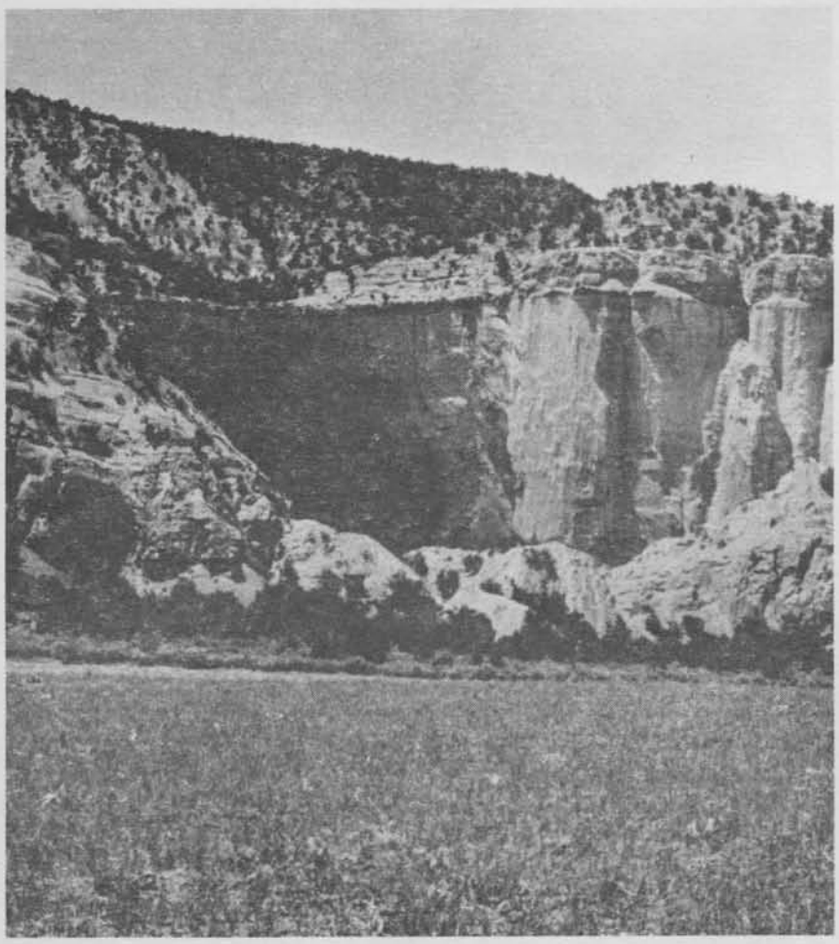
Seeding New Mexico Rangeland



Cooperative Extension Service • Circular 525
College of Agriculture and Home Economics

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Seeding New Mexico Rangeland

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Much of New Mexico's rangeland produces below its potential. Grazing management alone can improve much of this land but some rangeland will require brush control or seeding to restore its production potential. Rangeland seeding is done to change the composition of the vegetation. Reasons for seeding include achieving a higher quality forage resource to get a better seasonal balance of forage supply, to stabilize soil and improve wildlife habitat.

WHEN TO SEED

Because seeding rangeland is expensive and the risk of failure is always present, carefully consider seeding before actually deciding to do it. When the management objective is to improve range condition, evaluate the quantity and distribution of existing desirable plants. If desirable plants make up less than 10 to 15% of the vegetation, seeding may be necessary. If desirable plants are uniformly distributed and make up more than 10 to 15% of the vegetation, grazing management and brush control will improve range condition.

Other management decisions may dictate the necessity for seeding. For example, seeding usually is necessary following a brush control method, such as root plowing, which destroys the existing turf. Also, when a better seasonal balance of forage supply is desired, seeding usually is required because the species needed to extend the period of green forage are not present. These plants often are introduced species and are usually seeded in pure stands.

Seeding is usually the most effective way to establish desirable vegetation on abandoned cropland because natural revegetation processes may take 50 to 100 years on land barren from farming. On other bare areas, such as newly constructed dams and newly laid pipelines, seeding to establish a plant cover is necessary to prevent wind and water erosion.

Seeding should correspond to a high probability (60% or more) of receiving effective precipitation (0.6 to 1.0 inch during any 3-week period). As a general rule, the following dates can be used within the following resource areas (see figure 1).

Resource Area	*Warm Season Species*	*Cool Season Species*
HP1*, CP1	Apr 1 to Aug 1	Feb 15 to Aug 1
HP2,3	Jun 15 to Aug 1	Jun 15 to Aug 1
CP2,3	Jun 15 to Aug 1	May 1 to Aug 1
CP4	Jul 1 to Sep 1	Jun 15 to Sep 1
WP1*,2	Jun 1 to Aug 1	Jul 1 to Aug 15
WP3	Jun 15 to Aug 15	Jun 15 to Aug 15
RM1*,2* AN1*	Jun 1 to Aug 1	Jun 1 to Aug 1
HV1*,2*	Jul 1 to Aug 1	Jun 15 to Aug 15
AN2,3	Jul 1 to Aug 15	Jun 15 to Aug 15
SA1	Jun 15 to Aug 15	Jun 15 to Aug 15

*Dormant cool season seedings (seed will not germinate until spring) are satisfactory.

Range seeding in desert regions (SD1,2,3 and ND1) without modifying microclimatic conditions is not recommended. If seedings are undertaken, special techniques should be used to reduce soil temperatures or increase soil moisture available for seedling establishment.

WHERE TO SEED

Seed only those sites with enough potential to ensure reasonable chances of success. First, survey the area to determine if there is a mixture of range sites or if one predominates. Then decide whether the sites are suitable for seeding. If the area is a mixture of sites, put the most effort into ones with the best chance for success. Select seeding sites so the area can be incorporated into overall ranch management.

Sites with enough soil depth for adequate root development and water storage, or sites that can be modified mechanically to accomplish a greater effective soil depth, usually are suitable. Avoid

barren, rocky sites that have greater temperature extremes at the soil surface, and are more droughty than sites with some soil and litter on the surface. Low soil moisture and wide temperature extremes can kill plant seedlings.

The amount of precipitation received on an area (figure 2) cannot be controlled, so select sites that receive runoff water, which increases the amount of moisture available. However, do not disturb steep, potentially erosive areas.

WHAT TO SEED

Plants selected for seeding depend on management objectives. For example, plants that improve range condition are different from those selected to stabilize a disturbed area or to extend the grazing season. However, regardless of management objective, select only those plant species that are adapted to the soil, climate and topography of the area to be seeded. If possible, choose plants that 1) establish easily, 2) are palatable to animals that will graze the seeded area, 3) are relatively productive, 4) will withstand invasion by undesirable plants, 5) will withstand moderate grazing, 6) will prevent erosion under moderate grazing and (7) are available at a moderate price.

