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AGRONOMY TECHNICAL NOTE NO. 38
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SUBJECT: COVER CROPS IN ORCHARDS AND VINEYARDS

Purpose. To be used as a guide for planning and applying resource management systems.

Effective Date. Effective when received.

Explanation. The attached "Cover Crops in New Mexico Orchards and Vineyards" is a guide for planning and applying resource management systems for control of erosion and maintaining soil tilth.

The table which starts on page 38 will provide a quick reference which will allow a cooperator to select the plants which are best adapted to the specific area of operation. The text then provides additional information on individual species and management systems and practices.

Additional copies of this Technical Note are available upon order from the State Office.

Ray T. Margo, Jr.
State Conservationist

Attachment

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NUMBER 38

COVER CROPS

IN

NEW MEXICO ORCHARDS AND VINEYARDS

by

WILLIAM W. FULLER

STATE AGRONOMIST/PLANT MATERIALS SPECIALIST

U.S. DEPARTMENT OF AGRICULTURE
Soil Conservation Service
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Cover Crops in New Mexico Orchards and Vineyards

by

William W. Fuller

In recent years erosion in orchards and vineyards in New Mexico has become an ever more troublesome problem. In 1980, there were only 85 acres of vineyards in the state. By the end of 1984, there were over 4,000 acres and the planned new vineyard acreage exceeds 38,000 acres. Many of these vineyards are being developed in parts of the state which have severe wind erosion problems. Due to the clean tillage practices presently used on most vineyards and orchards, some have experienced severe wind erosion. This erosion will continue until some type of soil stabilizer or cover crop is developed.

There are several soil stabilization products, or tackifiers, on the market which will hold bare soil for various periods of time. However, the frequency of application required or the high initial costs make this type of stabilization economically impractical.

Cover crops for orchards and vineyards are not commonly used in New Mexico. However, in states with large acreages of orchards and vineyards, such as Washington and California, cover crops have been commonplace for over 70 years. In California, cover cropping is prevalent in almond and walnut orchards, stone fruit orchards, and in table, raisin and wine grape vineyards. With the advent of drip irrigation, more orchards and vineyards are being planted on sloping land in California and interest in cover crops has been increasing.

At the present time, there is no research being conducted in New Mexico on cover crops in orchards or vineyards. The purpose of this Tech Note is to provide the best information presently available for establishing cover crops in orchards and vineyards in New Mexico until the research community provides better information.

BENEFITS

Water Penetration

Increased water penetration is a major benefit of cover crop systems. On clean-tilled orchards and vineyards water penetration may be slow due to formation of a tillage pan, compaction, or surface crusting. Tillage pans build up from repeated farming operations. Frequent use of equipment, especially in wet weather or too soon after irrigating, causes compaction of surface soil. Surface crusting or sealing is caused by water drops striking the soil.

Cover crop systems reduce tillage requirements and equipment use. Also, orchards and vineyards with vegetative cover can better support machinery during wet periods. As a result, tillage pan and surface compaction is reduced. Cover crops also intercept water drops, reducing their force and preventing crust formation.

Water penetration is also increased in other ways. Root systems provide passages through the soil, increasing intake. Cover crop residue helps maintain organic matter in the soil which in turn increases infiltration. Some cover crops are plowed under annually and others are plowed up and replanted

every few years. With the additional organic matter present, earthworms inhabit the soil, mixing the soil and developing tunnel systems which also aid in water and root penetration (2).

Erosion Control

Many orchards and vineyards, particularly vineyards, are in areas of the state where wind erosion is a critical concern. In clean tilled orchards and vineyards where the soil is bare, wind erosion is a problem every year. Additionally, water erosion can be a problem on sloping ground. Under border irrigation, cover crops also reduce erosion caused by a large head of water moving rapidly across the field.

Cover crops can greatly reduce both wind and water erosion. The covered areas prevent wind from moving soil particles and water drops from compacting and eroding the soil. This allows greater water insoak due to the open pores in the surface soil and, by slowing the movement of runoff water, greater insoak occurs and fewer soil particles are detached and carried off.

Dust Control (2)

Dust control is an important cover crop benefit. Keeping dust to a minimum improves working and environmental conditions and discourages spider mites and other insects associated with dust laden leaves (2).

Reducing dust is particularly advantageous during harvesting in nut orchards where sweepers and blowers are commonly used which raise large amounts of dust.

Insect Control (2)

Cover crops may be useful in insect control. In addition to reducing dust-associated insects, cover crops harbor beneficial insect predators. Ladybird beetles, lacewings, predatory mites, six spotted thrips, and other predatory insects thrive in cover crop habitats. These insects feed on a variety of harmful insects.

Temperature Control

Summer micro-climate in orchards and vineyards is favorably modified by cover crops. The soil surface is cooler, air temperature lower, and relative humidity is increased. Cover crops also reduce the reflection of sunlight and the characteristic of bare soils. This benefit is particularly important in table grapes where sunburn damages both vine and fruit (2). The presence of the cover also results in a slower soil warm-up in the spring which may be beneficial in preventing damage from late frosts. The cover also reduces diurnal temperature fluctuations.

LIMITATIONS (2)

Water and Nutrients

In some situations cover crops may compete with trees or vines for water and nutrients. This is often true when a cover plant makes its major growth in the summer. As a result, increased fertilizer and water applications may be needed.

Weeds

Noxious weeds may be harder to control if an orchard or vineyard is in permanent cover. Bermudagrass and Johnsongrass are two of the most troublesome weeds.

Plant Residue

Plant residue may interfere with harvesting of nut crops. Selection of the right cover plant combined with proper management and removal of vegetation from the base of the tree can minimize this problem.

Pests

Cover crop systems may encourage rodents and some insect pests which cannot be biologically controlled. If this happens, control measures may be necessary.

