Los Lunas Plant Materials Center
2013 Progress Report of Activities

Soil Health Study Nearly Plowed Under

A soil health study was initiated at the Los Lunas Plant Materials Center (LLPMC) to compare the performance of selected cover crops including soil health benefits, ease of establishment, forage value, and other agronomic characteristics. This study was initiated and designed in collaboration with the New Mexico State Resource Conservationist, the New Mexico State Agronomist, New Mexico Area Agronomists, and the New Mexico State Water Quality Specialist.

The study design consists of a split-plot, randomized, complete-block design with four replications and encompasses approximately 5.0 acres. The main plots contain the irrigation treatments; either adequate water to prevent wilting or limited water, considering both the amount of precipitation and irrigation for a combined total of 20 inches. The subplots contain the cover crop treatments, and each subplot is approximately 16 ft. by 280 ft. or approximately 0.10 acre. The cover crop treatments include a mix of four warm-season species and forage radish (a cool-season species), barley alone, hairy vetch alone, and a control (a plot left fallow). The seeding rates included the mix at 26 seeds/sq. ft., barley at 13 seeds/sq. ft., and hairy vetch at 9 seeds/sq. ft. The soil health characteristics being monitored include soil moisture, soil temperature, soil compaction, soil bulk density, plant cover and plant density.

One replication where the cover crop treatments (left, wet side) receives ample irrigation, while the other cover crop treatments (right, dry side) receives only half the amount of irrigation in order to stimulate the dryland conditions found in eastern New Mexico.

Unfortunately, the cover crop treatments were thought to be too sparse and too short by November to provide adequate soil protection. We discussed plowing them under; however, they are still intact today. The problem was caused because we seeded in early September instead of late July or early August, and at a lower seeding rate than what is required to obtain a stand density of 10 plants per sq. ft. (which is thought to be desirable for ground cover on dryland in eastern New Mexico).

Seedlings began to emerge three days after sowing, and they appeared to be growing well until a hard frost (29° F) occurred on October 15th and 16th. Frost killed most of the warm-season species in the mix. The cool-season species in the mix forage radish, and the treatments of barley and hairy vetch continued to grow. Generally, warm-season cover crop species planted for winter soil protection need to be seeded earlier to acquire a significant amount of growth before a hard frost occurs.

We measured plant density approximately 60 days after seeding, and the results were:

- Mix averaged 3.7 plants/sq. ft. (most were dead because they were warm-season species and many of the plants had dried up and possibly blown away and so were not counted)
- Barley at 3.7 plants/sq. ft.
- Hairy vetch at 4.0 plants/sq. ft.

Results were not a surprise because of the type of equipment used and the late date of the seeding. The equipment used for the seeding was a broadcast seeder (Land Pride) with a 'brillion-like' cultipacker which lacks the ability to control seeding depth. Also, flood irrigation (used at the LLPMC) has a tendency to reduce the establishment of seeded species. Shallow-planted seed may float and move to the edge or out of the plot while deep-planted see may not have the energy required for the plumule to reach the soil surface. To compensate for broadcast seeding, the seeding rate is typically doubled to accommodate for the lack of seeding depth control. To compensate for flood irrigation of light small seed, seeding rates are often increased by 20 percent. The seeding rate of vetch (where 10 plants per sq. ft. is desired under the conditions described) should be sown at the rate of 24 pls/sq. ft. A broadcast seeder was chosen because of the huge variability in seed size, from the very small millet seed to the large and robust barley seed. Typically, the smaller the seed the shallower it should be sown. The

cultipacker insured that some seed of all species would be planted at various depths which would include the ideal depth for establishment.

The cover crops for the soil health study will continue to be irrigated and monitored for improvements in soil health as the cover crops mature. If the cool-season cover crops continue to grow and provide 70 percent or more ground cover by spring, they may be roller mulched and incorporated into the soil. This addition of organic matter would improve the soil health of each plot. A milo commodity crop would then be seeded into the cover crop mulch of each plot. The performance of the milo crop would be another characteristic used to measure how soil health is affected by cover crop treatments.

Riparian Restoration Hands-On Workshop

In February 2013, the LLPMC provided a riparian restoration workshop to 44 participants that included private contractors and land owners, as well as city, county, state and federal employees who manage riparian ecosystems in New Mexico. The workshop was hosted by the US Fish and Wildlife Service, New Mexico Natural Resource Conservation Service, and the Bureau of Land Management District Office in Las Cruces, NM. The lecture portion was done in Las Cruces, and the hands-on workshop was done on the Rio Grande in Radium Springs, NM on the property of Pete and Gale Steen, about 15 miles north of Las Cruces.