Native plants are best adapted to an area, so it is important to determine the original source of seeds. When available, use certified, named varieties. Seed of native species should originate from local sources, or from within 300 miles south and 200 miles east, west or north of the area to be seeded. Recommended species and varieties for the various resource areas and soil groups are shown in table 1. Consult the local Extension Service or other government agencies for information about seeding specific range sites because some species are adapted to only certain range sites within a resource area.

Mixtures of native and introduced species are usually seeded to simulate natural conditions. The mixture is helpful because all areas have variations in soil, moisture and slope. Each species in the mixture is adapted better than other species to certain site characteristics. Variation in rooting habits of species in the mixture allows for more efficient use of moisture and nutrients from the various soil depths. The seed mixture usually extends the grazing season because each species varies slightly in its periods of lush growth and dormancy. A mixture provides a varied diet that often is more desirable to animals.

A pure stand of a single species is desirable under certain conditions. Species low in palatability, or species requiring intensive management should be planted alone. Many introduced species are easier to manage when planted in a pure stand.

Use seed of known quality. Know the germination and purity of the seed because seeding rates are based on pure live seed.

Seeding Rate

The quantity of seed to apply per acre depends on the species, method of seeding and site potential. Seeding rates usually are based on pounds of pure live seed (PLS) per acre. PLS is the percentage of the bulk seed material that is live seed. This is determined by multiplying percentage germination by percentage purity of the lot of seed. When hard seed are involved, PLS = (percent germination + percent hard seed) $\times$ percent purity.

Recommended seeding rates usually call for 20 live seeds per square foot. The number of seeds per pound varies with species. Table 1 gives the number of seeds per pound, and recommended seeding rates for species used in New Mexico.

Seed Treatment

Seed germination rates are a major part of seed quality when determining percent pure live seed (PLS). Various mechanical and chemical treatments are used to enhance seed germination. Common chemical treatments include applications of gibberellic acid (GA_3), potassium nitrate (KNO_3) and ammonium nitrate ($HN_4\ NO_3$) solutions. Heating seeds and mechanical scarification also enhances germination.

Commercial companies manufacture and market materials called super absorbents. The materials are either synthetic or natural starch polymers that hold many times their weight in water. They are used in commercial nurseries as a soil amendment to enhance water holding capacity and reduce watering frequency. These super absorbents have recently been mixed with seed in range seeding operations. There are several advantages of this seed treatment, especially under arid range conditions. The super absorbent sticks to the seed coat, can absorb hundreds of times its weight in water and forms a gel on the seed surface. Because a water source is provided at the seed surface, the seed coat is

softened, improving water entry into the seed to promote germination and emergence. Once the seed has been coated with a super absorbent, it should be used promptly to prevent moisture absorption from the air.

HOW TO SEED

Seedbed Preparation

An ideal seedbed is firm below seeding depth and has moderate amounts of mulch or plant residue on the soil surface. A major reason for seedbed preparation is to reduce competition from other plants.

Plowing is the most common way to prepare a seedbed and several plowing methods are available. The method selected depends on the type of vegetation to be controlled and the financial resources available. Use a moldboard, offset disk or one-way on abandoned cropland. Consider root plowing on a brush-infested area.

Herbicides can also control existing vegetation. After applying the herbicide, drill seeds of desired plants directly into the dead vegetative cover. Although this method of seedbed preparation is seldom used, it offers possibilities where wind erosion occurs.

In areas where wind or excessive heat is a problem, protect clean-tilled soil with a cover crop or dead litter crop. Sorghums make an excellent dead litter mulch. To prevent seed production in sorghum, plant it late in the growing season or harvest it, leaving the stubble to mulch. Small grains can also be used as a cover crop. After establishing the cover crop, drill or broadcast seeds of desired species into the stubble or mulch.

In some areas, seedbeds have been successfully prepared by burning. For example, prescribed burning can reduce competition from certain perennial plants, allowing seeded species to establish more easily. Seeding may be necessary to restore the area's productivity after a wildfire.

An ideal seedbed may be prepared without undue expense on abandoned cropland, but the ideal seedbed is a goal seldom attained on rangeland because costs exceed expected returns. Although an ideal seedbed may not be economically feasible, prepare the best seedbed that available resources allow. On some brush-infested rangeland, root plowing followed by roller chopping, raking or chaining is acceptable seedbed preparation. Roller chopping is usually done before seeding. On potentially productive sites, the expense of root plowing, raking and plowing with an offset disk may be justified. In addition, smooth seedbeds allow harvesting of seed, and the income from seed sales could pay for seedbed preparation costs.

Timing

Choosing the correct time to seed is important. Try to seed at the beginning of a period that will provide the best growing conditions (favorable temperatures and good soil moisture). In most cases, seed just before the season of expected high rainfall. Most parts of New Mexico receive enough rainfall in mid to late summer. In those areas, warm season plants can be seeded successfully during mid-summer. In terms of temperature, many cool season plants can be seeded either in the spring or early fall. However, late summer or fall is usually best because young seedlings will not tolerate high summer temperatures. On the other hand, warm season plants grow best if seeded in mid-summer.

Seeding Depth

Optimum seeding depth is roughly proportional to seed size. Because smaller seeds have a smaller quantity of stored energy, do not seed them as deeply as larger seeds. As a rule, plant seeds at a depth four to seven times the diameter of the seed. When using a mixture of small and large seeds, determine the planting depth by the diameter of smallest seed. In most rangeland seedings, plant seeds about ¼ to ½ inch deep, but not deeper than ¾ inch. Plantings can be deeper in light, sandy soils than in heavier, clay soils.

Seeding Methods

The two most common methods of seeding rangeland are drill and broadcast. Drilling puts the seed in the soil; broadcast puts the seed on the soil's surface.

Drilling is best because the drill places the seed in the soil, improving the probability of seedling establishment. Use drills on old fields and on areas where a smooth seedbed has been prepared.

A good drill has the following:

- Double-disk opener to make a trench with minimum soil movement.

- Depth bands for proper depth control.
- Packing mechanism to place seed more firmly in contact with soil.
- Seed boxes with agitators to keep seed mixed and prevent fluffy seed from lodging in box, separate boxes for large and small seed, divided or partitioned boxes to keep seed feeding to individual metering devices and a good metering device to control the amount of seed to be planted.

Types of Drills

Rangeland Drill. This drill is a rugged seeder with high clearance, designed to work on rough sites and performs well. It can be converted to a deep-furrow implement by cupping the discs enough to make good furrows. The furrow depth is controlled by adding or taking off disc arm weights. Weights up to 70 pounds have been used under some conditions.

Oregon Press Drill. This implement was developed by the Agri-Engineering Department, Oregon State University, and is designed for seeding on plowed or loose seed beds. A heavy press wheel packs the soil. Seed is placed in the packed furrow and an adjustable drag covers the seed. This drill cannot be used on rocky or rough seedbeds.

