
Evaluation of Cool Season Cover Crops in the Southwest Region



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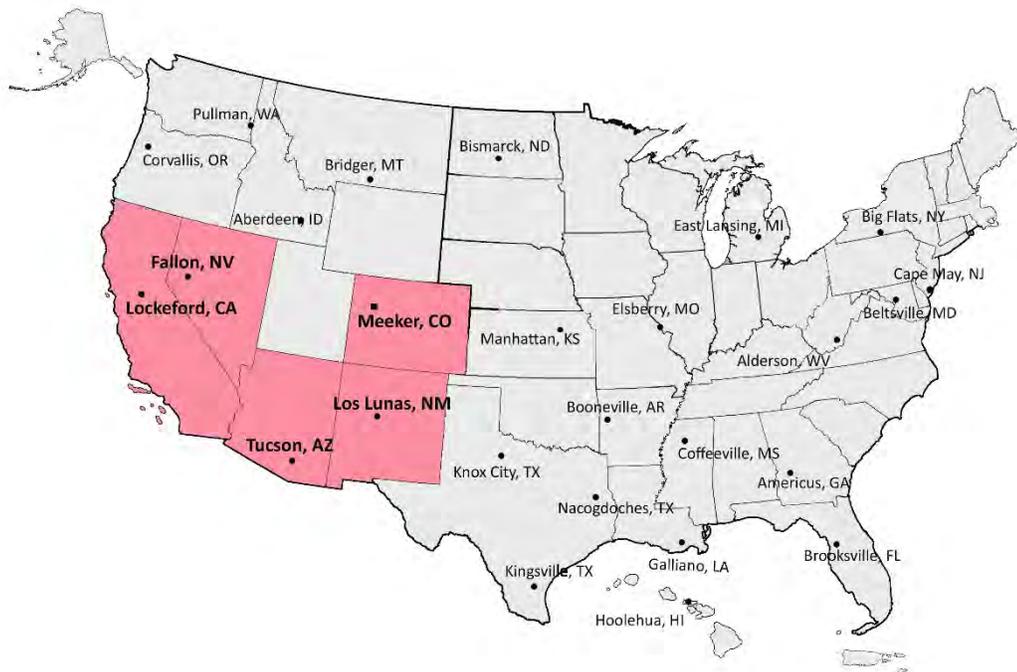
Preface

The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Plant Materials Program has been involved in the evaluation of conservation plants and planting technology for more than 80 years.

Plant Materials Centers (PMCs) in Tucson, AZ, Lockeford, CA, Meeker CO, Los Lunas, NM and Fallon, NV conducted a 2-year evaluation of 56 commercially available varieties of black oats, black seeded oats, cereal rye, crimson clover, daikon radish, hairy vetch, red clover, and winter/field pea to assess their adaptation and performance as cover crops in the Southwest PMC region. Information from the study will assist conservation planners and farmers in selecting varieties to meet the cover crop objectives of their production systems.

For additional information on specific species of plants mentioned in this publication, please see the USDA PLANTS database at: (<http://plants.usda.gov/java/>) or contact the nearest Plant Materials Center or plant materials specialist (<http://plant-materials.nrcs.usda.gov/contact/>) and/or the Land Grant Universities that serve the State. For specific information on soils and soil health, please see USDA NRCS soils website at: (<http://www.nrcs.usda.gov/wps/portal/nrcs/site/soils/home/>). Also, see technical resources on the National Plant Materials Program Web site at: (<http://www.plant-materials.nrcs.usda.gov/>).

USDA NRCS Plant Materials Centers Southwest Region



INTRODUCTION

Farmers rely on the latest crop variety trials to make informed decisions on planting the best adapted crop variety to maximize yield given their soils and production practices. With the ever-growing interest in planting cover crops, the USDA-Natural Resources Conservation Service (NRCS) Plant Materials Program initiated a nationwide study to identify adapted varieties of cool season annual species for cover cropping. With input from State Agronomists and State Soil Health Specialists, seven cool season annual cover crop species were identified for comparative evaluations using the network of NRCS Plant Materials Centers (PMCs). The PMCs assembled commercially available varieties of black oats, black seeded oats, cereal rye, crimson clover, daikon radish, hairy vetch, red clover, and winter/field pea to evaluate their performance and adaptation to different soils and geographical regions in the U.S. This technical note represents two years of data collected from PMCs in the region, performance may vary in other locations and years. Information from this study along with local research from university extension and other research entities can assist farmers and conservation planners in selecting adapted cool season annual varieties for their crop production systems. Additional information for each PMC location, including plant height and biomass (where collected), can be found in their final study reports hyperlinked at the end of this document.

CHOOSING VARIETIES FOR CONSERVATION PLANTINGS

Commodity crops are chosen to fit local climate and soil conditions, and producers select varieties of commodity crops carefully to maximize performance and returns. For the producer, variety selection is a dynamic process that takes advantage of the many options available when deciding which varietal attributes best meet their needs. When choosing cover crop varieties, the producer may also take advantage of differences among varieties to best meet the goals of their production system.



When a cover crop species is chosen to meet a resource concern, a variety from that species may be selected to meet needs such as: 1) production of early or late cover, 2) early or late maturity, or 3) winter survival. By choosing varieties based on the production system, cover crop plans and systems can be developed to:

- time planting and termination dates to fit within the cropping system,
- develop mixes with species that mature at similar times to facilitate mechanical termination,
- use winterkill as a method of termination,
- use moderate levels of winterkill to manage competition of aggressive species, and
- use maturity dates to regulate the amount of cover crop residue.

Through selection of varieties that fit production systems, producers may overcome obstacles that discourage the use of cover crops.

