National Park Service
Annual Report Year 2000
Grand Canyon National Park, Arizona

Prepared by

USDA Natural Resources Conservation Service
Los Lunas Plant Materials Center
Los Lunas, NM
February 2001

Background

An agreement between the Plant Materials Center (PMC) in Los Lunas, New Mexico and the Grand Canyon National Park (GCNP) in Arizona was first established in July 1990. The agreement provides for the collection, propagation, and increase of grasses, forbs, shrubs, and trees.

The GCNP will use the plant materials produced by the PMC in Los Lunas to revegetate disturbed sites, and also for native landscaping. Both the North and South rim areas of the park are covered in the agreement, and plant materials will be produced for use at both of these areas.

Accessions Involved

Table 1 lists the accessions involved in the Grand Canyon National Park Year 2000 project.

Table 1: Accessions Involved

Common Name	Scientific Name	Plant Symbol	Accession Number	Vegetation Association
Indian Ricegrass	*Oryzopsis hymenoides*	ORHY	9062857	122.3233
Squirreltail	*Sitanion hysterix*	SIHY	9062858	122.3233
Needle and thread	*Stipa comata*	STCO	9062859	122.3233
Western wheatgrass	*Agropyron smithii*	AGSM	9062860	122.3233
Muttongrass	*Poa fendleriana*	POFE	9062861	122.3233
Penstemon (blue)	*Penstemon spp.*	PE SPP.	9062862	122.3233
Penstemon (red)	*Penstemon spp.*	PE SPP.	9066054	122.3233
Lupine	*Lupinus spp.*	LU SPP.	9062863	122.3233
Apacheplume	*Fallugia paradoxa*	FAPA	9062865	122.3233
Fernbush	*Chamaebatiaria millifollium*	CHMI	9062866	122.3233
Curl-leaf mountain mahogany	*Cercocarpus ledifolius*	CELE	9062867	122.3233
Elderberry	*Sambucus spp.*	SA SPP.	9066047	122.3233
Utah serviceberry	*Amelanchier utahensis*	AMUT	9062869	122.3233
Wolfberry	*Lycium spp.*	LY SPP.	9062870	122.3233
Gambels oak	*Quercus gambelii*	QUGA	9062872	122.3233
Fourwing saltbush	*Atriplex canescens*	ATCA	9062873	122.4149
Century plant	*Agave utahensis*	AGUT	9062874	122.4149
Blue grama	*Bouteloua gracilis*	BOGR	9062875	122.4149
Rabbitbrush	*Chrysothamnus nauseosus*	CHNA	9062877	122.4149
Cliffrose	*Purshia mexicana*	COME	9062876	122.4149
Utah juniper	*Juniperus osteosperma*	JUOS	9066055	122.3233
Pinon pine	*Pinus edulis*	PIED	9066467	122.3233
Ponderosa pine	*Pinus ponderosa*	PIPO	9066466	122.3233
Big sagebrush	*Atriplex tridentata*	ARTR	9066056	122.3233
Currant	*Ribes spp.*	RI SPP.	9066057	122.3233
Datil yucca	*Yucca baccata*	YUBA	9066058	122.3233
Desert barberry	*Berberis fremonti*	BEFE	9066059	122.3233

Collection Information

The GCNP collected seed and sent it to the PMC in Los Lunas, New Mexico for propagation. Table 2 shows the seed species, weight and the location of the accession.

Table 2: Inventory of Seeds Sent to the PMC by GCNP – July 2000

Species	Weight (grams)	Location of Collection
ARTR	757	SR Village
FAPA	301	SR Village
ARTR	701	SR Desert View
FAPA	2	SR Desert View
PIED	56	SR Desert View
COME	160	SR Desert View
AGUT	1	SR Desert View
ATCA	96	SR Desert View
JUOS	247	SR Desert View
CELE	50	NR Pt. Imperial
ARPA	461	NR Pt. Imperial
RONE	6	NR Pt. Imperial
AMUT	127	NR Dev. Area
BERE	13	NR Dev. Area

Seed Condition Information

The condition of the seed collections made in the year 2000 by the Park will be reported in the 2001 report.

Seed Production Establishment

The PMC established a ½ acre field of Muttongrass at the PMC in Los Lunas, NM using seedling transplants. On October 17, 2000, PMC personnel used a mechanical transplanter to transplant the seedlings into field 20 North. After transplanting, the seedlings were irrigated and fertilized. Depending on maturity of plants, seed maybe produced in the spring of 2001.

