FY 2006 Progress Report for the Gila National Forest
Development of Legume *Dalea* for Use in Burn Rehab Seed Mixtures in Southwestern Pinyon/Juniper Communities

David R. Dreesen
Plant Materials Center
Natural Resources Conservation Service
US Department of Agriculture
Los Lunas, NM

The *purpose* of this project is to test *Dalea* species that establish naturally after burns to determine which species have potential for commercial seed production and are valuable as burn rehab species in the pinyon/juniper vegetation type in the Southwest. The USDA-NRCS Plant Materials Center (PMC) at Los Lunas will:

1. Test the candidate species for agronomic characteristics that would make them promising for commercial-scale production.
2. Produce sufficient quantities of seed for testing as a component in burn rehab seed mixtures.

The palatability and forage value of the species will be assessed to determine potential wildlife use. The *goal* of the PMC is to develop legume releases that will be requested by land managers and can be produced economically by commercial growers. This report covers the following topics:

- Seed germination and scarification treatments
- Field trials using plug seedlings
- Direct seeding into flats
- Optimizing vegetative growth
- Potential seed production and future plans
- Billing

Seed Germination

Dalea leporina seed was collected by Ralph Pope on October 7, 2005 from the edge of the ball fields behind the US Forest Service Office in Silver City, NM. The seed was cleaned by the PMC and yielded:

- 41.8 g of seed greater than 1/18” sieve
- 3.6 g smaller than 1/18” and larger than 1/25”

Many of the seeds were damaged by miniature weevil infestation. To kill any weevils that might emerge, the cleaned seed was treated with Sevin powder.

Scarification Treatments

Scarification treatments were tested to determine methods to provide a complete and rapid germination of seed in greenhouse or seed production field plantings. To disrupt the hard seed coat of this legume species, the two types of treatments tested were hot water and percussion.

- Hot water treatments–The hot water treatments involved heating water in a beaker to the desired temperature, immersing a known quantity of seed, removing the beaker from the hot plate, letting the water cool several hours before separating the seed, and then sowing in a pot containing soil-less mix.
- Percussion treatments–Duplicate percussion treatments (A and B) both involved shaking a known small quantity of seed vigorously in a plastic bottle for approximately one (1) minute.

The number of plants that emerged was evaluated periodically for 3½ months to determine germination percentages. Hot water at 80º to 85º C resulted in rapid and almost complete germination. The maximum germination of about 60% probably resulted from weevil damage to approximately 40% of the seed. The control and 25º C water treatments allowed only about 10 to 15% of the viable seed to germinate rapidly. The boiling water treatment killed the seed while the 90º C water reduced germination somewhat relative to the best hot water treatments. The percussion treatments eventually yielded almost complete germination after 2 months; germination was delayed appreciably with only about 50% of the viable seed germinating after 2 to 3 weeks. These data are summarized in Table 1.

Table 1. **Germination of *Dalea leporina* seed from the Gila National Forest after various scarification treatments.**

Treatment	**% germinated after 4 days**	**% germinated after 19 days**	**% germinated after 64 days**	**% germinated after 102 days**
None “Control”	7	9	12	14
25º C water	9	10	14	14
75º C water	33	38	38	39
80º C water	54	57	57	59
85º C water	54	56	56	56
90º C water	43	49	49	49
boiling water	0	0	0	0
percussion A	12	36	50	52
percussion B	5	33	47	56

Field Trial Established with Plug Seedlings

Plug seedlings of *Dalea leporina* were produced in two types of deep plug trays:

- Plantel plug tray with 341 cells each 0.75" x 0.75" x 2.5"
- Beaver Plastics Styroblock #1 with 448 cells each 0.7" x 0.7" x 2.8".

We tested the Styroblock tray because its insulation properties might reduce root temperatures while the plug seedlings were hardened in the nursery in late May and early June. On April 27, 2006, two batches of seed (one containing approximately 1100 seed and the other 900 seed [viable seed of about 700 and 550 seed, respectively]) were hot water treated at 85º C. After the water had cooled, the moist seed was dispersed in a soil-less medium of peat moss and perlite, and the same medium was used to fill the plug cells. The seed and medium mixture was uniformly spread over each plug tray; the larger batch over the Styroblock tray and the smaller batch over the Plantel tray. The seed was then covered with a thin layer of medium (~⅛") and then micro-sprinkler irrigated daily. Emergence occurred within two to three days. The seedlings were grown in the greenhouse until early June and then hardened off in the nursery until the field planting date of June 14, 2006.