PROCEDURE

Cool season, annual, cover crop varieties were evaluated at NRCS PMCs in Tucson, AZ; Lockeford, CA; and Fallon, NV in 2016-2017 and 2017-2018; Los Lunas, NM in 2016-2017, and Meeker, CO 2017-2018 and 2018-2019 (Table 1). Replicated plots were drilled in the fall using the pure live seed planting method (Table 2), and seeding rates were determined by averaging the recommended seeding rates from NRCS cover crop standards and specifications for uniform data analysis (Table 3). Legumes were inoculated with appropriate rhizobia prior to planting. Non-legumes were fertilized with 40 lbs. N/acre, and all entries received 60 lbs. P/acre and 30 lbs. K/acre both years. Plots at Tucson, AZ and Fallon, NV (1 year) received irrigation during establishment while plots at Lockeford, CA, Meeker, CO, and Los Lunas, NM received no irrigation. Cover crop varieties were evaluated for:

- Quick fall cover—Emergence at 14 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25%,
- Fall stand quality—Yes is >65% emergence at 28 days after planting,
- Winter survival—Plant survival rating of Excellent >75%, Good 50-75%, Marginal 25-50%, Poor <25%,
- Maturity date— Days after planting to 50% bloom, data was grouped over the region by <175=Early, 175-200=Mid, >200=Late to identify varietal differences, and
- Disease and insect ranking—Damage observed was None, Low, Moderate, or High.

Table 1. Soil type, long-term yearly rainfall, average frost date, and low temperatures Tucson, AZ; Lockeford, CA; Meeker CO; Los Lunas, NM and Fallon, NV.

| Plant Materials Center | Soil type | Average Yearly Rainfall (inches) | Average Frost Date | Low Temperature (F) | |
|------------------------|------------------------------------|----------------------------------|--------------------|---------------------|-----------|
| | | | | 2016-2017 | 2017-2018 |
| Tucson, AZ | Comoro silt loam | 12 | Nov 29 | 28 | 28 |
| Lockeford, CA | Columbia and Vina fine sandy loams | 19 | Nov 15 | 28 | 29 |
| Meeker, CO | Work loam | 17 | Sept 15 | -20 | -17 |
| Los Lunas, NM | Bluepoint loamy fine sand | 10 | Oct 12 | 14 | 14 |
| Fallon, NV | Sagouspe loamy sand | 5 | Sept 25 | 9 | 12 |

Table 2. Planting date/year and planting method in Tucson, AZ; Lockeford, CA; Meeker CO; Los Lunas, NM and Fallon, NV.

| Plant Materials Center | Planting Date (Year) | | Planting Method |
|------------------------|----------------------|-------------|-----------------|
| | 2016 | 2017 | |
| Tucson, AZ | Oct 18 | Oct 18 | Drill |
| Lockeford, CA | Nov 11 | Oct 19 | Drill |
| Los Lunas, NM | Sept 27 | ----- | Drill |
| Fallon, NV | Oct 19 | Sep 27 | Drill |
| | 2017 | 2018 | |
| Meeker, CO | Aug 4 | Aug 3 | Drill |

Table 3. Cover Crop planting rates at NRCS Plant Materials Centers in Tucson, AZ; Lockeford, CA; Meeker CO; Los Lunas, NM and Fallon, NV.

| Common Name | Species | PLS lbs./Acre |
|-------------------|-----------------------------|---------------|
| black oats | <i>Avena strigosa</i> | 60 |
| black seeded oats | <i>Avena sativa</i> | 60 |
| cereal rye | <i>Secale cereale</i> | 100 |
| crimson clover | <i>Trifolium incarnatum</i> | 18 |
| daikon radish | <i>Raphanus sativus</i> | 9 |
| hairy vetch | <i>Vicia villosa</i> | 18 |
| red clover | <i>Trifolium pratense</i> | 9 |
| winter/field pea | <i>Pisum sativum</i> | 70 |



Hairy vetch blooming at the Tucson Plant Materials Center.

COVER CROP PERFORMANCE AND RESULTS

BLACK OATS/BLACK SEEDED OATS

Description: upright, winter annual grass. Height from 2 ½–5 feet. Black oats are not cold hardy and will winterkill at temperatures less than 19°F depending on growth stage. Black seeded oats are more cold tolerant than black oats, but susceptible to winter damage in northern locations. Prefers sandy or loamy soils but can also grow in heavy clay. It is used as a rotational cover crop either seeded alone or in a mixture.

Benefits: N scavenger, improves organic matter and soil structure, erosion control, weed suppressor, livestock forage.



Black oats

Performance of Black Oats/Black Seeded Oats Varieties

| Cover Crop | Quick Fall Cover ^{1/} | Fall Stand Quality ^{2/} | Winter Survival ^{3/} | Maturity Date ^{4/} | Disease Ranking ^{5/} | Insect Ranking ^{5/} |
|------------|--------------------------------|----------------------------------|-------------------------------|-----------------------------|-------------------------------|------------------------------|
| Cosaque | Good | Yes | Excellent/WK ^a | Late | Low | Low |
| Soil Saver | Good | Yes | Good/WK ^b | Mid | Low | Low |

^{1/}Quick fall cover—Emergence at 14 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25%; ^{2/}Fall stand quality—Yes is >65% emergence at 28 days after planting; ^{3/}Winter survival—Plant survival rating of Excellent >75%, Good 50-75%, Marginal 25-50%, Poor <25%; ^{4/}Maturity date—Days after planting to 50% bloom: <175=Early, 175-200=Mid, >200=Late; and ^{5/}Disease and insect ranking—Damage observed was None, Low, Moderate, or High. WK—Winterkill.

^aExcellent to good winter survival at all locations except CO; ^bWinterkilled in CO and NV.

Expected Adaptation: Soil Saver (black oats) and Cosaque (black seeded oat) rated good to excellent for quick fall cover and acceptable stand quality at all locations both years except in 2017-2018 in Lockeford, CA and Tucson, AZ where Cosaque rated poor and fair for fall cover. Soil Saver also rated fair for fall cover at these two locations in 2017-2018. Cosaque had good to excellent winter survival at all locations but winterkilled in Meeker, CO both years. Soil Saver also exhibited good winter survival at all locations except in Meeker, CO and Fallon, NV where it winterkilled both years. Where winter survival was best, Soil Saver reached maturity (50% bloom) before Cosaque. Both varieties exhibited low disease and insect damage.



Soil Saver provided good, quick fall cover with acceptable stand quality in Fallon, NV but winterkilled both years.

CEREAL RYE

Description: upright, cool season, annual grass. Height from 3 to 6 feet. Grows in a wide variety of climate and soil conditions but performs best in light loams or sandy soils. It also does well in clay soils.

Benefits: N scavenger, improves organic matter and soil structure, erosion control, weed suppressor, livestock forage.