Plains Double-Disc Drill. This machine is equipped with double disc, depth bands, covering device, press wheels, seed agitator and an adjustable feeding mechanism that handles trashy seed. The plains drill is not built strongly enough, and does not have enough clearance, to be used on rough or brushy sites. This drill is most suited to fairly level, non-stony sites that commonly exist in the plains and mountain parks.

Grain Drill. Drills in this group are designed and built for use on cultivated fields. They are too lightly constructed for seeding on rough seedbeds. Breakage is a problem and the seed is often not placed properly in the ground. For these reasons, these drills should not be used for rangeland seedings if other drills are available.

Range Interseeder. This drill is equipped with a furrow opener, double disc, depth bands, boxes for large and small seed, and press wheels. The furrow openers will open a trench about 14 inches wide and 2 inches deep, and space furrows 34 to 42 inches apart. The seed is planted in the flat-bottom furrow.

Range interseeding can be used to introduce desirable plants into stands of less desirable perennial plants. It also offers a method of introducing browse species into existing vegetation.

To be successful, the seeded species must be of a higher successional level than the vegetation into which the new species is being introduced. Seeding should not be done in annual vegetative cover because moving surface soil at this time usually covers seed too deeply.

The use of aggressive vegetative reproducing species or good seeders should be practiced in range interseedings. Grazing management should be based on the seeded species. With proper management, seeded rows will spread into associated vegetation.

Range interseeding is not a substitute for a complete seeding where full seedbed preparation can be done. It is primarily intended for use on sandy sites where erosion hazards are too great to destroy existing vegetation, or where a partial stand of desirable plants already exists. Seeding rate should be half that of a common drill.

Browse Seeders. These implements operate like the range interseeder in that small furrows are opened at wide intervals for seeding of browse. Furrows are about 4 inches wide, rather than 14 and the seeding device is simpler than that of the interseeder. Its use is limited to the introduction of browse and forbs in established vegetation on non-stony sites.

Kimseed Regeneration Machinery. These implements are, in fact, broadcast seeders mounted behind chisels and sweeps or disks. There are two types, the pitter seeder and the countour seeder. These implements modify the soil surface and micro-climate and have been successful in Australian range seeding under extremely arid conditions.

The pitter seeder has a gang of four chisels with sweeps that make interrupted furrows. Seed is sown across these furrows, and the furrows pond water to increase soil moisture for the seedlings.

The contour seeder uses a type of border disk in front of the seeder. The rationale is the same as in the pitter seeder, but is used mainly on slopes where contour seeding is important.

Calibration of Seeding Equipment

There are several ways to calibrate seed drills for a certain number of pounds per acre. The following two methods are simple and adequate.

Place a canvas on the ground and run drill over the canvas. Count the number of seeds per foot of drill row. Suppose one is seeding the following mixture:

Pubescent wheatgrass, 4 pounds per acre
Hard fescue, 2 pounds per acre

In this case, the seed would be thoroughly mixed. From table 1 it is determined that pubescent at 4 pounds per acre should have 8 seeds per square foot, or 1 foot of linear drill row. Hard fescue at 2 pounds per acre should have 26 seeds per foot of linear drill row. A drill setting to have a combination of about 34 seeds per foot of drill row would be right for the above example.

An alternative method is the weight method. Scales should be accurate to 1 gram. In each instance, the formula is devised to cover 192 square feet in test runs. With this area, the weight of the seed sample in grams, multiplied by the factor 0.5, will be pounds of seed per acre at that drill setting. This is a constant factor to be used for all drilling settings and row spacings.

The variable that has to be determined for each drill and row spacing is the number of revolutions of the drive wheel to be used. This can be found using the following formulae, where C equals the circumference of the drive wheel in feet and R equals number of revolutions necessary to cover the required area (192 square feet):

Row Spacing	No. of Seed Spouts to Use	Turns of Drive Wheel
6"	4	$\frac{96}{C} = R$
7"	4	$\frac{82}{C} = R$
8"	3	$\frac{96}{C} = R$
10"	3	$\frac{77}{C} = R$
11"	3	$\frac{70}{C} = R$
12"	2	$\frac{96}{C} = R$
24"	1	$\frac{96}{C} = R$
30"	1	$\frac{77}{C} = R$
36"	1	$\frac{64}{C} = R$
40"	1	$\frac{58}{C} = R$
42"	1	$\frac{55}{C} = R$
48"	1	$\frac{48}{C} = R$

Jack up the drive wheel and measure the circumference in feet. Determine number of revolutions needed for the row spacing to be used. Put some seed in the box and turn the drive wheel until all spouts are feeding well. Place a container under the correct number of seed spouts and turn the drive wheel the correct number of revolutions. Weigh the sample in grams. Multiply this weight by 0.5 and the result is pounds per acre at that setting. Make adjustments in the drill setting and continue trials until the desired seeding rate is obtained.

Because most cropland drills are not sturdy enough to be used on rough rangeland, broadcast seeding often is used instead. However, broadcast seeding has limitations because seeds are poorly covered with soil and stand establishment is often slower. Broadcast seeding seldom is effective without some soil disturbance before the seeding operation. Be sure to distribute seed uniformly. Small, slick seeds lend themselves to broadcast seeding much better than large fluffy seed because small seed are easier to broadcast and are covered by natural sloughing of the soil.

Ground Broadcasters

Rotary Spreaders. In this type, the seed falls from a hopper onto a rotating ribbed disc that distributes the seed by centrifugal force. The width of throw depends on size and weight of seed, speed of the rotating disc and wind velocity. Rotary spreaders can be carried by hand, or mounted on or trailed behind a tractor or seedbed preparation unit. They are generally powered by hand, gasoline, electric motor or power take-off.

Limitations of this type of seeder are that swath width and rate of seeding vary with travel speed and the speed of the rotating disc. In most of these machines, there is no control over the drive motor speed. Seed is not spread as evenly as from a drill box; the amount of seed is greatest near the center of the swath. Where seed mixtures are used, seed sifting by weight occurs because an agitator is not used.

Seeder Boxes of the Drill-Like or Fertilizer-Spreader Type. In this type, a fluted or force gear feed mechanism lets seed fall out of the bottom of the box onto the ground. The seed box is mounted on equipment such as brushland plows or brush choppers.

In general, the seeder box type broadcaster distributes seed more uniformly than does the

rotary type. A recent adaptation of this type of broadcaster is the seed dribbler. The dribbler will mount on the right or left side of the deck of a track tractor. The direct-drive seed drop mechanism operates from a rubber-tired wheel riding on the tractor tracks, and uses a fluted, forced feed. Seed is metered onto the track pad just as it breaks over the front idler. Seed drops off the pad in front of the track and is embedded in the soil as the tracks pass over. Seed box units from a browse seeder can also be adapted for use as dribblers.

