of cool climates and will winterkill at first frost regardless of location. They are the most extensively grown warm-season annuals in the state because they are easy to establish, are very drought-tolerant, and lend themselves to multiple harvest options. In areas of year-round livestock grazing, sorghums can provide nutritious forage during hot, dry summer months when cool-season perennial grasses have gone dormant and warm-season perennial pastures are lacking nutrition. In addition, they make excellent hay and silage for supplemental feeding during times of inadequate forage production. Another advantage of sorghums is that they can be used as an emergency, late-planted crop to replace a primary crop that has been damaged by wind, hail, or drought early in the growing season. The ability of some varieties to tiller and regrow after cutting or defoliation makes them ideal for multiple cut or grazing situations. These forages respond well to nitrogen fertilization and irrigation, producing high yields of nutritious forage. Sorghum forage quality has been improved by the inclusion of the brown midrib (BMR) trait, and harvest flexibility has been improved by the photoperiod sensitivity trait. BMR varieties have a lower lignin concentration that increases available energy and digestibility. Heading in photoperiod sensitive varieties is not initiated until approximately mid-September when day length decreases. This broadens the harvest window, allowing for higher yields of high-quality vegetative forage.

Seeding rate can also affect quality. Plants seeded at higher rates have finer stems than those seeded at lower rates, which can speed drying time of hay. Due to the typically large stems, hay will need to be conditioned during mowing for proper curing. Lower seeding rates are recommended for BMR varieties because their finer stems, coupled with lower lignin concentrations, in-

crease the likelihood of lodging (falling over). Sorghums should not be sown until the soil temperature reaches 60°F, which normally occurs by mid-May in most of New Mexico. Sorghums can tiller freely, and will fill in gaps within the stand. Recommended seeding rates for irrigated, drilled pasture and hay are 20–40 lb/acre. Rates for forage sorghums planted in wider rows for silage are lower and range from 5–10 lb/acre.

Antiquity factors associated with sorghums

While sorghums have many benefits and make excellent-quality forage, there are a few toxicity concerns producers should be aware of. The two main toxicities associated with sorghum are nitrate and prussic acid (cyanogenic glycoside) poisoning in ruminants. Additionally, sorghums can cause a cystitis-ataxia (urinary incontinence and staggering) syndrome in horses.

Nitrates and prussic acid levels increase with environmental and management stresses, such as cool weather, frost, drought, cloudy days, high nitrogen fertility, and herbicide or other injury. Prussic acid is only of concern when grazing or feeding fresh, green forage, but nitrate poisoning can occur with both pasture and when feeding hay. However, because nitrates accumulate in the lower stem, if grazing animals are not forced to consume those, the likelihood of poisoning is greatly reduced. Suspect forage should be tested, and if toxic levels are found, animals should be removed from pasture. Toxic hay should be diluted with low-nitrate hay and/or a concentrated energy supplement, such as grain, should be fed. Initial grazing should be avoided until plants reach 24–30 inches of growth, and regrowth grazing deferred until plants reach 18 inches. While toxicities in ruminants can be avoided with careful management, sorghums are not recommended for horse pasture or hay.

New Mexico State University has more information on nitrate toxicity in Guide B-807, *Nitrate Poisoning of Livestock* (https://aces.nmsu.edu/pubs/_b/B807.pdf), and on prussic acid in Guide B-808, *Prussic Acid and Livestock Poisoning* (https://aces.nmsu.edu/pubs/_b/B808.pdf). For more general information on sorghum forage management and its use in New Mexico, including more detailed information on toxicities, see Guide A-332, *Sorghum Forage Production in New Mexico* (https://aces.nmsu.edu/pubs/_a/A332.pdf).

Pearl millet

Pearl millet (*Pennisetum glaucum*), also known as “cattail millet,” is a warm-season annual grass similar to sorghum that exhibits rapid summer growth. It is generally more leafy and higher in quality than sorghum. It is another choice for lower elevations in New Mexico since it does not perform well in cooler environments. Pearl millet is a tall, erect grass growing from 3–8 feet

in height, and it has the ability to tiller profusely. Generally, this species will not yield as much as the forage-type sorghums, but it tolerates high pH, caliche, and sandy soils better than sorghum. Typical dry forage yields of pearl millet range from 3–6 tons/acre under irrigation. Like sorghum, it can be grazed rotationally and/or cut for hay multiple times as the season allows. Grazing should be deferred until plants reach 18–24 inches. Grazing and hay cutting height should not go below 4–6 inches to ensure adequate regrowth. Nutritive value declines quickly after heading.