Cereal rye varieties at the Tucson Plant Materials Center.

Performance of Cereal Rye Varieties

| Cover Crop | Quick Fall Cover ^{1/} | Fall Stand Quality ^{2/} | Winter Survival ^{3/} | Maturity Date ^{4/} | Disease Ranking ^{5/} | Insect Ranking ^{5/} |
|-----------------|--------------------------------|----------------------------------|---------------------------------|-----------------------------|-------------------------------|------------------------------|
| Aroostook | Excellent | Yes | Excellent/Marginal ^a | Mid | Low | None |
| Bates | Excellent | Yes | Excellent | Early | Low/Moderate ^c | Low |
| Brasetto | Excellent | Yes | Excellent | Mid | Low | None |
| Elbon | Excellent | Yes | Excellent | Mid | Low | Low |
| FL 401 | Excellent | Yes | Excellent/Poor ^b | Early | Low/Moderate ^c | Low |
| Guardian | Excellent | Yes | Good | Mid | Low/Moderate ^c | None |
| Hazlet | Excellent | Yes | Excellent | Mid | Low/Moderate ^c | None |
| Maton | Excellent | Yes | Excellent | Mid | Low | None |
| Maton II | Excellent | Yes | Excellent | Mid | Low | None |
| Merced | Excellent | Yes | Excellent/Poor ^b | Early | Low/High ^c | Low |
| Oklon | Excellent | Yes | Excellent | Mid | Low | None |
| Rymin | Excellent | Yes | Excellent | Late | Low/Moderate ^c | None |
| Wheeler | Excellent | Yes | Excellent | Mid | Low/Moderate ^c | None |
| Wintergrazer 70 | Excellent | Yes | Excellent/Marginal ^a | Mid | Low | Low |
| Wrens Abruzzi | Excellent | Yes | Excellent/Marginal ^a | Mid | Low | Low |

^{1/}Quick fall cover—Emergence at 14 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25%; ^{2/}Fall stand quality—Yes is >65% emergence at 28 days after planting; ^{3/}Winter survival—Plant survival rating of Excellent >75%, Good 50-75%, Marginal 25-50%, Poor <25%; ^{4/}Maturity date—Days after planting to 50% bloom: <175=Early, 175-200=Mid, >200=Late; and ^{5/}Disease and insect ranking—Damage observed was None, Low, Moderate, or High.

^aExcellent to good winter survival at all locations except in CO where winter survival was marginal in 2017-2018; ^bExcellent to good winter survival at locations except in CO and NV where survival was poor in 2017-2018; ^cDisease damage of moderate and high in CA.

Expected Adaptation: Cereal rye varieties provided good to excellent, quick fall cover and fall stand quality across locations both years, except in Tucson, AZ in 2016-2017 due to dry conditions after planting. Winter survival was also good to excellent across all varieties and locations, except FL101 and Merced with poor winter survival/winterkill in Meeker, CO and Fallon, NV in 2017-2018. Winter surviving varieties had varying maturity dates (50% bloom). None of varieties exhibited notable disease or insect damage except in Lockeford, CA where disease damage was observed when varieties reached 50% bloom. The most notable damage was observed on Merced.



FL 401 and Merced provide excellent, quick fall cover and stand quality but poor winter survival in Meeker, CO and Fallon, NV.

CRIMSON CLOVER

Description: cool season annual legume. Plants are generally densely hairy with a rosette of upright, usually unbranched stems, reaching 1 to 3 feet tall supported by a central taproot and many fibrous roots. Flowers produce nectar and pollen that attract European honeybees, as well as a wide variety of native bees.

Benefits: N source, improves organic matter and soil structure, erosion control, weed suppressor, livestock forage, pollinator habitat.



Crimson clover

Performance of Crimson Clover Varieties

| Cover Crop | Quick Fall Cover ^{1/} | Fall Stand Quality ^{2/} | Winter Survival ^{3/} | Maturity Date ^{4/} | Disease Ranking ^{5/} | Insect Ranking ^{5/} |
|----------------|--------------------------------|----------------------------------|-------------------------------|-----------------------------|-------------------------------|------------------------------|
| AU Robin | Fair/Excellent ^a | Yes/No ^g | Excellent/Poor ^m | Mid | Low | Low |
| AU Sunrise | Good/Excellent ^b | Yes/No ^h | Excellent/Poor ^m | Mid | Low | Low |
| AU Sunup | Poor/Good ^c | Yes/No ⁱ | Excellent/Poor ^m | Mid | Low | Low |
| Contea | Good/Fair/Poor ^d | Yes/No ^j | Excellent/Poor ^m | Mid | Low | Low |
| Dixie | Fair/Poor ^e | Yes/No ^k | Excellent/Poor ^m | Mid | Low | Low |
| Kentucky Pride | Good/Poor ^f | Yes/No ^l | Excellent/Poor ^m | Late | Low | Low |

^{1/}Quick fall cover—Emergence at 14 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25%; ^{2/}Fall stand quality—Yes is >65% emergence at 28 days after planting; ^{3/}Winter survival—Plant survival rating of Excellent >75%, Good 50-75%, Marginal 25-50%, Poor <25%; ^{4/}Maturity date—Days after planting to 50% bloom: <175, 175-200=Mid, >200=Late; and ^{5/}Disease and insect ranking—Damage observed was None, Low, Moderate, or High.

^aFair in all locations except NM where it rated excellent one year; ^bGood in AZ, CA, fair in CO and NV, excellent in NM one year; ^cPoor, quick fall cover in all locations except NM where it rated good and CA where it rated fair; ^dGood, quick fall cover in NM and NV, fair in AZ and CA, poor in CO; ^eFair in AZ, CA, good in NV, poor in CO and excellent in NM; ^fGood in AZ, CA, NV, fair in CO and excellent in NM; ^gAcceptable for stand quality in CA, NM, NV only; ^hAcceptable fall stand quality in all locations except CO; ⁱAcceptable fall stand quality only in NM; ^jAcceptable fall stand quality in NM and NV; ^kAcceptable fall stand quality in all locations except CO; ^lAcceptable in all locations except CO; ^mExcellent to good winter survival in AZ, CA, and NM, marginal to poor in CO and NV.