Seed Production

Table 3 shows the climatological data for year 2000 at the PMC in Los Lunas, New Mexico.

Table 3: Climatological Data for Year 2000 – Los Lunas PM Weather Site

	Average Temperature Fahrenheit			
Month	High	Low	Monthly	Precipitation/Inches
Jan	59.8	17.1	38.5	0.00
Feb	63.4	23.5	43.5	0.27

Table 3: Climatological Data for Year 2000 – Los Lunas PM Weather Site

Month	Average Temperature Fahrenheit High	Low	Monthly	Precipitation/Inches
Mar	65.4	29.3	47.4	2.02
Apr	76.7	38.1	57.4	0.45
May	88.3	46.6	67.5	0.00
Jun	93.6	57.3	75.5	0.80
Jul	95.7	60.7	78.2	2.03
Aug	94.4	59.0	76.7	0.96
Sep	90.6	49.2	69.9	0.10
Oct	71.0	40.7	55.85	2.59
Nov	54.8	22.0	38.4	1.05
Dec	53.6	19.1	36.5	0.52
				Total 10.79

Harvest Data

The blue grama field was combined in October, but during the cleaning process no viable seed was detected. The Muttongrass field was not combined in 2000.

Seed Delivery

Table 4 lists the seed delivered by the PMC to GCNP in the year 2000.

Table 4: Seed Delivery – Year 2000

Species	PLS Pounds
Western wheatgrass	55.49
Blue grama	3.5
Bottlebrush Squirreltail	0.5
Penstemon	0.4
	Total 59.8

Field Management

<u>9062875 Blue Grama</u>

Field Residue Burned	2/16
Field Ripped to 12" depth	2/16
Fertilization, Broadcast spreader 50 lbs. nitrogen	6/02
Irrigation, 3" water application	6/02, 6/29, 8/03, 10/06
Herbicide Application 2,4-D @ 1.5 quart per acre	4/07, 5/15, 5/31
Cultural Weed Control	
Hand Hoeing	7/10, 8/05
Mechanical Cultivation	4/24, 6/13, 7/24

Harvest Combine	10/01
9062861 Muttongrass	
Fertilization, Broadcast spreader	
50 lbs. nitrogen	3/20, 7/25
50 lbs. P2O5	3/20, 7/25
Irrigation	
3" water application	2/11, 3/15, 4/17, 4/20, 5/02, 5/11, 5/26, 6/06, 6/03, 6/27, 7/28, 8/11, 8/15, 9/15, 10/02
Herbicide Application 2,4-D @ 1.5 quart per acre	3/17
Cultural Weed Control	
Hand Hoeing	4/06, 4/17, 6/09, 6/27, 7/17
Mechanical Cultivation	4/05, 6/26, 9/15
Harvest	
No harvest in 2000.	

Transplant Production

Table 4 describes the transplant production and delivery for the GCNP for year 2000.

Table 4: Transplant Production

Common Name	Treepots delivered – Year 2000
Mexican Cliffrose	38
Fernbush	258
Rubber rabbitbrush	152
Apache plume	298
Big Sagebrush	164
Gambel Oak	92
Utah Serviceberry	61
Desert Barberry	209
Curl-leaf Mountain Mahogany	116
Mormon Tea	107
Ponderosa Pine	252
Pinon Pine	130
Currant	95
Mountain Snowberry	80
NM Locust	178
	Total 2230

Table 5 lists the year 2000 plant inventory for the north and south rim of the GCNP.