Temperature

Cover crops keep temperatures cooler in winter as well as summer. Compared to bare, firm, moist ground, which is the warmest condition, temperatures may be reduced one to two degrees with unmowed cover, and only one-half degree with shredded cover. If cover is kept mowed with the tree or vine row bare, threat of freezing is minimized.

The drawbacks of cover crop systems can be reduced or eliminated with careful management and control practices. Limitations are small compared to the alternatives. Erosion, compaction, and poor water infiltration can, in time, reduce production to the point where it is no longer profitable to continue using the land for orchard or vineyard.

STRIP COVER MANAGEMENT (2)

All recommendations in this publication are based on the use of strip cover management. Strip management refers to the practice of growing cover crops in strips between tree or vine rows. Instead of cover plants growing up to and under trees and vines, vegetation in this area is controlled mechanically or by approved herbicides. The width of the strips under the tree row ranges from two to six feet.

Controlling plant growth in the tree or vine row simplifies cover crop management. Using only the middle to grow cover crops makes mowing easier. By keeping the tree and vine row free of weeds, there is less competition for nutrients and water, tree trunks are kept dry, and rodent damage is minimized.

FERTILIZER REQUIREMENTS

When first seeding a cover crop, fertilizer can be applied at planting time to assure a better stand and reduce possible competition with trees and vines. Fertilizer rates should be based as a soil test. However, if test

results are not available, the following can be used as a guide. Grasses should be fertilized with 30-40 pounds of actual nitrogen per acre and legumes can be fertilized at 50-100 pounds of P_2O_5 per acre.

Additional fertilizer is not usually needed on winter growing cover. Nutrient needs are supplied by the fertilizer applied for the trees and vines. The addition of nitrogen fertilizer to the cover crop during the summer months can also stimulate the trees into additional growth. Due to this possibility, the timing of fertilizer applications becomes a critical factor.

MANAGEMENT SYSTEMS (2)

A successful cover crop system must take into account existing or proposed orchard or vineyard operation. Plants which are useful under some conditions may be a liability under others. For example, a cover crop which competed for attention of pollinators would be undesirable. Selecting the system that best fits an existing or planned operation will lead to the proper selection of species. The following section outlines the most common cover crop management systems.

NONTILLAGE SYSTEMS

Under a nontillage management system the cover crop is mowed instead of being disced into the ground. Nontillage reduces soil compaction and improves infiltration. However, nontillage does not work well where some perennial weeds or soil insects are a problem.

A nontillage system can be started in an existing or new orchard. An existing orchard should be properly prepared soon after harvest. It is particularly important to do a good job of leveling and grading, since the soil will not be reworked.

Following are management methods for nontilled orchards or vineyards:

A. Frequent Clipping

In this system the cover crop is clipped 4 to 7 times beginning in early spring. This is ideal for drag hose operations and is used with sprinkler, border, furrow and drip irrigation. It is used with nut orchards where the fruit is swept from the ground and in apple, apricot, pear, and prune orchards. This system is also applicable to both wine and table grape vineyards.

Frequent mowing eliminates the use of many deep-rooted, reseeding annual and perennial plants. Plants which can be used under this type of management are low growing, reseeding annuals and perennials. Many of the taller growing plants will not stand frequent clipping.

B. Infrequent Clipping

With this system the cover crop is infrequently clipped, usually in early spring for frost protection and in late spring for residue control.

This is used with border, furrow, sprinkler and drip irrigation. It is not well adapted to drag hose irrigation. This system permits the use of deep rooted, reseeding annual or perennial plants which is not possible in the frequent clipping system. If reseeding winter annuals are used, spring mowing must be timed to allow a crop of seed to mature for the next year's stand. Through close and careful management the danger from frost or residue buildup can be minimized. This system can be used in nut, apple, apricot, pear, and prune orchards and table and wine grape vineyards.

TILLAGE SYSTEMS

Under a tillage management system, the soil is cultivated some time during the year.

Following are management methods for tilled orchards and vineyards:

A. Annually fall seeded cover crop

In this system annually fall seeded cover crops are disced in early spring, followed by either; 1) summer fallow until fall, or 2) volunteer summer annuals. Early tillage is used to turn under a green manure crop and break up plow pans formed during the previous year. This system can be used with border, furrow, or sprinkler irrigation in most orchards and vineyards.

Frequent tillage is a disadvantage of this system. Only short season annual plants can be used, and the soil is exposed for much of the year.

B. Reseeding winter annual cover crop

In this system reseeding winter annuals are disced down in late spring, followed by either; 1) summer fallow, or 2) volunteer summer annuals, which are mowed, then disced down in the fall.

The cover crop can be clipped until late spring to control height of the vegetation. Mowing must be timed to allow the reseeding annuals to produce a mature seed crop before discing them down.

This system works well with border, furrow, sprinkler and drip irrigation in all fruit and nut orchards and in raisin, wine and table grape plantings. Many reseeding, deep rooted annuals are ideal for this system.

C. No winter cover

In this system winter cover is eliminated by cultivation or chemical control. This is followed by either 1) volunteer summer annuals, 2) annually summer seeded annuals, or 3) reseeding summer annuals. The summer cover is used from mid-spring until frost.

This system works well with border, furrow or sprinkler irrigation, it is most frequently used in table grape vineyards. In the high plains and southern part of the state, this system would not be applicable due to the wind erosion problems. However, it could be used in the apple orchards in the northern part of the state.

COVER CROP PLANTS

A good cover crop plant is one that maintains or improves soil conditions while it satisfies the soil, site and management requirements of a particular orchard or vineyard. The wide variety of management systems in orchards and vineyards creates a demand for a wide variety of cover crops.

Grasses have fibrous root systems which make them particularly useful in building soil structure, providing erosion control and improving water penetration. Legumes are not as effective as grasses in improving water penetration but they do contribute nitrogen to the soil and their residues break down more rapidly.