Two rows were formed in Field 35N in sandy-loam soil. Each row, approximately 350 feet long, had a 36-inch-wide kraft paper (40 lb type) mulch applied as a weed barrier. On June 14, 2006, the paper was perforated with a sharpened soil corer to create a one-inch hole and then a dibble the size of root plug was inserted into the soil. The plug seedlings were about 3- to 4-inches tall and very slender with minimal leaf area; many plugs contained more than one seedling (see Figures 1a and 1b). After all of the plugs were planted, the field was flood irrigated twice a week for three weeks, and then weekly thereafter except during periods of high rainfall.

Figure 1a: **Styroblock plug tray with residual *Dalea leporina* seedlings, 70 days after field planting date.**

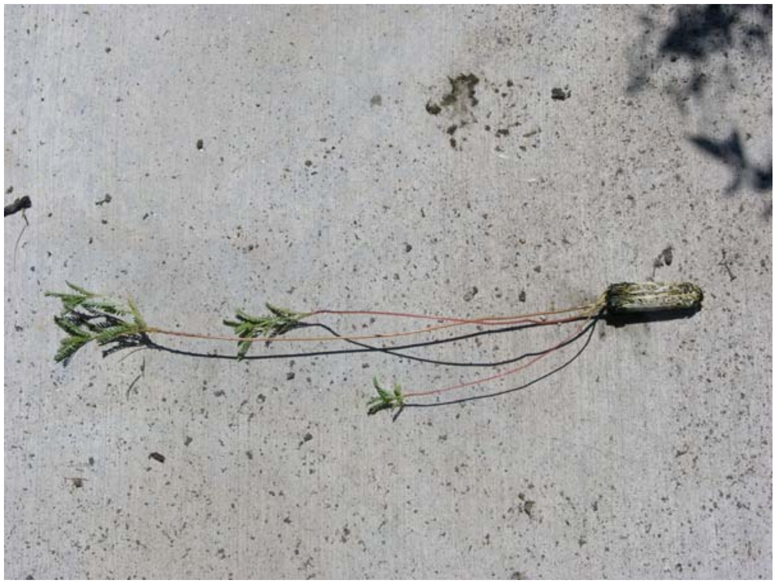

Figure 1b**: Residual plug seedling of *****Dalea leporina*****, 70 days after field planting date.**

On August 23, 2006, a final stand count was conducted. The west row had 65 plant units, and the east row had 116 plant units; in many instances there was more than one plant per unit. Approximately 300 plugs were planted in each row. The poor survival rate may be partially due to moisture stress. The survival rate was higher for the plants located closer to the irrigation riser (88 plant units) than at the far end (48 plant units).

The east row was planted with plug seedlings primarily from the Plantel tray while the west row seedlings were grown in the Styroblock tray. One possible reason for the difference in survival between the two rows might involve more damage occurring to the Styroblock plug roots as they were extracted from the tray. The paper mulch was somewhat effective in restricting weed growth. The mulch lost some integrity after the first few waterings. The degradation rate seemed to slow down after the first few weeks; the mulch was still fairly well intact as of late August.

Figure 2 shows plant density and plant size in late August for *Dalea leporina* in the moister end of the field.

Figure 2: Dalea leporina **rows in the field, 70 days after planting plug seedlings.**

Three plants (Samples A, B, and C) were dug up at random from the rows and measured and dried for dry matter production (see Figure 3). Root crowns were harvested (see Figure 4) for dry weight measurements and to examine for nitrogen-fixing nodule presence. These data are presented in Table 2. The large discrepancies in shoot-to-root ratios reflects the root crown containing variable but significant amounts of soil as well as the inconsistent harvest of roots among samples. All of the root samples had substantial numbers of small nitrogen-fixing nodules on the fine (tertiary) roots. The shoot samples will be submitted for forage analysis.