Expected Adaptation: Quick fall cover and stand quality varied by variety and location. Winter survival ranged from excellent to good in Tucson AZ, Lockeford, CA and Los Lunas, NM but was generally marginal in Fallon, NV and poor in Meeker, CO. Kentucky Pride reached maturity (50% bloom) later than all other varieties. All varieties exhibited low disease and insect damage.



Kentucky Pride blooming at the Lockeford, California Plant Materials Center.

DAIKON RADISH

Description: winter annual with stiff, straight hairs near the base of the leaves. Seed stalks elongate from the rosette. Flowers in the spring with four pink, white, or lavender petals. Fruit resemble small bean pods. Radish develops a unique taproot which may reach depths of 24 inches or more. The upper 12-20 inches of the taproot thicken and can grow to 2 inches or more in diameter. Concorde, Control and Defender are oilseed radishes while other radishes are daikon/forage varieties.

Benefits: N scavenger, improves organic matter and soil structure, erosion control, weed suppressor, livestock forage.



Daikon radish taproot

Performance of Daikon Radish Varieties

| Cover Crop | Quick Fall Cover ^{1/} | Fall Stand Quality ^{2/} | Winter Survival ^{3/} | Maturity Date ^{4/} | Disease Ranking ^{5/} | Insect Ranking ^{5/} |
|------------|--------------------------------|----------------------------------|-------------------------------|-----------------------------|-------------------------------|------------------------------|
| Big Dog™ | Good | Yes | Excellent/WK ^d | Early | None/Moderate ^e | None/Low ^g |
| Concorde | Good/Excellent ^a | Yes | Excellent/WK ^d | Mid | None/High ^e | None/High ^h |
| Control | Good/Excellent ^a | Yes | Excellent/WK ^d | Early | None/High ^e | None/Low ⁱ |
| Defender | Good/Fair ^b | Yes | Excellent/WK ^d | Early | None/High ^e | None/Low ⁱ |
| Driller | Good/Excellent ^c | Yes | Excellent/WK ^d | Early | None/Moderate ^e | None/Low ⁱ |
| Eco-Till™ | Good | Yes | Excellent/WK ^d | Early | None/Moderate ^e | None/Low ⁱ |
| Graza | Fair | No | Excellent/WK ^d | Mid | None/Moderate ^e | None/Low ^g |
| Groundhog™ | Good | Yes | Excellent/WK ^d | Early | None/Moderate ^e | None/Low ^g |
| Lunch | Good/Fair ^b | Yes | Excellent/WK ^d | Early | None/Moderate ^e | None/Low ⁱ |
| Nitro™ | Good/Excellent ^a | Yes | Excellent/WK ^d | Early | Low/High ^f | None/Low ^g |
| Sodbuster | Good/Fair ^b | Yes | Excellent/WK ^d | Early | None/Moderate ^e | None/Low ⁱ |
| Tillage® | Good/Fair ^b | Yes | Excellent/WK ^d | Early | None/Moderate ^e | None/High ^h |

^{1/}Quick fall cover—Emergence at 14 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25%; ^{2/}Fall stand quality—Yes is >65% emergence at 28 days after planting; ^{3/}Winter survival—Plant survival rating of Excellent >75%, Good 50-75%, Marginal 25-50%, Poor <25%; ^{4/}Maturity date—Days after planting to 50% bloom: <175=Early, 175-200=Mid, >200=Late; and ^{5/}Disease and insect ranking—Damage observed was None, Low, Moderate, or High. WK—Winterkill.

^aGood in all locations except NM where it rated excellent; ^bGood quick fall cover at all locations except in AZ where it rated fair; ^cGood in all locations except NM and NV where it rated excellent; ^dExcellent to good winter survival in AZ, CA, and NM, poor in NV and winterkilled in CO; ^eDisease damage at 50% bloom was moderate to high in CA only; ^fLow disease damage in NM, high in CA, none in all other locations; ^gLow to moderate insect damage in AZ, CA, NV; ^hHigh insect damage in AZ, low in CA; ⁱLow to moderate insect damage in AZ and CA.

Expected Adaptation: Except for the variety Graza, daikon radish varieties provided excellent to good, quick fall cover and stand quality. Winter survival ranged from excellent to good in all locations except in Fallon, NV and Meeker, CO. Most varieties reached maturity (50% bloom) early with Concorde and Graza maturing 1 to 2 weeks later at most locations. Disease damage was none or low with the exception of Lockeford, CA. High insect damage was observed in Tucson, AZ in the Concorde and Tillage varieties. Insect damage was also noted in Los Lunas, NM and Lockeford, CA.



Daikon radish varieties blooming at the Lockeford, California Plant Materials Center.

HAIRY VETCH

Description: trailing or climbing, winter annual, legume with stems 2 to 5 feet. Leaves are terminated by branched tendrils. Stems and leaves are usually covered with soft woolly fuzz. Flowers in clusters of 10 to 40 and usually violet to purple colored. Lana is a variety of woollypod vetch (*Vicia villosa ssp. dasycarpa*) included in this study because of its similarity in usage to hairy vetch.

Benefits: N source, weed suppressor, improves organic matter, soil structure, pollinator habitat.



Hairy vetch flowers

Performance of Hairy Vetch Varieties

| Cover Crop | Quick Fall Cover ^{1/} | Fall Stand Quality ^{2/} | Winter Survival ^{3/} | Maturity Date ^{4/} | Disease Ranking ^{5/} | Insect Ranking ^{5/} |
|-------------------|--------------------------------|----------------------------------|---------------------------------|-----------------------------|-------------------------------|------------------------------|
| CCS Groff | Good/Fair ^a | Yes | Excellent/Marginal ^h | Late | Moderate ^j | Low ^k |
| Lana | Good/Fair ^b | Yes/No ^f | Excellent/WK ⁱ | Mid | High ^j | Low ^k |
| Purple Bounty | Good/Fair ^c | Yes/No ^g | Excellent/Marginal ^h | Mid | Moderate ^j | Low ^k |
| Purple Prosperity | Good/Fair ^a | Yes | Excellent/Marginal ^h | Late | Moderate ^j | Low ^k |
| TNT | Good/Fair ^d | Yes | Excellent/Marginal ^h | Mid | Moderate ^j | Low ^k |
| Villana | Good/Fair ^e | Yes/No ^f | Excellent/Marginal ^h | Late | Moderate ^j | Low ^k |

^{1/}Quick fall cover—Emergence at 14 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25%; ^{2/}Fall stand quality—Yes is >65% emergence at 28 days after planting; ^{3/}Winter survival—Plant survival rating of Excellent >75%, Good 50-75%, Marginal 25-50%, Poor <25%; ^{4/}Maturity date—Days after planting to 50% bloom: <175=Early, 175-200=Mid, >200=Late; and ^{5/}Disease and insect ranking—Damage observed was None, Low, Moderate, or High.