During the hands-on workshop, participants installed monitoring wells, tested soil samples for electrical conductivity, built poultry wire treeguards for beaver protection, and planted long-stem shrubs and cottonwood poles.

Workshop participants drilling a groundwater monitoring well at Radium Springs, NM on the Rio Grande

Before the workshop, the soil electrical conductivity was measured at 8.1 ds/m at a 0-5 inch depth and 5.2 ds/m at a 24–60 inch depth. However, cottonwoods can tolerate a salinity of only about 3 ds/m. Cottonwood poles were planted regardless of the high levels of salinity because the demonstration of the pole planting process was important to participants at the workshop. As a result, the cottonwood poles displayed severe salt burn on leaf margins when they leafed out in the spring and eventually died. However, the shrubs species planted were tolerant to the high-levels of salinity and are doing well.

Leaf margins of cottonwood poles blackened by salt burn recently plant at Radium Springs, NM on the Rio Grande

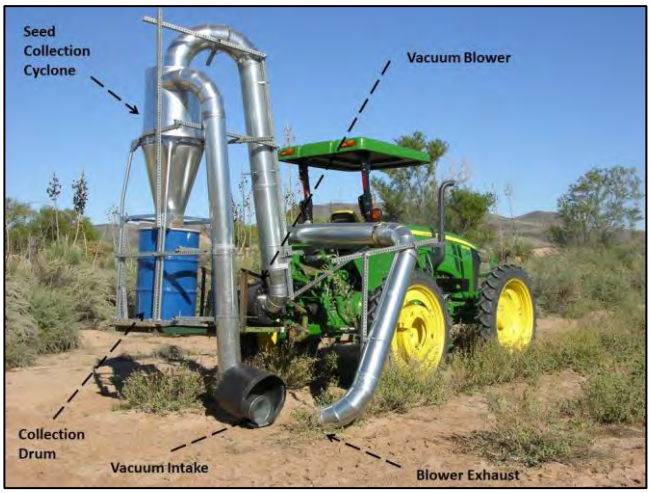
Vacuum Harvester with Blower Facilitated Seed Detachment

One of greatest limitations in obtaining high seed yields from production fields is the indeterminate seed maturation of many native plants. Seed harvesters such as the Woodward Flail-Vac Seed Stripper can be used to attempt to repeatedly harvest a seed production field as the seed matures. The brushes on seed strippers can damage ripening seedheads as well as developing flowers especially on some forb species. We have attempted to use a PTO-driven vacuum to harvest forb seed using a handheld collection vacuum hose as well as a toolbar mounted vacuum intake hood. Two principal problems encountered with these approaches were the:

1. Vacuum hose or collection hood had to brush the plant to dislodge most of the seed
2. Seed and chaff had to go through the vacuum blower impellers where unknown damage could occur to the seed.

To address these issues, we fabricated a vacuum system based on the same PTO-driven vacuum but incorporated a seed collection cyclone in the airstream upstream of the blower and used the exhaust from the vacuum blower to dislodge seed and blow the seed into a vacuum collection hood. The harvester uses a Trac-Vac Model 854 PTO Leaf Collection Vacuum with 8-inch diameter intake and exhaust hoses, approximate 2,000 cfm (cubic feet per minute) capacity, and a cost of $3,000 (not including

shipping). The collection cyclone (designed for 1,200-1,900 cfm) and cyclone stand, 8-inch and 10-inch steel ducts and fittings, and collection drum were purchased from Oneida Air Systems for $1,700 (not including shipping). The system was designed to be 3-point hitch mounted to allow ease of height adjustment. See the following photograph.



Vacuum seed harvesting system

Our initial trials were performed on smallflower globemallow (*Sphaeralcea parviflora*). The system was configured to maintain a distance of 24-inches between the blower exhaust outlet and vacuum collection hood. This distance appeared to be near the maximum span between inlet and outlet and still attain good seed detachment. We will attempt to install some snouts to gather the stems and reduce this span in future trials to obtain greater seed detachment. The typical harvesting speed was about 3 mph, and it took 20 minutes to harvest a one-half acre field (twelve 300-ft. rows at 6.3 ft. row spacing).