Pearl millet is considered safe for horses and does not cause prussic acid poisoning. Nitrates, however, can accumulate to toxic levels in pearl millet under the same environmental conditions described above for sorghum.

All millets respond very well to nitrogen and phosphorus fertilizers. Seed size is small and must be planted shallowly at 15–25 lb/acre after soil temperatures reach 65°F. For more information on pearl millet, see Guide A-417, *Millets for Forage and Grain in New Mexico and West Texas* (https://aces.nmsu.edu/pubs/_a/A417.pdf).

Foxtail, German, or Italian millet

Foxtail millet (*Setaria italica*) is another commonly grown millet in New Mexico. Although it is best suited to the warmer growing regions, it can provide temporary summer pasture in New Mexico’s higher elevations. Foxtail millet is less productive than pearl millet, but its rapid maturity (65–70 days) allows it to be used in late-planted or emergency short-season situations. It is not very drought-tolerant due to its shallow root system, and it matures quickly in the hot summer months. Although some cool-season hay crops are superior in quality, foxtail millet makes good hay for cattle and sheep, but it has generally been displaced by sorghum-Sudangrass hybrids or pearl millet as a late-sown summer hay crop. Due to its fine stems and lower biomass, hay drying time is considerably less than pearl millet and the sorghums. However, foxtail millet will not grow much, if at all, after the first harvest. Its shallow root system makes it easy for grazing animals to uproot. As plants mature, they can accumulate setarian, a compound that acts as a diuretic in horses, causing excessive urination. This compound can lead to kidney problems and has been implicated in liver, bone, and joint damage, especially if foxtail millet is the only hay source for horses. In addition, high nitrates can be a problem with foxtail millet. Seeding rates range from 15–30 lb/acre when drilled or broadcast into a firm seedbed at 1/4–1/2 inch deep. For more information on foxtail millet, see Guide A-417.

Teff

Teff (*Eragrostis tef*) is a high-quality, fine-stemmed summer annual that has gained in popularity as a forage crop in the region. It is fast-growing and can be cut multiple times as the growing season allows. It will be killed at first frost. Teff makes excellent hay, particularly for the small-bale horse market, but can be utilized for all classes of livestock. The fine leaves and stems make it very palatable. Overall nutritive value is often likened to timothy hay. Due to its shallow root system, it is not well suited for grazing; however, it can be used for 1–2 hay cuttings early in the summer, and then grazed out later in the year prior to freezing temperatures. Teff works well in alfalfa rotations as a highly marketable hay crop in between alfalfa stands.

Yields will be lower than sorghum and pearl millet hays. Research at Los Lunas and Tucumcari indicates yields range from 3–4 tons/acre per year. Teff should be cut prior to seedhead emergence for optimal regrowth, along with a 3–4 inch stubble height. The nitrogen requirement is low for teff, with about 30–40 lb N/acre needed after establishment and each harvest to maximize production. If significant amounts of residual soil nitrogen (e.g., 100 lb N/acre or more) remain following a terminated alfalfa crop, very little, if

any, additional nitrogen will be required for one season of teff. Like most warm-season annuals, soil temperatures should be 60°F or greater at planting. Seed is exceptionally small and must be planted very shallowly, preferably 1/4 inch or less. Seeding rate is 10–15 lb/acre for coated seed. Because of the small, slow-growing seedlings, weed control is especially critical during early establishment of this crop. For more information on teff, see “Teff: Recent Observations in the Southwest” at <http://forages.nmsu.edu/resources>.



Mark Marsalis is a professor and Extension Forage Specialist in the Department of Extension Plant Sciences at New Mexico State University. He earned his M.S. at the University of Tennessee and his Ph.D. at Texas Tech University. His Extension and research interests include efficient and sustainable management of irrigated and dryland forage crops to maximize yields and profitability in limited-water situations.

Contents of publications may be freely reproduced, with an appropriate citation, for educational purposes. All other rights reserved. For permission to use publications for other purposes, contact pubs@nmsu.edu or the authors listed on the publication. New Mexico State University is an equal opportunity/affirmative action employer and educator. NMSU and the U.S. Department of Agriculture cooperating.