Broadcast Units Using an Air Stream to Dispense Seed. Seed is metered from a hopper, either by gravity or positive feed, into an air stream. The air stream can be created either by exhaust from equipment motors or by a fan. Seed distribution is poor when seeding on days with high wind velocities. Swath width is unpredictable, depending on weather conditions.

Hydroseeding. Hydromulchers are often used to apply seed and mulch to disturbed areas such as road cut and fill slopes. This machine applies seed in a high-pressure stream of water. Seeding success can be increased by applying the seed in one operation, followed by a mulch application. Hydroseeding generally violates several of the basic principles of seeding. Many slopes that are hydroseeded are too steep for seed retention and stabilization. Proper slope design and attention to basic seeding principles will improve seeding success considerably.

Aerial Broadcaster

Aerial application is popular in remote areas because it is faster. Aircraft must be equipped with a spreader and a positive, power-driven seed metering device. An adjustable opening that allows seed to drop out of the hopper by gravity is not acceptable when various seed sizes and weights are mixed.

The following points must be taken into consideration when seeding with aircraft.

Planning Seed Needs. To determine the amount of seed needed for the total project, use gross acreage. It is cheaper to seed gross areas than to try to avoid islands and other areas not desired for seeding.

If the terrain is rough and the area has uneven edges, figure seed needs on gross acreas plus 10%.

Preparation Before Aerial Seeding. Mix seed before scheduled aerial application. Weigh and mark weight on each sack of mixed seed. Each sack should not weigh more than 50 pounds. Weights will pregroup each load before actual loading operations and also help keep an estimate of seed being applied per acre.

The pilot should fly a reconnaissance to acquaint himself with the area, and feel out terrain and air conditions. Locate landing spots so seeding can be done with minimum ferry time. Generally, one landing spot per 1000 acres is enough; however, this will vary with the layout of the area to be seeded.

Keep seed dry. If there is a chance of rain, do not leave seed in field overnight, or provide for covering with rainproof material.

Procedure During Seeding Operation Calibrate seeding rate. Place cardboard cards, 1-foot square, perpendicular to line of flight about 10 feet apart. Cover the cards with a light grease. Seed will stick to the greased cards. The number of seeds on each card can be counted and related to the desired number of seeds per square foot. The greased cards also help determine seed distribution and the effective swath width.

A further calibration check can be made by establishing a check area of a given acreage. Have the pilot fly until he has covered this known acreage. Check the hoppers and adjust accordingly. This may have to be repeated a couple of times. Make the first seeding pass around exterior boundaries of area. This assures seed coverage for the edges and facilitates turnaround efforts for the aircraft.

Fly grids against or with wind. Do not fly crosswind unless absolutely necessary. When flying with or against wind, flight time per day can be extended considerably. Flights should start as early as possible, as soon as there is light enough for pilot to see for safe flight. Normally this is the quiet time of day. Winds will dictate the duration of operation in any one day. Do not seed in winds in excess of 15 miles per hour.

Keep track of pounds of seed and acreage covered as a check on distribution of seed and calibration of aircraft.

Keep strings, seed tags and other foreign material out of seed hopper. Paper seed sacks are recommended.

Covering Broadcast Seed

Broadcast seeding is more successful if seeds are broadcast on loose, rough soil where natural sloughing and settling will cover the seed, or when seeding is followed by harrowing, chaining or cultipacking. If the seedbed consists of large clods of soil, seed may be buried too deeply.

An efficient and economical way to cover seed following broadcasting on large projects is by chaining. There are additional benefits for areas that have been burned. Mixing ashes with mineral soil helps prevent crusting, and further reduces debris, to give the landscape a more pleasing appearance.

Chaining should start immediately after seeding. All chaining should be done on the contour, but chaining should not be done if the soil is too wet. Within limits, the heavier the chain, the better the overall results. This may vary with the debris on the soil.

Double chaining with a lighter chain will give more complete seed coverage and will not bury seed as deeply as a single, heavy chain. In areas where residual vegetation such as blue grama is dense, double chaining to break up the sod is necessary. Properly done, chaining provides a method of interseeding into low-producing blue grama stands.

CRITICAL AREA STABILIZATION

Soil surface is torn up on extensive areas each year by construction work to develop recreation areas, stock tanks and other water impoundments, utility rights-of-way, mining areas and similar projects. It is desirable to stablilize and rehabilitate disturbed areas as soon as possible.

On these areas where erosion control is the primary purpose of the planting, species should be used that will give a fast, dense cover. In addition, they should have a large, strong fibrous root system to bind and hold the soil. Grass is the plant that comes closest to having these desirable characteristics Shrubs develop slowly and leave bare areas for a considerable period of time. Flowering shrubs can be used for landscaping in conjunction with grass for erosion control.

Highly palatable plants are not recommended in seed mixtures for cut and fill slopes because of their high attraction to livestock and wildlife, and the resulting safety hazard.

On new construction to be seeded immediately, leave cut slopes with 4 to 6 inches of loose soil. The prepared surface should be similar to a disked field. Road design specifications should provide for this scarification on earth cut slopes.

On old construction, scarify the surface 4 to 6 inches deep. Rip, disk and harrow on the countour, or parallel to the road, wherever possible. On steeper slopes, it may be necessary to work equipment at an angle, or with a lead cable from above or below the slope.

On cut slopes 1½:1 or steeper, use a hydroseeder or prepared mulch, or stake mulch in place. When the surface is 70% or more rock, no revegetation is recommended except for aesthetic values.

Drill seed whenever possible in prepared seedbed. Drilling should be done on the contour or parallel to the roadbed, when possible. Where drilling is impractical, broadcast seed on roughed-up seedbed then harrow the area to cover the seed. On steep slopes, 1½:1 or greater, seed with a hydromulcher, or broadcast seed and cover with prepared mulch strips.

On newly constructed projects, seed as soon as practical after the bank is finished. On old construction, time seedbed preparation and seeding to take advantage of rainfall pattern in local area.

Kimseed regeneration machinery holds promise for critical area stabilization. These implements modify soil surface relief and microclimate for seedlings through a series of interrupted furrows or contour ridges. These machines are manufactured in Australia, so there is limited experience with these implements in America. Results in Australia appear very promising in arid areas.

MULCHING

Mulching is needed on steep slopes where it is difficult to keep seed in place, or where excessive soil drying will take place. Hydromulching and asphalt mulching are popular with highway departments and large mining companies. Proper mulching can also be done by spreading grass, hay or aspen excelsior, followed by a light disking to anchor the mulch. Hand mulching with excelsior mats is sometimes used with the excelsior rolls staked in place vertical to the slope. Prepared mulch rolls are expensive and should be used only on special treatment areas.