Vacuum harvest of smallflower globemallow (*Sphaeralcea parviflora*) on October 1, 2013

With globemallow, the vacuum-collected material appeared to be 20–25% seed with the remainder being seedhead parts. Most of the seed harvested by the vacuum system had reached maturity. When the globemallow is harvested with a combine, 90% of the pre-cleaned weight is stems, and much of the seed is immature.

Bureau of Land Management *"Seeds of Success"* Activities in 2013

The Natural Resources Conservation Service (NRCS) entered into an Interagency Agreement with the Bureau of Land Management (BLM) "*Seeds of Success"* (SOS) Program in 2010 to establish seed production fields at the Los Lunas Plant Materials Center (LLPMC) of native species selected by BLM in an effort to improve the commercial availability of seed adapted to the Colorado Plateau. The LLPMC has been producing seed of several forb species, some of which are rarely produced under agronomic conditions:

- *Oenothera pallida* – Pale Evening Primrose
- *Ipomopsis aggregata* – Scarlet Gilia
- *Sphaeralcea parvifolia* – Smallflower globemallow
- *Ratibida columnifera* – Upright prairie coneflower.

Oenothera pallida – Pale Evening Primrose

Our seed production efforts started with 0.3 g of primrose seed received from SOS in 2010 which produced an initial 20 containerized transplants. By 2012 we had sufficient seed to produce 800 seedlings in 2.5"dia. x 3" deep (12 $in^{3)}$ containers. The seedlings were transplanted into the field in late August 2012 using a water wheel transplanter that set the plants 12-inches apart in rows with between row spacing of 76 inches. The final planting contained 2.75 rows each 300 feet in length.

Oenothera pallida – Pale Evening Primrose in early July, 2013. Seedlings were planted in August 2012.

In 2013, we initially tried to harvest the seed using the vacuum harvester described in *Vacuum Harvester with Blower Facilitated Seed Detachment* on page 3 of this report. The large distance (>3 ft.) between the vacuum intake and the blower outlet required by the width of plants resulted in negligible seed dispersal out of the seed capsules into the air stream. The small seed size, the vining nature of the species, and the need to harvest green stems precluded the use of a combine harvester. Therefore, the plot was harvested with a forage harvester in late August. The green material was spread on a tarp in a hot greenhouse to be dried before storage. The dried material yielded 4.5 lb. (2.0 kg) of cleaned seed, a 7,000 fold increase from the initial seed weight.

Ipomopsis aggregata – Scarlet Gilia

In spring of 2012, the negligible seed from our failed initial field planting was used to produce 155 transplants in 2.5" dia. and 5.0" deep (19 in^3) containers. The seedlings were transplanted as a double row into a Weed Guard Plus Heavy Weight Creped Organic paper mulch in mid-July 2012. A row of T-tape drip tape was placed adjacent to each row. The transplants were drenched initially with 'Subdue Maxx' fungicide and later with 'Banrot' fungicide with approximately 6 oz. of drench solution per plant at the labeled rate for preventative care. As of early fall, 135 out of the 155 plants (87%) were still alive.

Ipomopsis aggregate – scarlet gilia planting in mid-October 2012

This biennial sent up flowering stems in 2013 which reached heights of up to 6 ft. and produced numerous flowers and appreciable activity from hummingbirds for pollination

Ipomopsis aggregate – scarlet gila test plot on October 1, 2013

Entire stems were hand-harvested on October 23, 2103 and placed in woven polyethylene bulk bags for drying. These approximate 100 plants yielded 0.4 lbs of cleaned seed (about 1/3 purity).

Ratibida columnifera - Upright prairie coneflower

In 2013, two seed fields of *Ratibida columnifera* were in production at the LLPMC: Field 23S with 0.50 acre and Field 8 with 0.55 acre for a total of 1.05 acres.

Ratibida columnifera – upright prairie coneflower planting in Field 8 on October 15, 2012

These fields were harvested in late October 2013 with a Gleaner K2 combine. The harvesting head was modified with crop lifting snouts to lift the spreading stems to allow more seedheads to be swathed. The pure live seed (PLS) yield from the two fields for 2013 was 129 pls/lbs.

***Sphaeralcea parvifolia* – Smallflower globemallow**

With the 0.6 grams of seed that was originally obtained from SOS in 2010, 80 transplants were produced in 2011 and installed in a two-row planting. Seed was collected from of these two rows of plants in the late summer and early fall of 2011 and used to grow seedlings in 2.5" dia. x 3" deep (12 in^3) containers in the spring of 2012. The seedlings were transplanted in late August 2012 using a water wheel transplanter to set the seedlings 12 inches apart in rows with a between row spacing of 76 inches. The final planting contained 11.75 rows and comprised about 3,500 plants.