^aGood, quick fall cover in CO, fair at all other locations; ^bGood, quick fall cover in CO, fair in AZ, CA, NV and poor in NM; ^cGood in CO, fair in CA, NM and poor in AZ, NV; ^dGood in CA, CO, fair in all other locations; ^eGood in CA, CO, fair in AZ, NM and poor in NV; ^fUnacceptable fall stand quality in NM; ^gUnacceptable fall stand quality in AZ; ^hMarginal survival in CO and NV; ⁱWK in CO and NM; ^jDisease rankings from CA only, all other locations none; ^kInsect ranking from CA only, all other locations none.

Expected Adaptation: Varieties generally provided a good to fair quick fall cover with acceptable fall stand quality but varied between locations. CCS Groff, Purple Prosperity and TNT ranked the highest for stand quality across the region. Most varieties had excellent winter survival except in Meeker, CO and Fallon, NV. Lana vetch winterkilled in both Meeker and Los Lunas, NM. Maturity dates varied slightly with Lana being the earliest to reach maturity at ~182 days and Purple Prosperity the latest at ~202 days. Disease and insect damage were only observed in Lockeford, CA.



Purple Bounty blooming in Lockeford, California.

RED CLOVER

Description: biennial or short-lived perennial that grows as one of two types: medium (double-cut) or mammoth (single-cut). Plants grow from crowns with hollow, hairy stems and branches. Stem lengths of medium and mammoth types average 18 inches and 24 to 30 inches, respectively. Each leaf consists of a slender stalk bearing 3 leaflets. Flowers borne in compact clusters or heads and are usually rose-pink in color.

Benefits: N source, improves organic matter and soil structure, erosion control, weed suppressor, livestock forage, pollinator habitat.



Red clover

Performance of Red Clover Varieties

| Cover Crop | Quick Fall Cover ^{1/} | Fall Stand Quality ^{2/} | Winter Survival ^{3/} | Maturity Date ^{4/} | Disease Ranking ^{5/} | Insect Ranking ^{5/} |
|---------------|--------------------------------|----------------------------------|---------------------------------|-----------------------------|-------------------------------|------------------------------|
| Cinnamon Plus | Excellent-Poor ^a | Yes/No ^g | Excellent-Marginal ^k | Late ^l | None | None |
| Cyclone II | Excellent-Poor ^a | Yes/No ^h | Excellent-Marginal ^k | Late ^l | None | None |
| Dynamite | Excellent-Poor ^b | Yes/No ^g | Excellent-Poor ^k | Late ^l | None | None |
| Freedom | Excellent/Fair ^c | Yes/No ⁱ | Excellent-Poor ^k | Late ^l | None | None |
| Kenland | Excellent-Poor ^d | Yes/No ^j | Excellent-Marginal ^k | Late ^l | None | None |
| Mammoth | Excellent-Poor ^e | Yes/No ^g | Excellent-Poor ^k | Late ^l | None | None |
| Starfire II | Good-Poor ^f | Yes/No ^j | Excellent-Marginal ^k | Late ^l | None | None |
| Wildcat | Excellent-Poor ^b | Yes/No ^g | Excellent-Marginal ^k | Late ^l | None | None |

^{1/}Quick fall cover—Emergence at 14 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25%; ^{2/}Fall stand quality—Yes is >65% emergence at 28 days after planting; ^{3/}Winter survival—Plant survival rating of Excellent >75%, Good 50-75%, Marginal 25-50%, Poor <25%; ^{4/}Maturity date—Days after planting to 50% bloom: <175=Early, 175-200=Mid, >200=Late; and ^{5/}Disease and insect ranking—Damage observed was None, Low, Moderate, or High.

^aExcellent in NM, good in CO, fair in CA and NV, poor in AZ; ^bExcellent in NM, good in CO and NV, poor in AZ and CA;

^cExcellent in NM, fair in all other locations; ^dExcellent, in NM; fair in CO and NV; poor in AZ and CA; ^eExcellent in NM, good in CO, fair in all other locations; ^fGood in NM, fair in CO and poor in all other locations; ^gAcceptable fall stand quality in CO, NM, and NV; ^hUnacceptable fall stand quality in AZ; ⁱUnacceptable stand quality in AZ and CO; ^jAcceptable fall stand quality only in NM;

^kAll varieties had excellent/good winter survival across locations except in CO and NM where survival was marginal to poor;

^lMaturity date is based upon NM.

Expected Adaptation: Red clover varieties varied in quick fall cover and fall stand quality across locations. Survival was excellent to good across locations except in Meeker, CO and Fallon, NV where survival was marginal to poor. Los Lunas, NM was the only location where varieties reached maturity (50% bloom) at ~229-245 days after planting. Red clover varieties never reached maturity at the other locations. No disease or insect damage were observed at spring regrowth where red clover varieties reached maturity.



Red clover blooming in late June in Lockeford, California.

WINTER/FIELD PEA

Description: winter annual, legume with bluish-green waxy vines. Vines can reach 9 ft long, but modern varieties have shorter vines, about 2 feet long. Stems are hollow and leaves alternate, pinnately compound. Flowers white, purple or pink. Winter pea varieties include Frost Master, Lynx, Survivor 15, Whistler, and Windham. Spring pea varieties include Arvica 4010, Dunn, and Maxum.

Benefits: N source, improves organic matter and soil structure, erosion control, weed suppressor, livestock forage, pollinator habitat.