Table 5: Grand Canyon North and South Rim Plant Inventory as of December 2000

Genus	Species	Rim	Collection	One Gallon Treepots Ready by Spring 2001	One Gallon Treepots Ready by Fall in 2001	One Gallon Treepots Ready in 2002	Super Cell (10 in^3) Seedlings Started Dec 2000	Mortality Risk
Agave	*utahensis*	South		300				
Amelanchier	*utahensis*	South	Yavapai		40	120		Moderate
Amelanchier	*utahensis*	South		140	120	120		Moderate
Artemisia	*nova*	South	Desert View		20	80		High
Artemisia	*nova*	South	Mather Pt.		10	30		High
Artemisia	*tridentata*	South			25		500	High
Artemisia	*tridentata*	South	Desert View				300	High
Atriplex	*canescens*	South	Desert View	20	40	20	400	
Berberis	*fremontii*	South		90	300	400		
Cercocarpus	*ledifolius*	South		10	40	20		Moderate
Cercocarpus	*ledifolius*	South	Grandview		60	60		Moderate
Chamaebatiaria	*millefolium*	South		30	230	100		
Chrysothamnus	*nauseosus*	South			100			
Cowania	*mexicana*	South		40	140	130		High
Cowania	*mexicana*	South	Hermits Rest		25	150		High
Cowania	*mexicana*	South	Trailview		20	40		High
Cowania	*mexicana*	South	Mather Pt.		10	40		High
Ephedra	*viridis*	South			70	270		
Fallugia	*paradoxa*	South		200	100		1100	
Fallugia	*paradoxa*	South	BA Cabins		120	120		
Pinus	*edulis*	South		30	100	200		Moderate
Pinus	*ponderosa*	South		50	150	100		
Quercus	*gambelii*	South		10	10			
Ribes	*cereum*	South	Desert View		10	10		Moderate
Ribes	*cereum*	South			50	100		Moderate
Ribes	*cereum*	South	Shoshone		30	20		Moderate
Ribes	*velutina*	South			50	70		Moderate
Ribes	*velutina*	South	Grandview		20	30		Moderate
Robinia	*neomexicana*	South		30	100			
Symphoricarpos	*oreophilus*	South		80	190	50		
Symphoricarpos	*oreophilus*	South	Village		140	40		
Yucca	*baccata*	South			80	220		
Total				**1030**	**2400**	**2540**	**2300**	
Berberis	repens	North	Developed Area			40		
Cercocarpus	ledifolius	North	Developed Area		30	160		Moderate
Cercocarpus	ledifolius	North	Pt Imperial		20	40		Moderate

Table 5: Grand Canyon North and South Rim Plant Inventory as of December 2000

Genus	Species	Rim	Collection	One Gallon Treepots Ready by Spring 2001	One Gallon Treepots Ready by Fall in 2001	One Gallon Treepots Ready in 2002	Super Cell (10 in^3) Seedlings Started Dec 2000	Mortality Risk
Ribes	cereum	North	Developed Area		20	40		Moderate
Robinia	neomexicana	North	Developed Area		20			
Robinia	neomexicana	North	Pt Imperial		20			
Rosa	arizonica	North	Pt Imperial		25	25		
Symphoricarpos	oreophilus	North	Pt Imperial		10	20		
Symphoricarpos	oreophilus	North	Developed Area		40	100		
Total					**185**	**425**		

Specialized Treatments

Outplanting Site: Grand Canyon National Park, South Rim

Target Seedling Information:

Stock Type:

One Gallon Tree Pot, 4" x 4" x 14"

Root system:

Consolidated root mass sufficient to prevent root ball disintegration during outplanting.

Seed Propagation:

Propagation Equipment:

Greenhouse 70 F day 55 F night during winter, maximum summer temperatures 85 F. A watering bench with mini-sprinklers automatically waters plug trays once a day in early morning. In extremely hot periods during the summer, twice a day watering is programmed. The watering bench is covered with a copper-coated fabric (Texel Forestry Fabric) to reduce root egress from the plug cells via capillary water movement.

Seed Propagation Method:

Dry or pretreated seed are sown in plug flats with square deep cells (288 or 512 cells per flat). Media is a commercial soil-less mix (Sunshine #1); plug trays are loosely filled with dry to slightly moist media, leveled off, and then compressed with an empty plug tray. The number of seed sown depends on size and estimated germination. Small or fluffy seed are dispersed as evenly as possible. Larger and more easily handled seed are sown with a goal of 2 to 5 seed per cell. Very small seed is not covered if its size will allow the seed to be washed into the media with overhead sprinkling. Larger seed with a possible light requirement are lightly covered with perlite. Fluffy seed receive a light covering of media enough to provide contact between seed and the moist plug media. Larger seed is covered with 5 to 10 mm of media.

Seed Treatment:

Cold Stratification:

Those species which require cold stratification are typically sown in plug trays as described above and placed on the watering bench for several days to ensure that the media is thoroughly moist an seed are imbibed. The seeded plug flats are covered with an inverted empty plug flat; to allow space between the seeded flats, then 4 to 5 seeded flats are stacked with the spacers. These stacked flats are placed in clean or disinfected polyethylene bags used for soil-less media and are sealed with twist ties; these bags contain perforations punched by the media manufacturer, which allow air exchange. These plug tray stacks are placed in a walk-in cooler held at 40 F and periodically checked for signs of germination or the need for adding moisture. When germination has started or when a sufficient stratification period has passed, the plug flats are moved to the greenhouse and placed on the watering bench.