Sphaeralcea parvifolia – smallflower globemallow field on July 5, 2013

The field was harvested initially in late June 2013 with a Kincaid XP2 row plot combine, because the vacuum harvester was still being fabricated. The vacuum harvester described elsewhere in this report was used several times between late August and early October 2013 to collect mature seed. A final combine harvest was completed at the end of the growing season in late October 2013. The total amount of cleaned seed was 39 lb. (17.7 kg) or a 30,000 fold increase from the initial seed weight.

Sphaeralcea parvifolia – smallflower globemallow being collected with the vacuum harvester on October 1, 2013

Milkweed Seed Production Trials for the Xerces Society

As outlined by Xerces Society's Project Milkweed, "milkweeds (*Asclepias* spp.) are the required host plants for caterpillars of the monarch butterfly (*Danaus plexippus*) and thus play a critical role in the monarch's life cycle. The loss of milkweed plants in the monarch's spring and summer breeding areas across the United States is believed to be a significant factor contributing to the reduced number of monarchs recorded in overwintering sites in California and Mexico. Xerces is working with the Los Lunas Plant Materials Center to conduct an initial seed increase of select milkweed species. The seed stock that is produced will be transferred to private native seed producers for commercial-scale production."

The Xerces Society sponsored efforts to collect seed of three species which might be most appropriate for New Mexico growing conditions: *Asclepias speciosa*, *Asclepias latifolia*, and *Ascelpias asperula*. The LLPMC produced transplants of these three species in peat pots because of concerns about poor root system cohesion. These seedlings were planted into weed barrier fabric in July of 2012. The final planting layout consisted of 2 rows of each species with 1000 plants of *Asclepias speciosa*, 1000 plants of *Asclepias latifolia,* and 600 plants of *Ascelpias asperula.* The *Ascelpias asperula* plants lacked vigor as peat pot seedlings and later after outplanting with few plants emerging in the spring of 2013 and fewer still flowering in the summer of 2013. The other two species grew well during the summer and fall of 2012 and throughout the growing season of 2013. The following photograph shows the field in July 2013.

Milkweed seed production trial in July 2013. The two left rows are *Asclepias speciosa*; the two middle rows are *Asclepias latifolia*; the two right rows are *Ascelpias asperula.*

During the summer of 2013, *Asclepias speciosa* produced very few flowering heads, whereas, *Asclepias latifolia* produced a large number of flowering heads. However, *Asclepias latifolia* heads failed to produce many seed pods and many of these pods were infested by weevil larvae. There was considerable pollinator activity on *Asclepias latifolia* with great numbers of tarantula hawk

wasps (*Pepsis formosa*. No seed pods of *Ascelpias asperula* were observed. Overall, the seed production results thus far have been very disappointing.

Asclepias latifolia with a tarantula hawk wasp (*Pepsis formosa*) and a native bee

Assisting the National Park Service

The LLPMC continued interagency agreements for seed and transplant production with the National Park Service (NPS) including: Arches National Park, Canyonlands National Park, Glen Canyon National Recreational Area, Grand Canyon National Park, and Zion National Park. Seed of seven native grass species were grown on a total of 7.41 acres. The LLPMC also grew a total of 5,215 transplants of eight native species for the NPS agreements in 2013. Seed for both the production fields and vegetative transplants were collected onsite at the individual parks by park personnel. The intent is to use these plant materials at the parks to restore severely degraded sites such as roadsides, trails, and abandoned historical mine sites.

Harvesting Zion National Park bottlebrush squirreltail seed using a PTO-driven vacuum.

Grand Canyon National Park muttongrass seed production field planted in September 2013 replaces a four-year-old field that no longer could produce an adequate amount of seed.

Grand Canyon National Park blue grama seed production field at LLPMC September 2013

'Windbreaker' Big Sacaton Cultivar

In 2013 the Los Lunas Plant Materials Center (LLPMC) was contacted by Lisa Dennisson, Soil Conservation Technician at the NRCS Estancia Field Office. A cooperator in their service area was trying to solve the soil erosion conditions on the family ranch by installing cross fencing and permanent water facilities as part of the conservation management system plan developed in cooperation with the NRCS and the East Torrance Soil and Water Conservation District (SWCD). To help prevent soil erosion during the windy season, the Estancia Field Office suggested installing a vegetative windbreak consisting of 'Windbreaker' big sacaton which can become established fairly quickly. 'Windbreaker' big sacaton is a variety adapted to many ecological types of locations in New Mexico and Arizona, and it has proven to be an excellent species for windbreaks. Under ideal conditions, 'Windbreaker' big sacaton can grow up to 10 feet with

relatively low water use. This makes it an effective tool for wind protection plantings.