Field pea

Performance of Winter/Field Pea Varieties

| Cover Crop | Quick Fall Cover ^{1/} | Fall Stand Quality ^{2/} | Winter Survival ^{3/} | Maturity Date ^{4/} | Disease Ranking ^{5/} | Insect Ranking ^{5/} |
|--------------|--------------------------------|----------------------------------|---------------------------------|-----------------------------|-------------------------------|------------------------------|
| Arvica 4010 | Good ^a | Yes | Excellent-Poor ^l | Early | None-High ^p | Low |
| Dunn | Good/Fair ^b | Yes | Excellent-Poor ^m | Early | None-High ^q | Moderate |
| Frost Master | Good-Poor ^c | Yes/No ⁱ | Excellent-Poor ^m | Mid | None-High ^q | Moderate |
| Lynx | Fair/Poor ^d | Yes/No ^j | Excellent-Poor ^m | Mid | High-Moderate ^f | Moderate |
| Maxum | Good/Fair ^e | Yes | Excellent-Poor ^l | Mid | None-High ^p | Moderate |
| Survivor 15 | Good ^f | Yes ^k | Excellent/Marginal ⁿ | Late | None-High ^s | Moderate |
| Whistler | Good/Fair ^g | Yes/No ⁱ | Excellent-Poor ^o | Mid | None-Moderate ^t | Moderate |
| Windham | Good-Poor ^h | Yes/No ⁱ | Excellent-Poor ^m | Late | None-High ^q | Moderate |

^{1/}Quick fall cover—Emergence at 14 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25%; ^{2/}Fall stand quality—Yes is >65% emergence at 28 days after planting; ^{3/}Winter survival—Plant survival rating of Excellent >75%, Good 50-75%, Marginal 25-50%, Poor <25%; ^{4/}Maturity date—Days after planting to 50% bloom: <175=Early, 175-200=Mid, >200=Late; and ^{5/}Disease and insect ranking—Damage observed was None, Low, Moderate, or High.

^aGood to excellent (CO) quick fall cover; ^bGood, quick fall cover in all locations but fair in NV; ^cGood in CA, fair in AZ, NM, NV and poor in CO; ^dFair in AZ, CA and NV, poor in CO and NM; ^eGood in CA and CO, fair in AZ, NM, NV; ^fNo data for CO; ^gGood in AZ and CA, fair in CO, NM, NV; ^hGood in CA and NM, fair in AZ and NV, poor in CO; ⁱAcceptable fall stand quality in all locations but CO; ^jAcceptable fall stand quality in all locations but CO and NM; ^kAcceptable fall stand quality at all locations except in CO where it was not planted; ^lExcellent winter survival in all locations but CO and NV; ^mExcellent winter survival at all locations except CO, NM and NV; ⁿExcellent survival in AZ, CA and marginal in NM, NV, not planted in CO; ^oExcellent survival in AZ, CA, NM, good in NM, poor in CO; ^pNo disease observed in AZ, CO and NV, high disease in CA and low in NM; ^qHigh disease in CA, NM; ^rHigh disease in NM, moderate disease in CA; ^sHigh disease observed only in CA; ^tModerate disease in CA and low in AZ; ^uInsect damage ranking from moderate-low in CA and NM, no damage at all other locations.

Expected Adaptation: Field pea varieties varied in quick fall cover and fall stand quality. Arvica 4010 and Survivor 15 were the only varieties to provide consistent quick fall cover and good stand quality across locations where it was planted. Survival varied across locations but was generally excellent to good in Lockeford, CA and Tucson, AZ. Maturity date varied by variety and location. Disease and insect damage was observed in Lockeford, CA and Los Lunas, NM.

Comparison of Cool Season Cover Crops and Varieties in the Southwest Region

| Cover Crop | Quick Fall Cover ^{1/} | Fall Stand Quality ^{2/} | Winter Survival ^{3/} | Maturity Date ^{4/} | Disease Ranking ^{5/} | Insect Ranking ^{5/} |
|--|--------------------------------|----------------------------------|---------------------------------|-----------------------------|-------------------------------|------------------------------|
| BLACK OATS | | | | | | |
| Soil Saver | Good | Yes | Good/WK ^a | Mid | Low | Low |
| *Winterkilled in CO and NV. | | | | | | |
| BLACK SEEDED OATS | | | | | | |
| Cosaque | Good | Yes | Excellent/WK ^b | Late | Low | Low |
| ^b Excellent to good winter survival at all locations except CO. | | | | | | |
| CEREAL RYE | | | | | | |
| Aroostook | Excellent | Yes | Excellent/Marginal ^a | Mid | Low | None |
| Bates | Excellent | Yes | Excellent | Early | Low/Moderate ^c | Low |
| Brassetto | Excellent | Yes | Excellent | Mid | Low | None |
| Elbon | Excellent | Yes | Excellent | Mid | Low | Low |
| FL 401 | Excellent | Yes | Excellent/Poor ^b | Early | Low/Moderate ^c | Low |
| Guardian | Excellent | Yes | Good | Mid | Low/Moderate ^c | None |
| Hazlet | Excellent | Yes | Excellent | Mid | Low/Moderate ^c | None |
| Maton | Excellent | Yes | Excellent | Mid | Low | None |
| Maton II | Excellent | Yes | Excellent | Mid | Low | None |
| Merced | Excellent | Yes | Excellent/Poor ^b | Early | Low/High ^c | Low |
| Oklon | Excellent | Yes | Excellent | Mid | Low | None |
| Rymin | Excellent | Yes | Excellent | Late | Low/Moderate ^c | None |
| Wheeler | Excellent | Yes | Excellent | Mid | Low/Moderate ^c | None |
| Wintergrazer 70 | Excellent | Yes | Excellent/Marginal ^a | Mid | Low | Low |
| Wrens Abruzzi | Excellent | Yes | Excellent/Marginal ^a | Mid | Low | Low |
| ^a Excellent to good winter survival at all locations except in CO where winter survival was marginal in 2017-2018; ^b Excellent to good winter survival at locations except in CO and NV where survival was poor in 2017-2018; ^c Disease damage of moderate and high in CA. | | | | | | |
| CRIMSON CLOVER | | | | | | |
| AU Robin | Fair/Excellent ^a | Yes/No ^g | Excellent/Poor ^m | Mid | Low | Low |
| AU Sunrise | Good/Excellent ^b | Yes/No ^h | Excellent/Poor ^m | Mid | Low | Low |
| AU Sunup | Poor/Good ^c | Yes/No ⁱ | Excellent/Poor ^m | Mid | Low | Low |
| Contea | Good/Fair/Poor ^d | Yes/No ^j | Excellent/Poor ^m | Mid | Low | Low |
| Dixie | Fair/Poor ^e | Yes/No ^k | Excellent/Poor ^m | Mid | Low | Low |
| Kentucky Pride | Good/Poor ^f | Yes/No ^l | Excellent/Poor ^m | Late | Low | Low |
| ^a Fair in all locations except NM where it rated excellent one year; ^b Good in AZ, CA, fair in CO and NV, excellent in NM one year; ^c Poor, quick fall cover in all locations except NM where it rated good and CA where it rated fair; ^d Good, quick fall cover in NM and NV, fair in AZ and CA, poor in CO; ^e Fair in AZ, CA, good in NV, poor in CO and excellent in NM; ^f Good in AZ, CA, NV, fair in CO and excellent in NM; ^g Acceptable for stand quality in CA, NM, NV only; ^h Acceptable fall stand quality in all locations except CO; ⁱ Acceptable fall stand quality only in NM; ^j Acceptable fall stand quality in NM and NV; ^k Acceptable fall stand quality in all locations except CO; ^l Acceptable in all locations except CO; ^m Excellent to good winter survival in AZ, CA, and NM, marginal to poor in CO and NV. | | | | | | |
| ^{1/} Quick fall cover—Emergence at 14 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25%; ^{2/} Fall stand quality—Yes is >65% emergence at 28 days after planting; ^{3/} Winter survival—Plant survival rating of Excellent 75%, Good 50-75%, Marginal 25-50%, Poor <25%; ^{4/} Maturity date—Days after planting to 50% bloom:<175=Early, 175-200=Mid, >200=Late; and ^{5/} Disease and insect ranking—Damage observed was None, Low, Moderate, or High. WK-winterkilled. | | | | | | |