Soaking/Leaching:

A number of species may benefit from a rigorous imbibition treatment and/or leaching of germination inhibitors. These seed are put in a rubber-lined rock tumbler jar along with tap water to undergo a wet tumbling which agitates the seed allowing easy oxygen and water entry into the seed. The water in the tumbler is changed daily to remove any inhibitors that may have leached out. The duration of tumbling is a guess me species with hard seed coats, carborundum grit and pea gravel are added to the tumbling water; this procedure can provide a scarification treatment for suitable species. based on the appearance of the seed and the leach water. For so

Seedling Production:

Container Type and Volume:

Ray Leach Super Cell – 10 cubic inch volume, 1.5 inch diameter, and 8.25-inch depth.

Growing Media:

Mix of 2 parts Sunshine #1 or #2 with 1 part perlite. 2 to 4 kg of controlled release fertilizer (CRF) Osmocote Plus 15-9-12 incorporated per cubic yard of mix. For plants started in the greenhouse during winter, 8-9 month release CRF is used, but for spring growth material 3-4 month release CRF is used.

Total Time:

The time required to produce a seedling ready for transplanting into a gallon tree pot is very dependent on species and the time of year in the greenhouse. Fast growing species can be ready in 3 to 4 months from germination. Slow growing species can take over a year.

Planting Technique:

The filled Super Cells are dribbled to provide a hole for the plug seedling. The plug seedling root ball is removed using a flat powder spatula with a blade about 6mm wide and 30mm long attached to a handle. The blade is plunged along the side of the root ball and the seedling plug is levered out of the cell. The plug is dropped into the dibbled hole. Top watering firms and fills any voids around the plug. If excessive numbers of seed have germinated, excess seedlings are cut off during the plug transplanting process.

Establishment Phase:

The Super Cell seedlings in the greenhouse are fertilized with a soluble fertilizer at every other watering. The fertilizer solution is Peters Peat Lite Special 20-10-20 at a rate of 200 mg/l nitrogen. Thinning of seedlings down to one per container occurs during this phase, usually when the seedlings are 2 to 4 cm tall.

Rapid Growth Phase:

Fertigation continues as described above.

Hardening Phase:

The goal is to have the Super Cell seedlings ready to move outside in early May after the last freeze, but before excessively hot outdoor temperatures. In the outdoor nursery, larger seedlings may require watering every day, smaller seedlings generally every other day. The seedlings are fertigated about once a week with Peters Peat Lite Special 20-10-20 at a rate of 200 mg/l nitrogen.

One-Gallon Treepot Production

Container Type and Volume:

One Gallon Tree Pot, 4"x4"x14"

Growing Media:

Commercial nursery canning mix of aged screened softwood bark, pumice, and sphagnum peat moss.

Total Time:

The fastest growing species can be ready in one year after transplanting, if transplanting occurs in May. The slowest growing species can take 3 or more years.

Planting Technique:

The treepots are filled with media and dibbled with a Super Cell planting dibble. Controlled release fertilizer is topdressed at planting or soon thereafter. Osmocote Plus or Sierrablen CRF was used. For pots transplanted in late spring, a 5 to 9 month release CRF is used. Seedlings transplanted later in the summer will receive 3 to 4 month release CRF. The treepots are supported in cages 36"x36"x8" constructed of 4" galvanized steel fence that holds 81 pots.

Establishment Phase:

Watering frequency in this phase is usually once or twice a week. Plants are grown without shade cloth or with (30%) shade). The shade has not been required to produce any of the species thus far.

Rapid Growth Phase:

Watering frequency can be as often as every day for large plants of certain species with substantial leaf areas. The most xeric species may only require once a week watering even in mid-summer.

Hardening Phase.

The watering frequency is reduced in late September to early October to promote hardening-off. The treepot cages are surrounded by straw bales before winter to lessen temperature fluctuations and provide some insulation for the root systems

Table 6 lists the specifics about the species grown for the GCNP.

Table 6: Species Specifics

Agave utahensis

Planting Technique:

Must be transplanted soon after germination before radical elongates excessively.

Stratification:

None required. Very slow growing, water infrequently.

Amelanchier utahensis

Seed Treatment:

Pre-soaking or wet tumbling results in mucilaginous mass that makes sowing difficult.

Stratification:

2 to 3 months. Fast seedling growth; moderate later growth, moderate water requirement.

Artemisia tridentata

Seed Treatment:

No cover for seed.