In June of 2013, the LLPMC delivered 200 'Windbreaker' big sacaton transplants to the cooperator. The transplants were installed within two days of delivery, and the planting consisted of two, 500-foot rows of transplants placed on 5-foot centers. The planting was installed next to an existing fence and is being irrigated from an established drip system to provide adequate moisture to the transplants for optimum establishment and growth. The newly planted windstrip will also be protected from any grazing that could occur from the cooperator's livestock. The windstrip planting will be maintained by removing any vegetative competition during its establishment.

'Windbreaker' big sacation windstrip planting near Estancia, New Mexico, June 2013

'Windbreaker' big sacaton windstrip planting and drip irrigation system near Estancia, New Mexico, June 2013

Marketing Conservation Uses for 'Windbreaker' Big Sacaton

Because of its versatility, 'Windbreaker' is an optimal plant selection for several NRCS conservation practices, and it continues to be showcased at meetings to encourage its use in New Mexico. The following marketing presentations were provided in 2013:

Organization or Event	Attendance
Northeastern New Mexico Prairie Partners Fourth Annual Meeting	40
New Mexico Organic Farming Conference 2013	250
City of Grants Agricultural Day	350
McKinley County Youth Water and Energy Awareness Days	150
Valencia County Women's Landowners Symposium	18
Rio Arriba County Soil Health and Cover Crop Workshop	50
Native American Livestock Days	75
NMSU Los Lunas ASC/NRCS Los Lunas Plant Materials Center Annual Field Day	292
Lava Soil and Water Conservation District Annual Meeting	65
East Annual Meeting Torrance Soil and Water Conservation District	45
Valencia Soil and Water Conservation District Annual Meeting	12

New Mexico Organic Farming Conference 2013, Albuquerque, New Mexico

Alfalfa Project

In cooperation with the NRCS Los Lunas Field Office, the NMSU Los Lunas Agricultural Science Center and a Valencia County landowner/cooperator, the LLPMC initiated a project to determine the drought tolerance of an alfalfa field located in Tomé, New Mexico. The landowner has not irrigated this alfalfa field since 2006. In 2012, this situation was brought to the attention of the Los Lunas Field Office and to Danny Goodson, Agronomist at the LLPMC.

The ability of this alfalfa planting to continue to grow and produce average or above average yields without supplemental irrigation is notable, although sub-irrigation from underground water is a possibility. The absence of irrigation applications to any crop, especially a high-value cash crop like alfalfa, could have a substantial economic impact on alfalfa growers in New Mexico.

On June 20, 2013, staff from the NRCS Los Lunas Field Office, the NRCS New Mexico State Office and NRCS LLPMC met with the landowner who agreed to allow NRCS to determine what dynamics are occurring on this particular alfalfa field. A soil investigation on the landowner's field was done in July of 2013 by Aaron Miller, NRCS Soil Scientist and by Wayne Sleep, NRCS Hydrological Technician. Soil samples were taken and sent to a soil laboratory for analysis. The results showed no abnormalities or problems with the Gila soil series found in the field. Two water table monitoring wells were installed at separate locations in the field. The water table depth at Well A was 68.9" and at Well B was 66.9". The water table depth will be checked every two weeks for one year. Water table depth fluctuation may be a contributing factor to how this alfalfa has been able to survive.

Danny Goodson discussed this project in July 2013 with Dr. Mark Marsalis, NMSU Forage Specialist. Dr. Marsalis, Danny Goodson and the landowner met at the property and discussed the details of the landowner's forage production operation. Dr. Marsalis suggested taking a forage sample of the alfalfa which was done in August 2013. The sample was sent for testing to a forage laboratory in New York, and Dr. Marsalis concluded the results were typical to most varieties of alfalfa grown in New Mexico.

Prior to the 2014 forage season, the drought tolerant project plan will be reviewed with the participants. Additional activities may include an agricultural suitability test of the underground water, checking root zone development, gathering weather data for this area during production years, and obtaining a complete forage production summary of this field for previous years.