Figure 3: **Shoot measurement of *Dalea leporina* plant, 70 days after planting plug seedlings (36" ruler underneath plant).**

***Figure 4*: Root sample of *Dalea leporina* plant, 70 days after planting plug seedlings.**

***Table 2.* Height, width, caliper and dry matter production of *Dalea leporina* samples 70 days after planting plug seedlings in the field.**

	Sample A	Sample B	Sample C
Height (cm)	68	74	69
Width (cm)	67	59	71
Caliper (cm)	1.73	1.07 and 1.27	1.42
Shoot Fresh Weight (g)	370	270	270
Dry Matter Shoots (g)	110	74	71
Dry Matter Roots (g)	20	37	42
Shoot/Root Ratio	5.5	2.0	1.7

Direct Seeding Into Flats

Because of the poor survival rate in the field planting of plug seedlings, some small-scale tests of direct seeding were carried out in flats (16" x 16" x 5") containing a 3-inch layer of sandy-loam field soil. At the time this study was started, it was assumed that direct sowing would have to involve imbibed seed following hot water treatment. Sowing imbibed seed would require the seed to be mixed with a moist soil-less mix to prevent the seed from desiccating, to protect the swollen seed from mechanical damage, and to provide optimum aeration and moisture. This method would be similar to plug-mix planters used in the vegetable industry to sow a mix of seed and soil-less mix.

The amount of soil-less mix was varied in this study by forming miniature furrows of three different depths in three individual soil-filled flats: 0.25", 0.5" and 0.8" deep. The furrows were filled with a moist plug-mix (sieved-composted-bark nursery medium) incorporating hot water scarified seed. The control flat with a 0.25" furrow was sown with seed that had been vigorously shaken in a glass test tube for one minute; the seed furrow was then covered with field soil.

The flats were evaluated 12 and 28 days after sowing the seed. By setting the 0.25" plug-mix furrow emergence at 100%, the 0.5" plug mix, 0.8" plug-mix, and 0.25" soil-only treatments had relative emergence values of 80%, 71%, and 85%. As expected, the deeper furrows buried some seed too deep to emerge. The vigor of the plants varied drastically among the treatments with the deeper plug-mix treatments having the most vigorous plants (see Figure 5).

***Figure 5*: Soil furrow treatments for direct-sown *Dalea leporina* seed, 50 days after sowing. Treatments left to right: plug-mix 0.8-inches deep, plug-mix 0.5 inches deep, plug mix 0.25 inches deep, and soil furrow 0.25 inches deep.**

The percussion treated seed had a much higher, early germination rate than the earlier germination tests of percussion. It is assumed that the hard-glass test tube imparted more force on the seed coat than the plastic bottle in the earlier tests. This outcome indicates that through manipulation of percussive forces, germination rates and percentages could be altered. This technique might have application in wild-land seeding to manipulate the timing of germination.

The poor survival rate of plug seedlings in the field planting prompted a test of an alternative seed production method. The use of beds filled with a nursery mix (composted bark-pumice-peat moss medium) possibly could enhance growth and might result in sufficient seed production per unit area to justify such an intensive cultural practice. On July 13, 2006, a nursery bed 80 inches long and 32 inches wide was filled with about 10 inches of nursery mix and sown with approximately 550 hot water treated viable seed incorporated into moist nursery mix. The seed mix layer was covered with a thin covering (~3/16") of additional mix to assure seed burial. Although the emergence percentage was low, sufficient seedlings developed to produce a dense stand (see Figure 6). The seed production from this bed will determine whether such an intensive culture is justified.

Figure 6: **Direct-sown *Dalea leporina* in nursery bed 46 days after seeding (wood side panel measures 11-inches tall).**

Optimizing Vegetative Growth

The PMC has never grown an annual *Dalea* for seed production, so it was necessary to determine what cultural factors might be optimized to promote vegetative growth and enhanced seed production. The two factors that could be tested on a small scale were soil influences and fertilizer treatments.

Soil Influences

Two extremes of soil types were evaluated: a sandy-loam field soil versus a soil-less mix of composted bark, pumice, and peat moss. Some of the plug seedlings from the field planting were planted into Styroblocks with one-gallon cells. Two blocks were filled with field soil, and one block was filled with nursery mix (composted bark, pumice, peat moss).

Fertilizer Treatments

The 16 soil-filled cells received four fertilizer treatments: control, 2 g, 5 g, and 15 g of 17-6-12 controlled release fertilizer with 3- to 4-month release period (see Figure 7). Each treatment was applied randomly to four cells. The eight cavities containing the nursery mix had fertilizer treatments of 2 g, 5 g, 10 g, and 15 g.