Comparison of Cool Season Cover Crops and Varieties in the Southwest Region (Cont.)

| Cover Crop | Quick Fall Cover ^{1/} | Fall Stand Quality ^{2/} | Winter Survival ^{3/} | Maturity Date ^{4/} | Disease Ranking ⁵ | Insect Ranking ^{5/} |
|--|--------------------------------|----------------------------------|---------------------------------|-----------------------------|------------------------------|------------------------------|
| DAIKON RADISH | | | | | | |
| Big Dog™ | Good | Yes | Excellent/WK ^d | Early | None/Moderate ^e | None/Low ^g |
| Concorde | Good/Excellent ^a | Yes | Excellent/WK ^d | Mid | None/High ^e | None/High ^h |
| Control | Good/Excellent ^a | Yes | Excellent/WK ^d | Early | None/High ^e | None/Low ⁱ |
| Defender | Good/Fair ^b | Yes | Excellent/WK ^d | Early | None/High ^e | None/Low ⁱ |
| Driller | Good/Excellent ^c | Yes | Excellent/WK ^d | Early | None/Moderate ^e | None/Low ⁱ |
| Eco-Till™ | Good | Yes | Excellent/WK ^d | Early | None/Moderate ^e | None/Low ⁱ |
| Graza | Fair | No | Excellent/WK ^d | Mid | None/Moderate ^e | None/Low ^g |
| Groundhog™ | Good | Yes | Excellent/WK ^d | Early | None/Moderate ^e | None/Low ^g |
| Lunch | Good/Fair ^b | Yes | Excellent/WK ^d | Early | None/Moderate ^e | None/Low ⁱ |
| Nitro™ | Good/Excellent ^a | Yes | Excellent/WK ^d | Early | Low/High ^f | None/Low ^g |
| Sodbuster | Good/Fair ^b | Yes | Excellent/WK ^d | Early | None/Moderate ^e | None/Low ⁱ |
| Tillage® | Good/Fair ^b | Yes | Excellent/WK ^d | Early | None/Moderate ^e | None/High ^h |
| ^a Good in all locations except NM where it rated excellent; ^b Good quick fall cover at all locations except in AZ where it rated fair; ^c Good in all locations except NM and NV where it rated excellent; ^d Excellent to good winter survival in AZ, CA, and NM, poor in NV and winterkilled in CO; ^e Disease damage at 50% bloom was moderate to high in CA only; ^f Low disease damage in NM, high in CA, none in all other locations; ^g Low to moderate insect damage in AZ, CA, NV; ^h High insect damage in AZ, low in CA; ⁱ Low to moderate insect damage in AZ and CA. | | | | | | |
| HAIRY VETCH | | | | | | |
| CCS Groff | Good/Fair ^a | Yes | Excellent/Marginal ^h | Late | Moderate ^j | Low ^k |
| Lana | Good/Fair ^b | Yes/No ^f | Excellent/WK ⁱ | Mid | High ^j | Low ^k |
| Purple Bounty | Good/Fair ^c | Yes/No ^g | Excellent/Marginal ^h | Mid | Moderate ^j | Low ^k |
| Purple Prosperity | Good/Fair ^a | Yes | Excellent/Marginal ^h | Late | Moderate ^j | Low ^k |
| TNT | Good/Fair ^d | Yes | Excellent/Marginal ^h | Mid | Moderate ^j | Low ^k |
| Villana | Good/Fair ^e | Yes/No ^f | Excellent/Marginal ^h | Late | Moderate ^j | Low ^k |
| ^a Good, quick fall cover in CO, fair at all other locations; ^b Good, quick fall cover in CO, fair in AZ, CA, NV and poor in NM; ^c Good in CO, fair in CA, NM and poor in AZ, NV; ^d Good in CA, CO, fair in all other locations; ^e Good in CA, CO, fair in AZ, NM and poor in NV; ^f Unacceptable fall stand quality in NM; ^g Unacceptable fall stand quality in AZ; ^h Marginal survival in CO and NV; ⁱ WK in CO and NM; ^j Disease rankings from CA only, all other locations none; ^k Insect ranking from CA only, all other locations none. | | | | | | |
| ^{1/} Quick fall cover—Emergence at 14 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25%; ^{2/} Fall stand quality—Yes is >65% emergence at 28 days after planting; ^{3/} Winter survival—Plant survival rating of Excellent >75%, Good 50-75%, Marginal 25-50%, Poor <25%; ^{4/} Maturity date—Days after planting to 50% bloom: <175=Early, 175-200=Mid, >200=Late; and ^{5/} Disease and insect ranking—Damage observed was None, Low, Moderate, or High. WK-winterkilled. | | | | | | |