Plants useful as cover crops can be classed as: 1) annually seeded winter growing grasses and legumes, 2) reseeding winter annual grasses and legumes, 3) summer annuals, 4) perennial grasses and legumes, and 5) other cover crop plants (2).

ANNUALLY SEEDED WINTER GROWING GRASSES AND LEGUMES

Annually seeded plants are useful for production of green manure or when orchard or vineyard management prevents use of reseeding annuals or perennials.

Cereal rye and barley - *Secale cereale* and *Hordeum vulgare*

Both barley and cereal rye must be seeded early each fall and disced down in the spring. They are easy to start. Both grow faster in winter and produce more vegetation than reseeding annuals. Cereal rye develops more rapidly during the colder weather, is taller growing and more upright than barley. Barley stools out better at the base and breaks down more slowly than rye. Seed barley at 90 pounds per acre and cereal rye at 60 pounds per acre.

Annual ryegrass - *Lolium multiflorum*

Annual ryegrass is an erect, vigorous growing, leafy, late maturing winter annual. It produces a good top growth and has a heavy fibrous root system. Seed is plentiful and relatively inexpensive. Ryegrass should be seeded in the fall at 9 pounds pure live seed (PLS) per acre and disced down in the spring.

Hairy Vetch - *Vicia villosa*

Hairy vetch produces a large volume of material, adds nitrogen to the soil and breaks down easily after discing. It is easily established and puts on major growth in the spring. Seed at 15-20 pounds per acre. Due to the

Zorro is best suited as a quick cover on droughty, sandy, or low fertility soils below 5,000 feet. Establish by drilling or broadcasting at 10 pounds per acre in the fall. Cover seed one-fourth inch deep. It is well suited to mowing. Mowing height should be 4 inches. For Zorro to reseed, it must be allowed a regrowth period of 3 to 4 weeks prior to April seed maturity.

Annual fescue has been successfully grown in the Ft Sumner area where it made good forage production and a high seed yield. Due to the high seed yields, it can be a pest if planted in a field that is rotated to another crop.

Annual ryegrass - *Lolium rigidum*

Annual ryegrass is a fast growing grass that matures in late May. It is upright in growth, has heavy roots and vegetation, and has strong seedling vigor. Due to these characteristics it is often used by developers to provide an "instant" cheap lawn for new houses. Annual ryegrass also makes a large amount of seed and can be a pest if the seed are carried into adjacent fields. Although there are a large number of varieties of annual ryegrass on the market, Wimmera 62 is a variety which has been widely used for cover crops in California.

Wimmera is well adapted to all orchard and vineyard soils in California below 3,000 feet. It can be used in similar sites as other reseeding annuals, if excessive growth is not troublesome. It tolerates sites with poor drainage, is more drought tolerant, has lower fertility requirements and matures about 2 weeks earlier than common ryegrass. Reseeding may not be as consistent as other grasses. Wimmera makes an excellent winter green manure crop. Due to

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its better drought tolerance, it should do better under New Mexico conditions than some of the other varieties. Unlike other annual ryegrass, it does not have awns on the seeds.

Seed on a prepared seedbed at 9 pounds PLS per acre in the fall. Cover seed one-half inch deep. Wimmera can be mowed frequently during the growing season above 2 inches. A three to four week growing period must be provided prior to the late May maturity to allow seed to be produced (2). Wimmera should be able to exist on 9 inches of moisture per year (8).

Black medic and Barrel medic - *Medicago* sp.

The medics are early maturing legumes which branch profusely at the base. The stems lay flat and attain a height of 6 to 10 inches. They start growing in the winter, but put most of their growth on during the spring.

Medic seed is in short supply in New Mexico but is readily available in California where it is frequently used. Seed at 6 pounds PLS per acre (2).

Jemalong and Hannaford barrel medics are varieties which have been grown in New Mexico and appear to be adapted to the southern part of the state (6).

Jemalong came from New South Wales, Australia. It is a leafy plant which grows close to the ground. Long runners are produced on which the leaves, flowers, and seedpods form. Jemalong requires 10 inches of rainfall and prefers alkaline soils. It makes good seedling and winter growth and has excellent seed production and revegetation (3).

Hannaford barrel medic is a semiprostrate annual that normally reaches 6 to 12 inches high. Under favorable conditions a single plant can cover up to a square yard in diameter. Hannaford is best suited to medium to light alkaline soils. It requires at least 10 inches of annual rainfall (3).

SUMMNER ANNUALS AND BIENNIALS

Where orchard management allows summer annuals to grow, the species present are usually volunteers. Plants such as watergrass commonly volunteer into orchards or vineyards where winter cover is disced down in the spring and the ground is left untilled through the summer. Other common annuals are crabgrass, millet, and panicums. Most of these make a satisfactory summer cover.

The selection of available annual summer grasses and legumes for seeding is small. Sudan grass, grain sorghums, millets, cowpeas, and soybeans may all be used. However, these are all relatively tall growing and require annual seeding.

Yellow sweetclover - *Melilotus officinalis*

Yellow blossomed sweetclover can act as both an annual or biennial. If planted in early fall it acts as an annual and will produce seed the first year. When planted in the spring it acts as a biennial and usually does not produce seed until the second year. Biennials have a higher percentage of roots to top growth than annuals and withstand lower temperatures after crown development. Yellow blossom sweetclover is more drought tolerant than white sweetclover. When drilled, seeding rates are 10 to 15 pounds per acre. Madrid is a variety of yellow sweetclover which is shorter, leafier, and

finer stemmed than other biennial sweetclovers. It also has better seedling vigor and is more drought resistant (1). Yellow sweetclover requires 10 inches of annual rainfall and white sweetclover requires an additional 2 inches (8). Sweet clover works well as a cover crop the first year and as a green manure crop plowed under the second year after the wind erosion season has passed.