Three of the four plants in each fertilizer treatment of the soil-filled blocks were harvested 55 days (replicates #1 and #2) and 63 days (replicate #3) after planting. These samples will be submitted for relative feed value analysis. The dimensions and dry matter of the plants are presented in Table 3. The roots were also harvested to determine dry matter and assess the presence of nitrogen-fixing nodules (e.g. *Rhizobium*). The lack of effect of nutrient additions on vegetative growth may result from the variable quantities of nitrogen-fixing nodules being present that overwhelmed the effect of any fertilizer. Observations of nodules indicate their presence on all but one of the root samples, but no sample had a large mass of nodules.

The plants grown in the nursery canning mix and in the remaining replicate of the soil filled block will be grown to maturity to determine nutrient level effects on seed production.

Table 3. **Caliper, height, fresh weight, and dry matter production of *Dalea leporina* grown at four fertilizer levels in sandy loam soil.**

Treatment	Caliper (cm)	Height (cm)	Fresh Weight (g)	Above-ground Dry Matter (g)	Below-ground Dry Matter (g)	Shoot/ Root Ratio
Control #1	0.59	56	32.06	8.60	1.21	7.1
Control #2	0.81	52	62.14	16.27	na	
Control #3	0.83	60	56.52	19.14	3.26	5.9
2 g CRF #1	0.61	52	29.55	8.63	1.84	4.7
2 g CRF #2	0.77	58	47.87	12.58	na	
2 g CRF #3	0.77	62	48.42	16.85	3.46	4.9
5 g CRF #1	0.65	54	30.34	7.87	1.27	6.2
5 g CRF #2	0.75	58	46.44	12.04	na	
5 g CRF #3	0.80	61	57.78	18.85	4.05	4.7
15 g CRF #1	0.75	59	50.02	13.28	2.22	6.0
15 g CRF #2	0.78	56	50.17	13.31	na	
15 g CRF #3	0.76	53	45.93	15.15	3.73	4.1

Potential Seed Production and Future Plans

It appears that flowering will occur in September for the field and nursery bed planting; viable seed may not be produced until late October. The large, vegetative size of the field grown plants with numerous branches is an indication that there is a high potential for many seedheads to be produced per plant.

After seed yields are determined and the success of direct seedling trials are known, it will be possible to determine whether future field production of *Dalea leporina* should be accomplished by direct seeding or by transplanting plug seedlings.

FY 2006 Billing Statement–IPAC Billing Information

FS Agency Code	12-40-1100
FS Reference Document No. (MO)	Provided by FS Financial Management
FS Agreement No.	06-IA-11030600-014
FS DUNS No.	929332484
FS Accounting Station	0306
Job Code	NFN0306
Budget Object Code	2510
Performing Agency Location Code	12401600
Performing Agency DUNS No.	119699171
Performing Agency Tax ID	850116579

Send copy of bill to: USDA Forest Service
Attn: Char Tellas
Gila National Forest
3005 E Camino del Bosque
Silver City, NM 88061

Accomplishments and Costs

1. Tested germination treatments for one seedlot of *Dalea leporina*.

   4 hours professional @ $40/hr = $160

2. Produced seedlings in greenhouse for tests of optimum seed and forage production as well as 700 seedlings for two rows of field planting.

   10 hr professional @ $40/hr = $400
   Supplies and materials = $75

3. Installed two, 300-foot rows of field production (approximately 600 seedlings planted) using a short term paper mulch weed barrier. Hand weeded, cultivated, and irrigated from June through September.

   12 hours professional @ $40/hr = $480
   20 hours technical @ $15 /hr = $300
   Weed barrier = $50

4. Harvest early growth stage plants, dry and weigh biomass, and submit for forage quality analysis (Relative Feed Value).

    <u>4 hours professional @ $40/hr = $160</u>
    <u>Analysis cost three samples = $36</u>

5. Write progress report for FY 2006

    <u>6 hours professional @ $40/hr = $240</u>

Total professional cost 36 hours x $40/hr = $1440
Total technical cost = 20 hours x $15/hr = $300
Total supplies and analysis cost = $161
Total direct costs = $1901 + 17.8% overhead = $2239

<u>Total NRCS Costs = $2239.00</u>