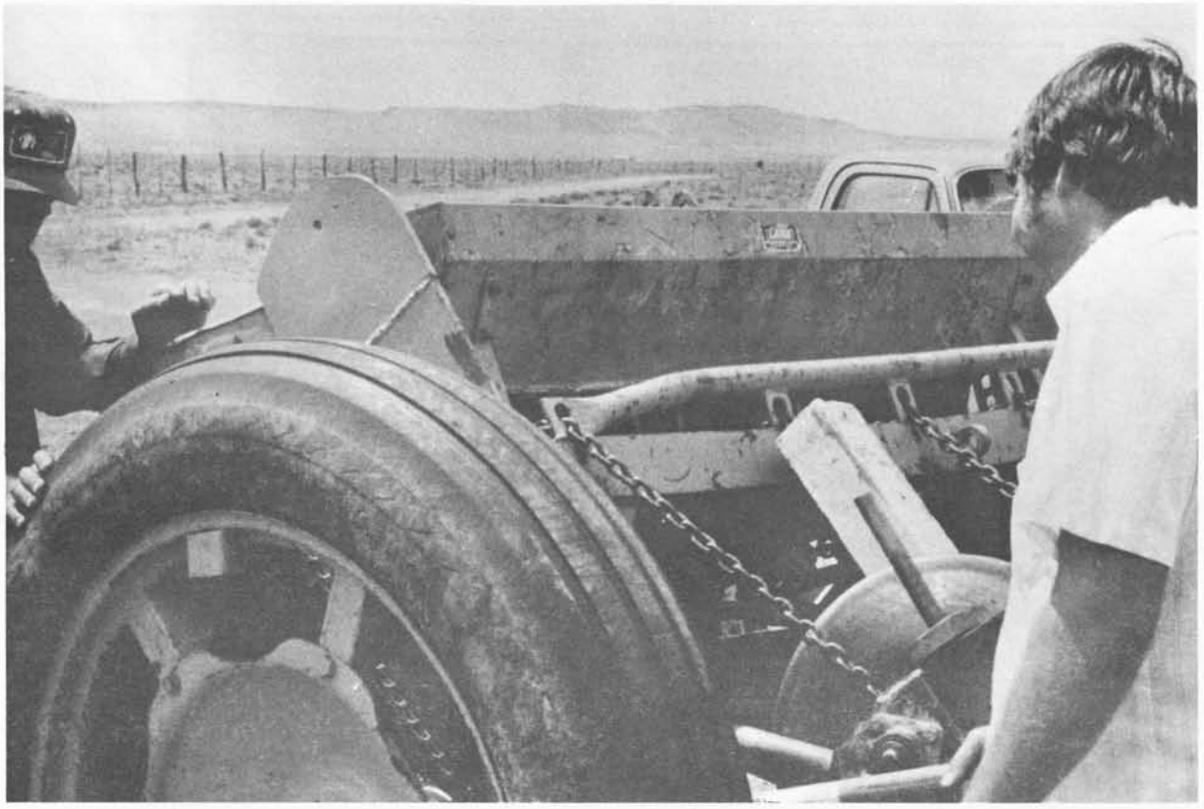
Mulch applied at rates of more than 3 tons per acre can be harmful. Small seedlings cannot break through when the mulch is too thick. Mulch is not a substitute for fertilizer, which is necessary on the raw soils of construction sites.

MANAGEMENT AFTER SEEDING

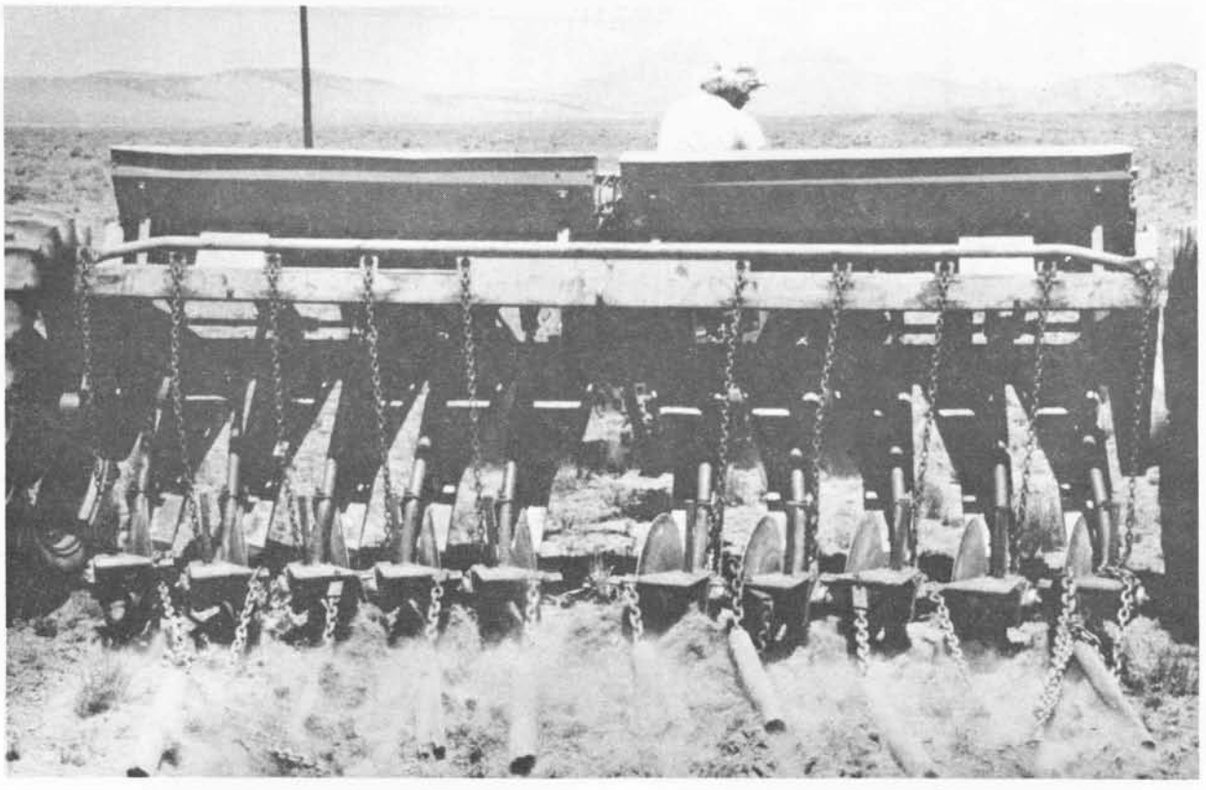
Protect a newly seeded area from grazing until plants are established. Some species establish sooner than others but in general, plants should be well-rooted before grazing to prevent seedlings from being pulled up. Length of deferment from grazing varies. In exceptionally good growing conditions, deferment through one growing season may be enough. During periods of harsh growing conditions, however, 2 or 3 years of deferment may be necessary. Grazing during dormant periods can improve the stand by scattering and trampling seed into the soil. After plants are established, practice good grazing management to maintain the seeded stand.