PERENNIAL GRASSES AND LEGUMES

Perennial grasses and legumes fit well into certain management systems. The advantages of perennials are deeper roots and improved infiltration. They provide year-round protection from erosion and produce a wear resistant sod for summer and winter travel. Competition with the tree or vine for summer moisture and nutrients is a drawback.

Birdsfoot trefoil - *Lotus corniculatus*

This 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 as it lacks heat tolerance. Adapted to most soil types, it may be grown on heavy, poorly drained or swampy soils that are unsuited for most other legumes. It also has good tolerance to flooding and salinity. When grazed it rarely causes bloat and it is compatible in mixtures with most cool season grasses (4).

Alsike clover - *Trifolium hybridum*

This is a short-lived cool-season perennial with an erect growth habit. It is not tolerant to heat or drought and, consequently, is adapted to only the cooler regions of the state. It is well adapted to wet, poorly drained soils but is adapted to a wide variety of soil types. It will tolerate more alkalinity than most other clovers but it has a low salt tolerance (4)(6).

Strawberry clover - *Trifolium fragiferum*

This clover is a low growing plant spreading vegetatively by creeping stems that root at the nodes. It is capable of growing on saline and alkaline soils. It is an excellent cover to use with border irrigation systems as it can tolerate flooding for one to two month periods. Although strawberry clover will live under relatively dry conditions, and will survive short periods of drought, it will not make sufficient growth to warrant its use on drylands. Seed at 9 pounds PLS per acre (1). Strawberry clover requires a minimum of 16 inches of annual moisture (8). It is well adapted to seeding in a mixture with a grass.

White clover - *Trifolium repens*

More commonly known by its variety names of White Dutch or Ladino clover, it can act as an annual, a biennial, or most commonly as a perennial. It is a cool season plant which reaches 3 to 12 inches in height which spreads by creeping stems which root at the nodes. It has strong seedling vigor and

should be seeded at 5 pounds PLS per acre. White clover requires 14 inches of annual moisture (8). It is well adapted to seeding in a mixture with a grass.

Alfalfa - *Medicago sativa*

This is the most widely grown legume in New Mexico. It is adapted to seeding with both cool season and warm season grasses. It would fit into an infrequent mowing management system but would be fairly short lived under a frequent mowing regime. A major drawback of alfalfa is its deep and extensive root system which can be a major competitor with the orchard or vineyard.

Tall fescue - *Festuca arundinacea*

Tall fescue is a cool season perennial bunch grass. It is vigorous and grows well on most soils. It tolerates heat well and is cold tolerant. However, it is tall growing and is recommended only for apple and pear orchards unless a mowing regime is planned. Tall fescue can withstand frequent mowings at a minimum height of two inches. When clipped regularly it makes a satisfactory turf for any orchard or vineyard. Tall fescue requires a minimum of 18 inches of annual rainfall (8). It is also more shade tolerant than many grass species.

Creeping red fescue - *Festuca rubra*

Red fescue is a fine leafed, sod forming perennial grass. Its primary use is for turf. Red fescue produces a dense sod, stands up under traffic, and is more shade tolerant than other commonly used turf grasses.

Red fescue is adapted to the same area and use as tall fescue. It is not as vigorous as tall fescue and requires less frequent mowing to maintain a low cover. Seed at 6 pounds PLS per acre on a firm seedbed, no deeper than one-half inch.

Chewings fescue is *Festuca rubra* var. *Commutata*. It is tufted and does not creep but can be used the same as the creeping red fescue. Chewings fescue has been successfully used in orchards in northern New Mexico. Presently, the southern limit of its area of adaptation is not known.

Orchardgrass - *Dactylis glomerata*

Orchardgrass is a perennial bunch grass, used primarily for hay and pasture. It is long lived and does not respond well to close or frequent clipping.

Orchardgrass is adapted to the same uses as tall fescue. It should be used where clipping will not be frequent or close. Seed orchardgrass at 8 pounds PLS per acre on a firm, clean seedbed.

Most of the orchardgrasses require a minimum of 16 inches of annual rainfall. However, two recently released varieties require less moisture. 'Berber' is a variety that has existed on 14 inches under California conditions. 'Paute' is a variety developed for use on arid rangelands in the Intermountain West. It was selected for its ability to establish and persist in areas which receive as little as 11 inches of annual rainfall. Under dryland conditions leaves are usually less than 12 inches in height. It is also shade tolerant so it should do well under orchard conditions. Another orchardgrass,

'Pomar,' was developed in Idaho specifically for an orchard cover crop. Four inches is the minimum height for clipping orchardgrass without damaging the stand. Orchardgrass has also been successfully used in northern New Mexico as an orchard cover crop. At the present time, the southern limit in New Mexico of the two new varieties, Paiute and Berber, is unknown.

Perennial ryegrass - *Lolium perenne*

Perennial ryegrass is a cool season, short lived perennial. It grows rapidly, is used for hay, pasture and lawns, and can be mowed closely.

Its adaptation, use and management is similar to tall fescue. Seed at 6 pounds PLS per acre on a clean, firm seedbed. There are a large number of varieties of perennial ryegrass. Only the turf varieties should be used.

The following grasses are either native or naturalized exotics which have been successfully grown in New Mexico:

Atherstone lovegrass - *Erogrostis atherstonei*

This is a perennial, warm-season bunch grass which is adapted to the southern third of the state. It can establish and exist in areas with 10 inches of annual rainfall on a wide range of soil types. Seed at 1/4 to 1/2 a pound PLS per acre in a firm seedbed without clods. 'Cochise' is the only named variety. Atherstone is a tall growing grass so it probably would not be a "first choice" species. However, it will stand fairly frequent mowing and it could fit into some operations.