Comparison of Cool Season Cover Crops and Varieties in the Southwest Region (Cont.)

| Cover Crop | Quick Fall Cover ^{1/} | Fall Stand Quality ^{2/} | Winter Survival ^{3/} | Maturity Date ^{4/} | Disease Ranking ^{5/} | Insect Ranking ^{5/} |
|--|--------------------------------|----------------------------------|---------------------------------|-----------------------------|-------------------------------|------------------------------|
| RED CLOVER | | | | | | |
| Cinnamon Plus | Excellent-Poor ^a | Yes/No ^g | Excellent-Marginal ^k | Late ^l | None | None |
| Cyclone II | Excellent-Poor ^a | Yes/No ^h | Excellent-Marginal ^k | Late ^l | None | None |
| Dynamite | Excellent-Poor ^b | Yes/No ^g | Excellent-Poor ^k | Late ^l | None | None |
| Freedom | Excellent/Fair ^c | Yes/No ⁱ | Excellent-Poor ^k | Late ^l | None | None |
| Kenland | Excellent-Poor ^d | Yes/No ^j | Excellent-Marginal ^k | Late ^l | None | None |
| Mammoth | Excellent-Poor ^e | Yes/No ^g | Excellent-Poor ^k | Late ^l | None | None |
| Starfire II | Good-Poor ^f | Yes/No ^j | Excellent-Marginal ^k | Late ^l | None | None |
| Wildcat | Excellent-Poor ^b | Yes/No ^g | Excellent-Marginal ^k | Late ^l | None | None |
| ^a Excellent in NM, good in CO, fair in CA and NV, poor in AZ; ^b Excellent in NM, good in CO and NV, poor in AZ and CA; ^c Excellent in NM, fair in all other locations; ^d Excellent, in NM; fair in CO and NV; poor in AZ and CA; ^e Excellent in NM, good in CO, fair in all other locations; ^f Good in NM, fair in CO and poor in all other locations; ^g Acceptable fall stand quality in CO, NM, and NV; ^h Unacceptable fall stand quality in AZ; ⁱ Unacceptable stand quality in AZ and CO; ^j Acceptable fall stand quality only in NM; ^k All varieties had excellent/good winter survival across locations except in CO and NM where survival was marginal to poor; ^l Maturity date is based upon NM. | | | | | | |
| WINTER/FIELD PEA | | | | | | |
| Arvica 4010 | Good ^a | Yes | Excellent-Poor ^l | Early | None-High ^p | Low |
| Dunn | Good/Fair ^b | Yes | Excellent-Poor ^m | Early | None-High ^q | Moderate |
| Frost Master | Good-Poor ^c | Yes/No ⁱ | Excellent-Poor ^m | Mid | None-High ^q | Moderate |
| Lynx | Fair/Poor ^d | Yes/No ^j | Excellent-Poor ^m | Mid | High-Moderate ^r | Moderate |
| Maxum | Good/Fair ^e | Yes | Excellent-Poor ^l | Mid | None-High ^p | Moderate |
| Survivor 15 | Good ^f | Yes ^k | Excellent/Marginal ⁿ | Late | None-High ^s | Moderate |
| Whistler | Good/Fair ^g | Yes/No ⁱ | Excellent-Poor ^o | Mid | None-Moderate ^t | Moderate |
| Windham | Good-Poor ^h | Yes/No ⁱ | Excellent-Poor ^m | Late | None-High ^q | Moderate |
| ^a Good to excellent (CO) quick fall cover; ^b Good, quick fall cover in all locations but fair in NV; ^c Good in CA, fair in AZ, NM, NV and poor in CO; ^d Fair in AZ, CA and NV, poor in CO and NM; ^e Good in CA and CO, fair in AZ, NM, NV; ^f No data for CO; ^g Good in AZ and CA, fair in CO, NM, NV; ^h Good in CA and NM, fair in AZ and NV, poor in CO; ⁱ Acceptable fall stand quality in all locations but CO; ^j Acceptable fall stand quality in all locations but CO and NM; ^k Acceptable fall stand quality at all locations except in CO where it was not planted; ^l Excellent winter survival in all locations but CO and NV; ^m Excellent winter survival at all locations except CO, NM and NV; ⁿ Excellent survival in AZ, CA and marginal in NM, NV, not planted in CO; ^o Excellent survival in AZ, CA, NM, good in NM, poor in CO; ^p No disease observed in AZ, CO and NV, high disease in CA and low in NM; ^q High disease in CA, NM; ^r High disease in NM, moderate disease in CA; ^s High disease observed only in CA; ^t Moderate disease in CA and low in AZ; ^u Insect damage ranking from moderate-low in CA and NM, no damage at all other locations. | | | | | | |
| ^{1/} Quick fall cover—Emergence at 14 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25%; ^{2/} Fall stand quality—Yes is >65% emergence at 28 days after planting; ^{3/} Winter survival—Plant survival rating of Excellent >75%, Good 50-75%, Marginal 25-50%, Poor <25%; ^{4/} Maturity date—Days after planting to 50% bloom: <175=Early, 175-200=Mid, >200=Late; and ^{5/} Disease and insect ranking—Damage observed was None, Low, Moderate, or High. WK-winterkilled. | | | | | | |

References

Clark, A., editor. 2012. Managing cover crops profitably, 3rd Edition. Sustainable Agriculture Research and Education. Handbook Series Book 9.

USDA, NRCS. 2019. The PLANTS Database (<http://plants.usda.gov>, 30 September 2019). National Plant Data Team, Greensboro, NC 27401-4901 USA.

For More Information

Analysis of the data used for compiling the tables in this regional report can be found at:

https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/natpmtnccatsupp.pdf

Final study reports with more details on the performance of the cover crop varieties at each PMC location can be found at:

Tucson, Arizona

https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/azpmcsr13597.pdf

Lockeford, California

https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/capmcsr13493.pdf

Los Lunas, New Mexico

Currently unavailable

Fallon, Nevada

https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/nvpmcsr13578.pdf