Because seeded areas usually receive some type of soil disturbance, weeds or weedy species often become abundant during the growing season following seeding. Weed control measures such as mowing, shredding or use of herbicides may be necessary during the first growing season to allow seeded species to become established. Most grass seedlings can tolerate a herbicide application after the seedlings have reached the fourth leaf stage.

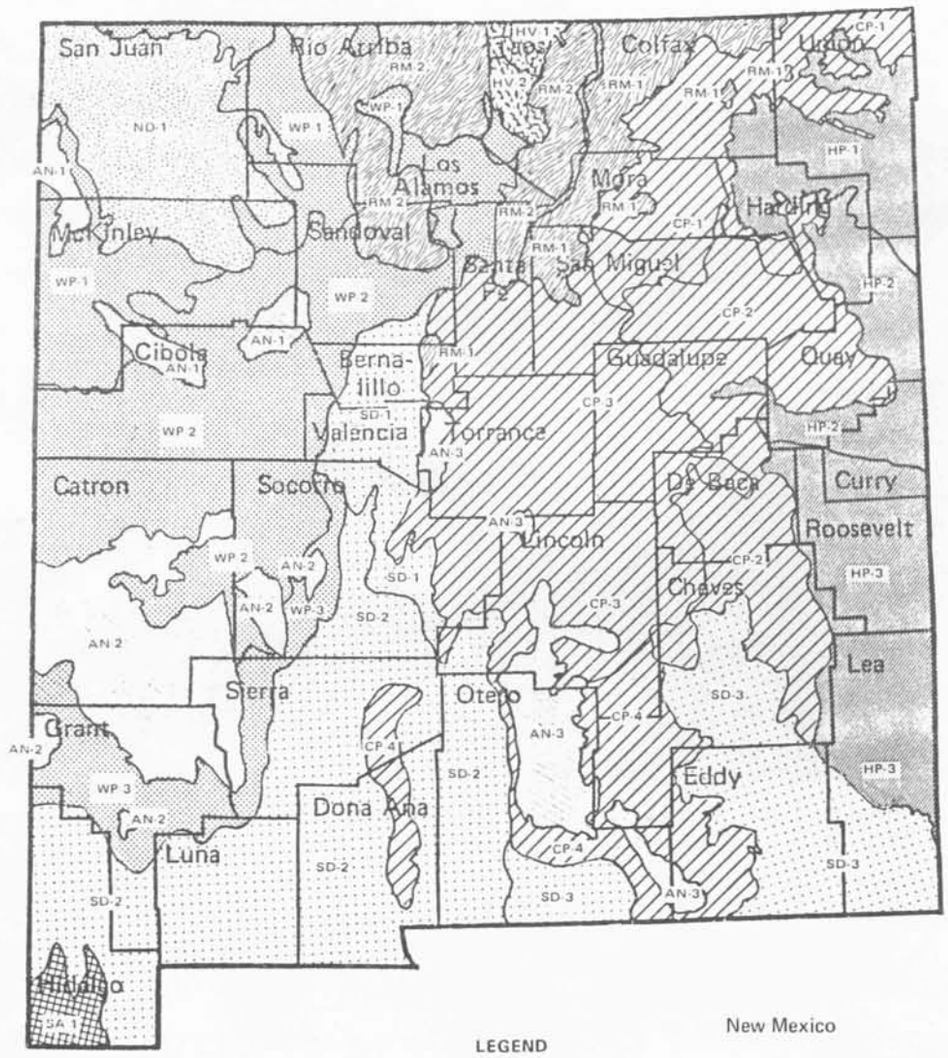
KIMSEED Seeder — This type of seeder modifies the microclimate by cutting interrupting furrows that act as water trapments, which holds soil moisture for good grass seed germination. The KIMSEED seeder is an Australian design.



Drill Calibration — A rangeland drill should be carefully calibrated for accurate seeding rates. An optimum seeding rate helps ensure a good stand and controls seeding costs.



Seeding — Seeding white grub-damaged rangeland in Catron County. The seed mixture in this project was a native range grass and shrub mixture.



LEGEND

New Mexico and Arizona Plateaus and Mesas (36)
WP-1
WP-2
WP-3

San Juan River Valley, Mesas and Plateaus (37)
ND-1

Arizona and New Mexico Mountains (39)
AN-1
AN-2
AN-3

Southern Arizona Basin and Range (41)
SA-1

Southern Desertic Basin, Plains and Mountains (42)
SD-1
SD-2
SD-3

Southern Rocky Mountains (48)
RM-1
RM-2

High Intermountain Valleys (51)
HV-1
HV-2

Pecos - Canadian Plains and Valleys (70)
CP-1
CP-2
CP-3
CP-4 *San Andres and Organ Mountains

Southern High Plains (77)
HP-1
HP-2
HP-3

Note:
Because the scale of this map does not permit delineation of areas smaller than several square miles, contrasting areas up to this size may occur in any of the delineations.