Bermudagrass - *Cynodon dactylon*

Bermuda is a perennial, warm-season sod forming grass which spreads by both stolons and rhizomes. Due to its prevalence in high rainfall areas, bermuda is usually considered to have a high water requirement. However, once it is established it is very drought tolerant and will exist indefinitely on less than 8 inches of annual rainfall. Common or forage type bermuda should never be used in orchards or vineyards as it can become a very troublesome weed. The turf types with short, narrow leaves such as 'Tifway' or 'Tifgreen' should be used. These varieties are sterile hybrids and can only spread by runners and rhizomes which can be controlled. Common bermuda and some forage types have viable seed which can cause the grass to spread into unwanted areas. Plant in the spring at the rate of a plug about every 12 inches or about 20 bushels of sprigs per acre.

Blue grama - *Bouteloua gracilis*

This grass is a warm-season sod forming or bunch grass. When uncut or ungrazed it will form a bunch type of growth. When frequently mowed or closely grazed, it is a sod former. It spreads by creeping stems. It is adapted to a wide range of soils and is moderately tolerant to salinity or alkalinity. It will tolerate flooding for only very short periods so probably should not be used under flood irrigation.

Two varieties have been released, 'Lovington' which requires about 14 inches of annual moisture and 'Hachita' which can exist on less than 8 inches of annual rainfall. Blue grama is not shade tolerant so it is

more suitable for use in vineyards rather than orchards. It can be used alone or it does well in a mixture of buffalo grass or western wheatgrass (9). In pure stands it should be drilled 1/4 to 1/2 inch deep at about 1 1/2 pounds PLS per acre. Broadcast seedings should double the seeding rate.

Boer lovegrass - *Eragrostis chloromelos*

This introduced warm season bunch grass requires about 11 inches of annual moisture. It is not as well adapted as Atherstone lovegrass to the tighter soils. It is also not as salt tolerant. It should be seeded on a firm seedbed without clods at 1/3 to 2/3 of a pound PLS per acre (8).

Buffalo grass - *Buchloe dactyloides*

This is a low growing warm-season grass that forms a sod by spreading with stolons. Although occasionally found on lighter soils, it is usually found on tighter soils. Buffalo grass requires about 10 1/2 inches of annual rainfall. In pure stands, this grass forms a dense sod which would seldom, if ever, require mowing. Dryland, a seeding rate of 20 pounds PLS per acre of burs or 3 pounds PLS per acre of grains should be used. If watered regularly during the first growing season, the seeding rate can be cut in half as the stolons will spread rapidly with adequate moisture. Buffalo is adapted to seeding in mixtures of other grasses such as blue grama or western wheatgrass if these taller growing grasses are under a frequent clipping regime. However, heavy shade will

eliminate it, so it is best adapted to vineyards or young orchards. There are two released varieties, 'Texoka' and 'Sharps Improved.' Both are satisfactory for use in New Mexico.

Canby bluegrass - *Poa canbyi*

This is a native cool-season perennial bunch grass. It is a small understory grass which makes vigorous early spring growth. It is shade tolerant so should be adapted to either vineyards or orchards. Leaves are mostly basal and flat. It requires well drained sites. Where season-long moisture is available, it is crowded out by other species when seeded in a mixture. It begins growing in early spring and becomes dormant in early summer. Dormant plants are very drought resistant, enabling it to survive on dry, shallow, or rocky sites. It can exist on 8 inches of annual moisture. In New Mexico, the southern limit of its adapted area is unknown. It should be seeded at one pound PLS per acre drilled or two pounds per acre PLS broadcast on a firm, clod-free seedbed. Fall seeding is a must in low rainfall areas. Only one variety, 'Canbar,' has been released.

Creeping foxtail - *Alopecurus arundinaceus*

This is a perennial cool-season species introduced from Europe. The only released variety is 'Garrison' selected for its vigorous rhizomes and broad leaves. Due to the amount of leaf development, Garrison would require frequent mowing. It makes a palatable, nutritious hay. It is particularly adapted to areas with high water tables or wet areas. It can withstand flooding for extended periods. Single plants have been

known to spread as much as four feet in crown diameter in a single growing season. It is adapted to a broad range of soils as long as sufficient moisture is available. A seeding rate of one pound per acre is adequate. However, the seed is very hairy and handles almost like feathers. Experience has shown that a seeding rate of 3 to 4 pounds PLS per acre is needed for ease of handling and uniform distribution. Uniform moist soil is a requisite for good germination of Garrison seed. The seedlings emerge within 12 days. Soil moisture exceeding 50 percent field capacity is necessary during that period. Seedlings are small and weak after emergence and the first six weeks growth is slow. Rhizomes start to appear by eight weeks and from then on growth is rapid. Established stands are long lived and improve with age because of the prolific rhizomes and the abundance of shattering seed. It has a high salt tolerance (14 millimhos per cm.) (7). Warm temperatures are the limiting factor in the area of adaptation. The southern limit of Garrison in New Mexico is unknown. It has been established and is performing very well on a high water table area in the Rio Grande Valley at Espanola. This is its present known southern limit.

Crested wheatgrass - *Agropyron cristatum*

This is a cool-season introduced bunch grass. Two named varieties 'Fairway' and 'Ruff' are turf types which are suitable for cover crops in vineyards and orchards. 'Nordan' is a variety which has also been used in Washington State as a cover crop. 'Ephraim' is a newly released variety that should also be adapted to New Mexico although it has not yet been tested in the state. These varieties are low growing with a weakly sodding growth habit. They are easily established and start

growth early in the spring. In favorable seasons they make good fall regrowth. They are long lived and drought resistant. They will not tolerate prolonged flooding. Crested wheatgrass will exist on eight inches of annual moisture (8). Warm temperature is the limiting factor in its area of adaptation. Its southern limit in New Mexico is presently unknown. Seed should be drilled at the rate of 3 pounds PLS per acre or broadcast at 6 pounds PLS per acre. Some states in the northwest drill 10-15 pounds PLS per acre for a rapid cover.