2013 Alfalfa drought tolerance project in Tomé, New Mexico soil investigation and water table monitor well installation

Revised Pollinator Plant Recommendations for New Mexico

In 2013, we revised our Technical Note #71 (http://efotg.sc.egov.usda.gov/references/public/NM/pmc71a-revision.pdf) about pollinator plant recommendations for New Mexico to include additional information for each species on:

1. Bloom season
2. Self-seeding potential
3. Ease of greenhouse production of transplants
4. Listing of nearest state to New Mexico where the species is native
5. Probable adaptation to dryland plantings
6. Potential invasiveness in irrigated situations
7. Other specific characteristics of certain species

In addition, new species have been added to the listings as we evaluate new species each year.

Leptosiphon nuttallii ssp. nuttallii Nuttall's linanthus
October 8, 2013

Dalea bicolor. var.argyrea silver prairie clover
October 8, 2013

Solidago velutina threenerve goldenrod
July 19, 2013

The species we are recommending currently include the following native annuals, native herbaceous perennials, introduced garden plants, and native shrubs:

Annuals	**Perennials A - He**	**Perennials He - Ps**
Bailey multiradiata	*Achillea millefolium*	*Helenium autumnale*
Cleome serrulata	*Agastache pallidiflora ssp. neomexicana*	*Helianthus maximiliani*
Dimorphocarpa wislizeni	*Agastache rupestris*	*Heliomeris multiflora var. multiflora*
Gaillardia pulchella	*Argemone pleiacantha*	*Heterotheca camporum*
Gilia capitata	*Coreopsis lanceolata*	*Machaeranthera pinnatifida*
Helianthus petiolaris	*Dalea candida*	*Melampodium leucanthum*
Lesquerella gordonii	*Dalea purpurea*	*Monarda fistulosa*
Machaeranthera tanacetifolia	*Erigeron pulcherrimus*	*Oligoneuron rigidum*
Monarda citriodora	*Eupatorium altissimum*	*Penstemon eatonii*
Nama hispidum	*Gaillardia aristata*	*Penstemon strictus*
Phacelia integrifolia	*Gaillardia pinnatifida*	*Physaria newberryi*
Verbesina encelioides	*Hedysarum boreale*	*Psilostrophe cooperi*

Perennials Py - So	**Perennials Sp - Z**	**Introduced Garden Plants**
Pycnanthemum verticillatum var. pilosum	*Sphaeralcea ambigua*	*Anethum graveolens*
Ratibida columnifera	*Sphaeralcea laxa*	*Cosmos bipinnatus*
Ratibida columnifera	*Symphyotrichum ericoides*	*Foeniculum vulgare var. azoricum*
Scrophularia californica	*Symphyotrichum laeve var. geyeri*	*Lavandula angustifolia*
Scrophularia lanceolata	*Symphyotrichum oblongifolium*	*Linum perenne*
Senecio flaccidus	*Thelesperma filifolium*	*Melilotus officinalis*
Silphium integrifolium	*Thelesperma subnudum*	*Nepeta cataria*
Silphium laciniatum	*Thymophylla pentachaeta*	*Ocimum basilicum*
Solidago nemoralis	*Verbena macdougalii*	*Origanum marjorana*
Solidago petiolaris	*Verbena stricta*	*Origanum vulgare*
Solidago speciosa	*Zizia aptera*	*Salvia officinalis*
		Scabiosa atropurpurea
		Tithonia rotundifolia

Shrubs A - L	Shrubs P - S
Amorpha canescens	*Parthenium incanum*
Baccharis emoryi	*Poliomintha incana*
Chamaebatiaria millefolium	*Prunus americana*
Dalea bicolor var. argyrea	*Prunus pumila* var. *besseyi*
Ericameria nauseosa	*Purshia stansburiana*
Eriogonum corymbosum	*Rhus trilobata*
Fallugia paradoxa	*Ribes aureum*
Forestiera pubescens var. pubescens	*Salix irrorata*
Lycium torreyi	*Salix lasiolepis*

Selected LLPMC Publications

The following publications may be of interest and are available at the following website:
http://plant-materials.nrcs.usda.gov/nmpmc/publications.html

- Pocket Guide to Beneficial Insects of New Mexico (Miscellaneous Technical Article)
- Pocket Guide to Native Bees of New Mexico (Miscellaneous Technical Article)
- Pollinator Plant Recommendations for New Mexico. (Revised Technical Note)
- 'Windbreaker' Cultivar Big Sacaton: A Foundation Class of Certified Seed (Refereed Journal Article)
- Deep-Planting of Longstem Native Riparian Shrubs (Published Abstract)