June 1980

Fig. 1. Major land resource and subresource areas

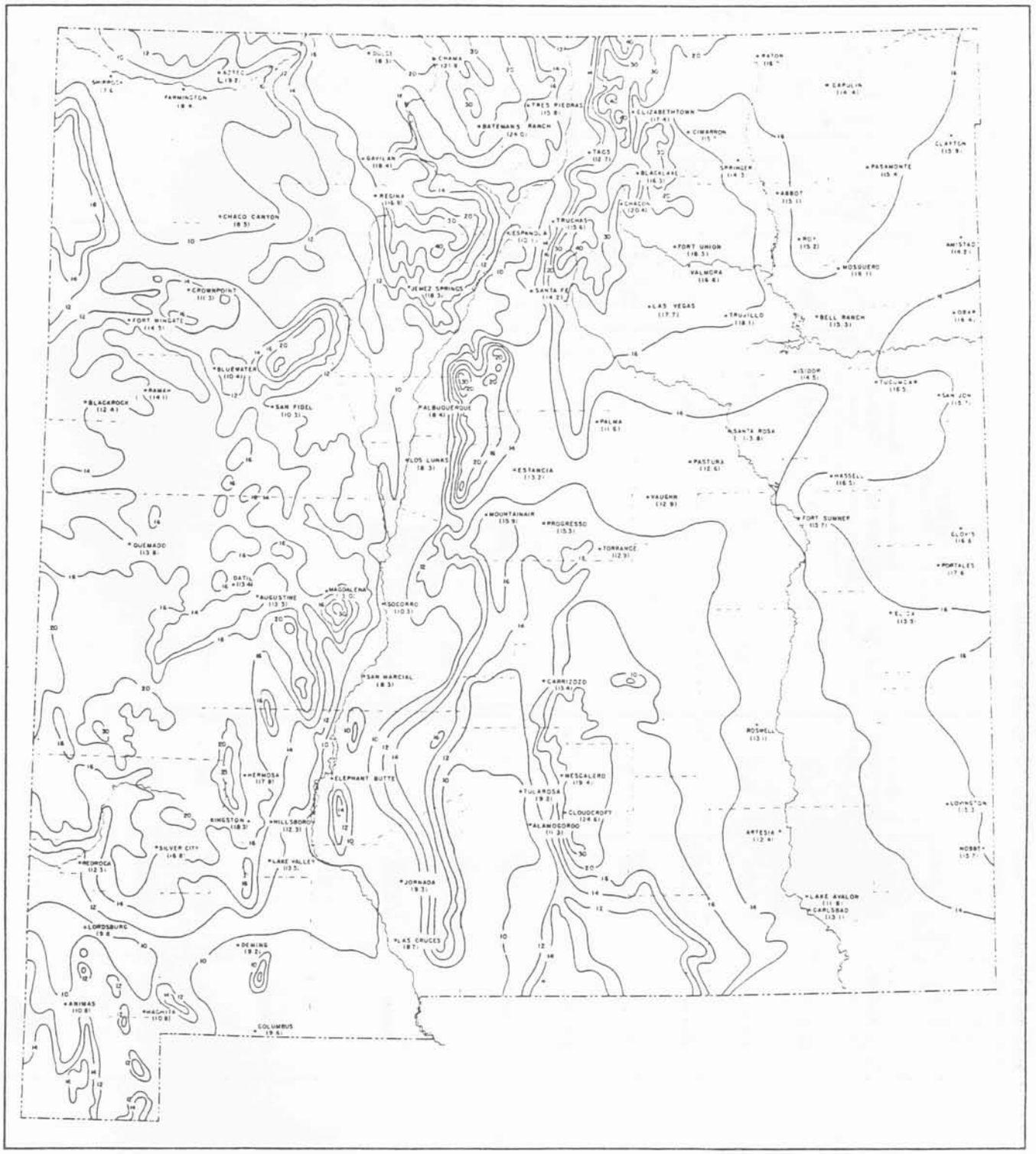


Fig. 2. Average annual precipitation

Source: The Climate of New Mexico, by Ti-Fu Tuan, Cyril E. Everard and Jerold G. Widdison, State Planning Office, Santa Fe, New Mexico, 1969.

Table 1. Seeding rates and adaptations of species used for seeding New Mexico Rangeland.

Name	Recommended Variety	Seeds Per Lb	Seeds Per Sq Ft (@ 1 lb/A)	Seeding Rate Lb. PLS Per Acre			Regional Adaptation[1]									Soil Adaptation[2]				
				Drilling (40" Rows)	Broadcast Or Drilling (20" or Less)	Broadcast Critical Area	SD 1,2,3	SA	AN 1,2,3	WP 1,2,3	CP 1,2,3	ND	HV 1,2	RM 1,2	HP 1,2,3	Sandy	Loam	Clay	Salty	Wet
Cool Season Grasses																				
Arizona Fescue* *(Festuca arizonica)*	Redondo	550,000	12.8	2.0	3.0	5.0			X					X			X			
Big Bluegrass *(Poa ampla)*	Sherman	917,000	21.0	1.0	2.0	3.0								X			X			
Crested Wheatgrass *(Agropyron desertorum)*	Nordan	200,000	4.6	5.0	8.0	13.0				X		X	X	X			X			
Hard Fescue *(Festuca ovina* var. *duriuscula)*	Durar	565,000	13.0	2.0	3.0	5.0			X					X			X	X		
Indian Ricegrass *(Oryzopsis hymenoides)*	Paloma	235,000	5.4	4.0	7.0	11.0				X		X	X	X		X	X			
Intermediate Wheatgrass *(Agropyron intermedium)*	Amur	100,000	2.4	7.0	10.0	17.0			X					X			X			
Kentucky Bluegrass *(Poa pratensis)*		2,156,000	50.0	0.5	1.0	1.0			X					X			X			
Meadow Brome *(Bromus biebersteinii)*	Regar	100,000	2.4	10.0	17.0	24.0			X					X			X			X
Mountain Brome* *(Bromus marginatus)*		90,000	21.0	1.0	2.0	3.0			X					X			X			X
Orchardgrass *(Dactylis glomerata)*	Potomac	540,000	12.0	6.0	8.0	10.0			X					X		X	X			X
Pubescent Wheatgrass *(Agropyron trichophorum)*	Luna	94,000	2.0	5.0	8.0	13.0			X	X				X			X	X	X	
Russian Wildrye *(Elymus junceus)*	Vinell	170,000	3.9	6.0	10.0	15.0				X		X	X	X			X			
Siberian Wheatgrass *(Agropyron sibericum)*		250,000	5.7	4.0	7.0	10.0				X		X	X	X			X			
Slender Wheatgrass *(Agropyron trachycaulm)*	Primar	160,000	3.7	7.0	12.0	17.0			X					X		X	X			
Smooth Brome *(Bromus inermis)*	Lincoln	236,000	3.0	8.0	12.0	19.0			X	X		X	X	X		X	X			X