Indian ricegrass - *Oryzopsis hymenoides*

This is a native cool-season densely tufted perennial grass with numerous narrow leaves. It is one of the most drought enduring native grasses, establishing with only six inches of annual moisture. It is adapted to a wide range of soils, doing best on the sands but able to establish and persist on the tighter clays. 'Paloma' is the best adapted variety for New Mexico and will grow anyplace in the state (8).

It is drought tolerant and will withstand weak salinity and alkalinity but it will not tolerate poorly drained soils, high water tables, or frequent flooding. Since the seed has an average 56 day germination period, it should be planted about two months prior to the period with the most favorable moisture and temperature conditions. Planting in fall to allow the seed to overwinter in the soil also assists in overcoming this dormancy problem. Seed should be planted 1 1/2 to 3 inches deep on medium to coarse textured soils at the rate of 5 1/2 pounds PLS

per acre drilled or 11 pounds PLS per acre broadcast. When broadcast, it is important that the soil be worked lightly to get an adequate soil cover or the seed will fail to germinate.

New seedings may need weeds controlled. A new seeding should not be mowed the first time until it starts to head out. Stands will be short lived unless they are occasionally allowed to head out. Indian ricegrass is not shade tolerant so it is more suitable for use in vineyards rather than orchards (9).

Lehmann lovegrass - *Eragrostis lehmanniana*

This is a warm-season, semi-prostrate, stoloniferous, bunchy sod former introduced from South Africa. It is easily established and thickens and spreads by self seeding and the stems rooting at the nodes (9). It is adapted to the southern third of the state. Lack of cold tolerance is the limiting factor in New Mexico. It is very drought tolerant and can exist on seven inches of annual rainfall. Research has shown that Lehmann lovegrass produces more forage with less water than any other known forage species. There are three released varieties of Lehmann lovegrass, 'A-68,' 'Puhumima', and 'Kuivata.' Kuivata is the variety which should be used in New Mexico as it is the most drought tolerant of the three. It should be able to exist on less than eight inches of annual moisture. It was selected for its seedling drought tolerance, plant survival, forage production, and reseeding characteristics under natural conditions (8). Seed at a quarter of a pound PLS per acre on a firm, clod-free seedbed.

Sheep fescue - *Festuca ovina*

Sheep fescue is a perennial cool-season bunch grass. 'Covar', the only released variety, is a dwarf, densely tufted with abundant fine stems. It is slow to establish but once established it is very persistent, winterhardy, and drought tolerant. In New Mexico, it is adapted to the San Juan Basin and the northern mountains. It should be seeded at 1 1/4 pounds PLS per acre drilled or 2 1/2 pounds PLS per acre broadcast (8). For a quicker cover, it can be used in a mixture with slender wheatgrass or crested wheatgrass. In Washington state, where this grass is frequently used as a cover crop, they seed at 12 pounds PLS per acre drilled or double that amount broadcast to achieve a quicker cover.

Siberian wheatgrass - *Agropyron sibiricum*

This is a cool-season drought resistant bunch grass. It is able to exist on eight inches of moisture in the northern mountains and the San Juan Basin (8). It may also be able to exist in the southern mountains, but has not been tested there. 'P-27' is the variety which should be used in New Mexico. In pure stands it should be drilled at 5 1/2 pounds PLS per acre or broadcast at 11 pounds PLS per acre.

Sideoats grama - *Bouteloua curtipendula*

This is a warm-season, slightly spreading native bunch grass. Established plants spread slowly by tillering and short scaly rhizomes (9). The leaves are mostly basal and with an occasional mowing, sideoats will form a dense sod. It can exist on as little as eight inches of annual

moisture (8). Sideoats grama is adapted to all of New Mexico except for the San Juan Basin where the dry cold is the limiting factor. There are several varieties on the market but 'Niner' is the variety which is best adapted to New Mexico conditions. Sideoats grama should be drilled at 3 1/2 pounds PLS per acre or broadcast at 7 pounds PLS per acre.

Slender wheatgrass - *Agropyron trachycaulum*

This is a native cool-season bunch grass, adapted to the north-central and north-eastern part of the state above 7,000 feet. In the wild it is seldom found in pure stands. It is normally short lived, living from 3-5 years. Several varieties are available but the one most suited to New Mexico conditions is 'San Luis.' San Luis was selected because of its outstanding establishment ability and its longevity. It will live at least two years longer than other slender wheatgrass varieties. It can also do well at 6,000 feet or lower if moisture is adequate (about 14 inches annually). In pure stands, slender wheatgrass should be drilled at 6 1/2 pounds PLS per acre and broadcast at 13 pounds PLS per acre.

Streambank wheatgrass - *Agropyron riparium*

This is a native cool-season sod grass which tolerates drought and spreads rapidly to form a good ground cover. 'Sodar' is the only named and released variety. It can be established and maintained on eight inches of annual moisture above 3,500 feet. Below 3,500 feet it requires 12 inches of moisture. Sodar is adapted to the northern part of New Mexico. The limiting factor is temperature. In Albuquerque, Sodar

will live but goes totally dormant during July and August even with an excess of supplemental water. Streambank wheatgrass lends itself to seeding in mixtures. In pure stands it should be drilled at 5 1/2 pounds PLS per acre or broadcast at 11 pounds PLS per acre. Seed germinate in about seven days under ideal conditions.