Stratification:

None required. Moderate seedling growth; moderate later growth, moderate water requirement, evergreen (needs more frequent winter watering). Have encountered catastrophic losses from unknown fungal pathogen.

Berberis fremontii

Seed Treatment:

Wet tumbling seems beneficial.

Stratification:

None required. Slow seedling growth; moderate later growth, moderate water requirement, evergreen (needs more frequent winter watering).

Cercocarpus ledifolius

Seed Treatment:

Wet tumbling has been used, followed by 3% hydrogen peroxide soak for 1 hour for disinfecting purposes.

Table 6: Species Specifics

Stratification:

1 to 2 months. Moderate seedling growth; slow to moderate later growth, low to moderate water requirement, evergreen.

Chamaebatiaria millefolium

Seed Treatment:

No seed cover or very light covering.

Stratification:

2 to 4 weeks. Moderate seedling growth, moderate later growth, moderate to high water requirement, semi-evergreen (needs more frequent winter watering).

Chrysothamnus nauseousus

Seed Treatment:

Bulk sowing of plumed seed with light covering.

Stratification:

None required. Moderate seedling growth, requires clipping during phase to promote branching, moderate later growth, moderate water requirement.

Ephedra viridis

Seed Treatment:

Wet tumbling seems beneficial.

Stratification:

2 to 6 weeks. Slow seedling growth, requires clipping during seedling phase to promote branching, slow later growth, low water requirement, and evergreen.

Fallugia paradoxa

Seed Treatment:

Bulk sowing of plumed seed with light covering.

Stratification:

None required. Slow to moderate seedling growth, benefits from clipping during seedling phase to promote branching, moderate to fast later growth, low to moderate water requirement, semi-evergreen.

Juniperus osteosperma

Seed Treatment:

Have tried long warm stratification followed by long cold stratification with very little success. Presently examining scarification techniques that will be followed by warm stratification and then cold stratification. Very slow seedling growth, evergreen.

Table 6: Species Specifics

Pinus edulis

Seed Treatment:

Soaking or wet tumbling seed for several days.

Stratification.

2 to 8 weeks. Slow seedling growth, slow later growth, low to moderate water requirement, evergreen (needs more frequent winter watering).

Pinus ponderosa

Seed Treatment:

Soaking or wet tumbling seed for several days.

Stratification:

2 to 8 weeks. Slow seedling growth; slow later growth, moderate water requirement, evergreen (needs more frequent winter watering).

Quercus gambelli

Seed Treatment:

Cold moist storage immediately after collection, radicle will emerge in cold.

Stratification:

Some acorns behave as if cold is required to overcome epicotyl dormancy. Slow seedling growth; moderate later growth, moderate water requirement.

Purshia mexicana (Cowania mexicana)

Seed Treatment:

Wet tumbling seems beneficial

Stratification:

1 to 2 months. Slow seedling growth, slow later growth, low water requirement, prone to winter mortality probably because of moisture extremes, evergreen.

Ribes cereum

Seed Treatment:

Wet tumbling seems beneficial.

Stratification:

2 to 3 months. Moderate seedling growth, moderate to fast later growth, moderate water requirement.

Rosa arizonica?

Seed Treatment:

Wet tumbling seems beneficial.

Table 6: Species Specifics

Stratification:

Moderate seedling growth, moderate to fast later growth, moderate water requirement.

Robinia neomexicana

Seed Treatment:

Scarification using dry tumbling with grit and pea gravel for 5 to 7 days.

Stratification:

None required. Fast seedling growth, fast later growth, high water requirement.

Symphoricarpos oreophilus?

Seed Treatment:

Wet tumbling seems beneficial.

Stratification:

2 to 4 months. Fast seedling growth, requires clipping during seedling phase to promote branching, moderate to fast later growth, high water requirement.

Yucca baccata

Planting Technique:

Must be transplanted soon after germination before radicle elongates excessively.

Stratification:

None required. Very slow growing, water infrequently.

Observations

A new field of muttongrass has been established, and it could possibly produce seed in 2001.The Blue grama field looked very promising in 2000, with abundant seedheads being produced. Upon cleaning of the harvested material, it was determined that no viable seed was produced. From the beginning of the muttongrass establishment at the PMC, this ecotype has been notorious for very low seed yields. A new field of Blue grama was established in 2001 and seed could be produced in 2001. The existing blue grama will be checked for insect damage and a spraying maybe initiated in 2001 to try to get a seed crop.