Streambank Wheatgrass *(Agropyron riparium)*	Sodar	170,000	3.6	7.0	11.0	17.0			X	X		X	X	X		X	X	X	X		
Tall Fescue *(Festuca arundinacea)*	Alta Fawn	242,000	- -	4.0	7.0	11.0			X	X		X	X	X			X	X	X	X	X
Tall Wheatgrass *(Agropyron elongatum)*	Jose Largo	79,000	1.8	8.0	12.0	20.0			X	X	X	X	X	X	X		X	X	X	X	X
Thickspike Wheatgrass *(Agropyron dasystachum)*	Critana	186,000	4.3	5.0	10.0	14.0			X	X	X	X	X	X		X	X				
Timothy *(Phleum pratense)*	Climax	1,300,000	30.0	1.0	1.5	2.0			X					X			X				X
Western Wheatgrass *(Agropyron smithii)*	Arriba Barton	110,000	2.5	8.0	16.0	24.0		X		X	X	X	X	X	X		X	X	X	X	X
Warm Season Grasses																					
Alkali Sacaton *(Sporobolus airoides)*		1,750,000	40.0	0.4	1.0	1.5	X	X	X	X	X	X	X	X	X		X	X	X	X	X
Arizona Cottontop *(Digitaria californica)*		1,092,000	- -	0.4	1.2	- -	X	X		X	X			X	X	X	X				
Big Bluestem *(Andropogon gerardii)*	Kaw	130,000	4.4	5.0	9.0	14.0					X		X	X	X	X					X
Black Grama* *(Bouteloua eriopoda)*	Nogal	1,335,000	31.0	0.5	1.5	2.0	X	X		X	X			X	X	X					
Blue Grama *(Bouteloua gracilis)*	Hachita Lovington	712,000	16.5	1.5	2.5	3.5		X	X	X	X	X	X	X	X	X			X		
Blue Panicgrass *(Panicum antidotale)*		1 657,000	16.0	1.5	3.0	4.0	X	X						X	X	X					
Boer Lovegrass *(Eragrostis chloromelas)*		2,922,000	69.0	0.5	0.8	1.0	X	X						X	X						
Buffalograss *(Buchloe dactyloides)*	Texoka	42,000 bur 867,000 grain	1.0	4.0 - -	16.0 3.0	16.0 - -		X		X	X			X	X	X	X				
Bush Muhly* *(Muhlenbergia porteri)*		1,500,000	38.0	1.0	1.0	1.5	X	X							X	X					
Galleta *(Hilaria jamesii)*	Viva	159,000	3.7	5.0	11.0	16.0	X	X	X	X	X	X	X	X	X	X	X	X	X		
Indiangrass *(Sorghastrum nutans)*	Llano	175,000	4.0	6.0	10.0	15.0			X	X	X	X	X	X	X	X	X				X
Lehmann Lovegrass *(Eragrostis lehmanniana)*		6,537,000	99	0.5	0.5	0.5	X	X							X	X					

Table 1. Continued

Name	Recommended Variety	Seeds Per Lb	Seeds Per Sq Ft (@ 1 lb/A)	Seeding Rate Lb. PLS Per Acre			Regional Adaptation[1]									Soil Adaptation[2]				
				Drilling (40" Rows)	Broadcast Or Drilling (20" or Less)	Broadcast Critical Area	SD 1,2,3	SA	AN 1,2,3	WP 1,2,3	CP 1,2,3	ND	HV 1,2	RM 1,2	HP 1,2,3	Sandy	Loam	Clay	Salty	Wet
Little Bluestem *(Schizachyrium scoparium)*	Pastura	260,000	8.7	3.0	6.0	10.0			X		X			X	X	X	X			
Old World Bluestem *(Dichantihium* spp.*)* *(Bothriochloa* spp. blend)	T-587	854,000	- -	0.5	1.2	- -	X	X		X	X				X	X	X			
Plains Bristlegrass* *(Setaria machostachya)*		293,000	7.0	3.0	5.0	8.5	X	X							X	X	X			
Sand Bluestem *(Andropogon hallii)*	Elida	125,000	2.9	6.0	14.0	21.0	X	X			X			X	X	X				
Sand Dropseed *(Sporobolus cryptandrus)*		5,298,000	123.0	0.5	0.5	0.5	X	X		X	X	X	X		X	X	X			
Sand Lovegrass *(Eragrostis trichodes)*	Bend	1,550,000	35.6	1.0	1.5	2.0	X	X							X	X				
Sideoats Grama *(Bouteloua curtipendula)*	Vaughn	143,000	3.3	5.0	12.0	18.0	X	X	X	X	X		X	X	X	X	X			
Spike Muhly *(Muhlenbergia wrightii)*	El Vado	1,635,000	38.0	1.0	1.5	2.0			X	X				X		X	X			
Switchgrass *(Panicum virgatum)*	Greenville	280,000	6.4	4.0	6.0	10.0			X	X	X		X	X	X	X	X			X
Tobosa* *(Hilaria mutica)*		204,000	4.7	5.0	9.0	13.0	X	X			X				X		X	X	X	X
Vine Mesquite* *(Panicum obtusum)*		143,000	3.3	5.0	12.0	18.0	X	X			X				X		X	X	X	X
Weeping Lovegrass *(Eragrostis curvula)*	Ermelo Morpha	1,463,000	34.0	0.5	1.0	1.5	X	X							X	X	X			
Wilman Lovegrass *(Eragrostis superba)*	Palar	1,103,000	25.3	1.0	1.5	2.5	X	X								X	X			
Yellow Bluestem and/or King Ranch Bluestem *(Bothriochloa ischaemum* var. *songarica)*	Ganada Plains King Ranch	1,045,000	32.0	2.0	3.0	3.0	X			X					X		X			

Forbs																						
Big Trefoil *(Lotus uliginosus)*	Marshfield	828,000	23.0	1.0	1.5	2.0			X				X		X	X						
Birdsfoot Trefoil *(Lotus corniculatus)*	Granger Cascade	418,000	9.6	3.0	4.5	6.0			X				X		X	X						X
Black Medic* *(Medicago lupulina)*		800,000	18.0	1.5	2.0	- -			X				X		X	X						X
Burnet *(Sanguisorba minor)*		53,000	1.2	8.0	20.0	- -			X				X		X	X						
Cicer Milkvetch *(Astragalus cicer)*	Lutana	122,000	2.8	8.0	13.0	22.0			X				X		X	X						X
Rocky Mountain Penstemon *(Penstemon strictus)*		280,000	6.4	3.0	6.0	10.0			X				X		X	X						X
Sainfoin *(Onobrychis viciaefolia)*	Renumex	18,000	0.4	45.0	90.0	135.0			X				X		X	X						
Strawberry Clover* *(Trifolium fragiferum)*		323,000	7.4	3.5	5.5	8.0			X				X		X	X						X
Sweet Clover *(Melilotus* spp.)		262,000	6.0	4.0	7.0	10.0			X				X		X	X						X
White Clover *(Trifolium repens)*		800,000	18.0	1.5	2.0	4.0			X				X		X	X						X
Browse Plants																						
Antelope Bitterbrush* *(Purshia tridentata)*		20,000	0.5	40.0	80.0	- -				X			X		X	X						
Apache Plume *(Fallugia paradoxa)*		- -	- -	3.0	5.0	9	X	X	X	X	X	X	X	X	X	X						
Four Wing Saltbush *(Atriplex canescens)*		45,000	1.7	8.0	16.0	- -	X	X	X	X	X	X	X	X	X	X	X	X	X			
Mountain Mahogany* *(Cercocarpus montanus)*		40,000	0.9	21.0	42.0	- -			X				X		X	X						
Winterfat *(Ceratoides lanata)*		150,000	3.3	6.0	12.0				X	X	X	X	X	X	X	X						

*Seed is usually in short supply or not available.
[1]Check with local officials for sub-resource area adaptation
[2]Check with local officials for specific range site adaptation

To find more resources for your home, family, or business, visit the College of Agriculture and Home Economics on the World Wide Web at http://www.cahe.nmsu.edu.

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