Tall wheatgrass - *Agropyron elongatum*

This is an introduced, cool-season, bunch grass. It is very vigorous and under irrigation can reach a height of five feet. Due to its size, we would normally not recommend it as a cover crop. However, it has been established on soils with a pH of over 10 and has the highest tolerance of any cultivated grass to saline, saline-sodic, and non-saline-sodic soils (9). Normally, in New Mexico, about 14 inches of annual moisture is required for tall wheatgrass to exist. However, experience has shown that 'Jose,' a variety developed and released in New Mexico, can be established and is presently existing satisfactorily on the dam of a Floodwater Retarding Structure in a 10 inch rainfall area east of Espanola in the Rio Grande Valley. Farther north, in Wyoming, tall wheatgrass is recommended for seeding in areas with 5-9 inches of annual precipitation (9).

Tall wheatgrass can withstand frequent mowing as long as it is not cut closer than four inches. It is usually planted in pure stands. It will tolerate frequent flooding, shallow water tables, and imperfectly drained sites. It has only fair shade tolerance so would be more suitable for vineyards and new orchards rather than mature orchards.

Tall wheatgrass should be drilled at about 12 pounds PLS per acre or broadcast at 24 pounds PLS per acre. Seed germinates in 21 days under ideal conditions and seedling vigor is good to very good (9).

Thickspike wheatgrass - *Agropyron dasystachyum*

This is a strongly rhizomatous, cool-season, sod forming grass that is very similar to western wheatgrass. It has the same area of adaptation as streambank wheatgrass. 'Critana' is the only named variety of this species. It has excellent seedling vigor. Germination occurs in 21 days under ideal conditions (9). Thickspike wheatgrass should be drilled at 6 pounds PLS per acre or broadcast at 12 pounds PLS per acre. Broadcast seed should be lightly covered with soil. It can be seeded alone or used in a mixture. After a stand becomes fully established, it will soon become sodbound and start to deteriorate unless additional nitrogen is applied (9).

Weeping lovegrass - *Eragrostis curvula*

This is an introduced, warm-season bunch grass. It is adapted to a wide range of soils and is noted for its ability to do well on poor sites. It can exist on 10 inches of annual moisture but does much better in the 15 - 20 inch zone. Due to its dense, bunch growth habit, this grass would not normally be a first choice for a cover crop. However, it is quick to establish and is not weedy so it is easy to control in the orchard.

Most seeds germinate in seven days and they have a strong seedling vigor. It will make a good cover the first year and some plants head out under good moisture conditions (9). Weeping lovegrass can withstand frequent mowing if clipped no closer than three inches. It should be allowed to grow during the last 30 days before a killing frost to establish a root reserve. If clipped closely throughout the fall, the lack of root reserves will rapidly thin out a stand.

'Catalina' is the most drought tolerant variety and should be used in the southern part of New Mexico. 'Morpa' or 'Ermelo' varieties should be used in the northern part of the state as they are more cold tolerant and also require more moisture than 'Catalina.' 'Morpa' is more cold tolerant than 'Ermelo.' Weeping lovegrass should be drilled at 3/4 of a pound PLS per acre or broadcast at 1 1/2 pounds PLS per acre on a clod-free seedbed. A good firm seedbed is very important in stand establishment.

Western wheatgrass - *Agropyron smithii*

This is a native, cool season, sod-forming grass which spreads by strong rhizomes. It thrives on fine to very fine textured soils having moderate or higher levels of soil moisture (9). Although, often planted on sandler soils, it is normally crowded out by thickspike, streambank, or Siberian wheatgrass which do better on the lighter soils. It is tolerant of poor drainage, water tables within six inches of the soil surface, and spring flooding. It will grow in pure stands or in mixtures with other wheatgrasses, alkali sacaton, buffalograss, and blue and sideoats grammas.

There are several varieties of western wheatgrass on the market but 'Arriba' is the best adapted variety for New Mexico. Under ideal conditions germination occurs in 28 days. Seedling vigor is only fair and plants develop slowly until they are well established. Once established it is very hardy and durable (9). Without supplemental water, it often takes several years to develop a full stand. Once established it can be mowed as closely as two inches without damaging the stand.

Western wheatgrass should be drilled at 7 3/4 pounds PLS per acre or broadcast at 15 1/2 pounds PLS per acre. When broadcast, the seed should be lightly covered with soil.

Yellow bluestem - *Bothriochloa ischaemum*

This is an introduced, warm season, semi-prostrate bunch grass. There are several varieties on the market but the variety best adapted for New Mexico is 'Ganada.' 'Ganada' is cold tolerant throughout the state yet is much more drought tolerant than other varieties. It has been established and maintained in the southern part of the state on less than eight inches of annual moisture on clay and clay-loam soils. Although it will grow on sandy soils, 'Ganada' is better adapted to the finer textured soils.

When mowed 'Ganada' has a tendency to flatten out and become more prostrate. Continued close mowing (not closer than two inches) will result in a turf being formed. It will do very well without fertilization.

However, if a stand needs to be "thickened up," it will respond very well to fertilizer. It should be seeded at 1 1/2 pounds PLS per acre or 3 pounds PLS broadcast.

OTHER ORCHARD AND VINEYARD COVER CROP PLANTS

Volunteer weeds

Frequently there are enough weed seeds in the soil to produce a cover if the operator will allow them to grow. Weeds are usually thought of as plants that should be destroyed, but much of the vegetation that is commonly termed weeds can provide many of the benefits described earlier. If weeds produce the desired growth habits, such as adequate top growth and an abundant root system, then they should be utilized as a cover crop and their presence can be an advantage rather than a detriment. In general, volunteer weeds should be used and managed as reseeding annuals.

Vegetative types will be selected out by management methods, such as mowing, and these will tend to dominate sites until the management changes. For instance, close clipping will eliminate tall growing species.

INITIAL ESTABLISHMENT

When the orchard or vineyard is flood irrigated, a seedbed can be prepared and the cover crop seeded as if it were a pasture planting. When drip irrigation is used, the cover crop will need to be established the

same as if it were a range seeding. This could entail developing a temporary cover crop prior to seeding a perennial grass or legume cover crop.

Unfortunately, in the Southern Desert major land resource area, which covers about a fourth of the state, range seedings are seldom successful. In this part of the state, a temporary watering system will be required to successfully establish a cover crop. After watering through the first growing season, many of the plants discussed above will provide many years of satisfactory cover on very low amounts of rainfall.

In making all of the seedings, the amount of seed to plant per acre should be computed on a pure live seed (PLS) basis. Pure live seed is computed by determining the percent of inert matter, and the percent germination from the seed tag and computing the amount of seed that will actually germinate. Seeding rates are then adjusted to insure adequate seed is planted. For example, if you want to seed 10 pounds PLS per acre, and the tag showed 10 percent inert, and 85 percent germination. Take 10 pounds \times .10 = 1 pound of inert matter. Subtract this amount from the 10 pounds leaving 9 pounds. Take .85 \times 9 lbs = 7.65 lbs. This is the amount of pure live seed which can be expected to germinate from each 10 pounds planted.

TABLE 1

Name	Longevity	PRECIPITATION				Growth Habit	Adapted Area
		0-8"	8-12"	12-16"	16"+		
Alfalfa <i>Medicago sativa</i>	P			X		Bunch	Entire state
Alsike clover <i>Trifolium hybridum</i>	P				X	Bunch	Cooler regions of state
Annual fescue <i>Vulpia myuros</i>	A		X			Bunch	Entire state
Annual ryegrass <i>Lolium multiflorum</i> <i>Lolium rigidum</i>	A		X			Bunch	Entire state
Atherstone lovegrass <i>Eragrostis atherstonei</i>	P		X			Bunch	Southern third of state
Barley <i>Hordeum vulgare</i>	A			X		Bunch	Entire state
Barrel medic <i>Medicago species</i>	A		X			Creeping	Southern half of NM. Northern limit unknown
Bermudagrass <i>Cynodon dactylon</i>	P	X				Creeping	Entire state
Birdsfoot trefoil <i>Lotus corniculatus</i>	P				X	Bunch	Entire state in cooler Mountainous regions
Black medic <i>Medicago species</i>	A		X			Creeping	Southern half of NM. Northern limit unknown
Blue grama <i>Bouteloua gracilis</i>	P	X				Bunch	Entire state
Boer lovegrass <i>Eragrostis chloromelos</i>	P		X			Bunch	Southern third of state

^{1/} P = Perennial

B = Biennial

A = Annual

TABLE 1 (Continued)

Name	Longevity	PRECIPITATION				Growth Habit	Adapted Area
		0-8"	8-12"	12-16"	16"+		
Buffalo grass <i>Buchloe dactyloides</i>	P		X			Creeping	Entire state
Canby bluegrass <i>Poa canbyi</i>	P	X				Bunch	Northern third of N.M. Southern limit unknown
Creeping foxtail <i>Alopecurus arundinaceus</i>	P				X	Creeping	Northern third of N.M. Southern limit unknown
Creeping red fescue <i>Festuca rubra</i>	P				X	Creeping	Entire state
Crested wheatgrass <i>Agropyron cristatum</i>	P	X				Bunch	Northern Third of N.M. Southern mountains
Hairy vetch <i>Vicia villosa</i>	A			X		Creeping	Entire state
Indian ricegrass <i>Oryzopsis hymenoides</i>	P	X				Bunch	Entire state
Lehmann lovegrass <i>Eragrostis lehmanniana</i>	P	X				Bunch	Southern 1/2 of N.M.
Orchardgrass <i>Dactylis glomerata</i>	P			X		Bunch	Entire state
Perennial ryegrass <i>Lolium perenne</i>	P				X	Bunch	Entire state
Purple vetch <i>Vicia atropurpurea</i>	A			X		Creeping	Southern 1/2 of N.M.
Rye <i>Secale cereale</i>	A				X	Bunch	Entire state
Sheep fescue <i>Festuca ovina</i>	P		X			Bunch	San Juan Basin & Northern mountains
Siberian wheatgrass <i>Agropyron sibiricum</i>	P		X			Bunch	San Juan Basin & Northern mountains

TABLE 1 (Continued)

Name	Longevity	PRECIPITATION				Growth Habit	Adapted Area
		0-8"	8-12"	12-16"	16"+		
Sideoats grama <i>Bouteloua curtipendula</i>	P		X			Bunch	Entire state
Slender wheatgrass <i>Agropyron trachycaulum</i>	P			X		Bunch	North-central & Northeast N.M. above 7,000 feet
Strawberry clover <i>Trifolium fragiferum</i>	P				X	Creeping	Entire state
Streambank wheatgrass <i>Agropyron riparium</i>	P		X			Creeping	North 1/2 of N.M. & Southern mountains
Tall fescue <i>Festuca arundinacea</i>	P				X	Bunch	Entire state
Tall wheatgrass <i>Agropyron elongatum</i>	P			X		Bunch	Entire state
Thickspike wheatgrass <i>Agropyron dasystachyum</i>	P		X			Creeping	North 1/2 of N.M. & Southern mountains
Volunteer weeds	A-B-P	X				Various	Entire state
Weeping lovegrass <i>Eragrostis curvula</i>	P			X		Bunch	Entire state except mountains
Western wheatgrass <i>Agropyron smithii</i>	P		X			Creeping	Entire state
White clover <i>Trifolium repens</i>	P			X		Creeping	Entire state
Yellow bluestem <i>Bothriochloa ischaemum</i>	P	X				Bunch	Entire state
Yellow sweetclover <i>Melilotus officinalis</i>	B		X			Bunch	Entire state

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