

Plant Survival in the Arid Southwest

30 Years after Seeding

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Highlight: *Adaptability and survival of range plantings are important to those interested in artificial seeding of rangelands. An analysis of exotic plantings made in 1945 in the semidesert shrub, chaparral, semidesert grassland, and pinyon-juniper in the Tonto National Forest, Arizona, show that, of 48 species planted, 13 appear to be able to survive for at least 20 years and should be candidates for restoring depleted rangelands and seven survived for a 30-year period. No species survived for the 30 years in the semidesert shrub and pinyon-juniper types. Boer and Lehmann lovegrasses, blue panicgrass, sand dropseed, and menodora survived in the chaparral and crested wheatgrass and weeping lovegrass in the grassland.*

Revegetation of depleted rangelands was an early subject for research. Griffiths (1907) concluded that reseeded on an economic basis is applicable only to those areas where moisture is adequate. Sampson (1913) and Glendening (1937a, 1937b, 1938) stressed the importance of soil treatment, covering seed, and protecting seeded areas with mulch until plants are established. This paper reports results of survival of 41 species of grasses and grasslike plants, and 7 species of shrubs that were seeded in the arid Southwest 30 years ago.

Sites, Plantings, and Results

Four planting sites were located in four vegetation types (semidesert shrub, chaparral, semidesert grassland, and pinyon-juniper) on the Tonto National Forest in Arizona. These types were selected because they constitute a major portion of the forest acreage and represent difficult management situations because of low rainfall.

Semidesert Shrub

This site is occupied principally by mesquite (*Prosopis juliflora* (Swartz) D.C.), catclaw acacia (*Acacia greggii* A. Gray), paloverde (*Cercidium* spp.), and spiny hackberry (*Celtis pallida* Torr.). In the early spring there is usually a dense ground cover of woolly

Indianwheat (*Plantago purshi* Roem. and Shult.) with some annual grasses. Elevation is approximately 2,100 feet. Annual precipitation varies from 8 to 25 inches with an average of about 16 inches. This site represents an extreme environment to seed because of low temperatures, high temperatures and evaporation rates, and surface-sealing of soils.

In 1945 plantings were made in a semidesert shrub site using the following methods: (1) disking, broadcast seeding, cultipacking, and mulching with native brush; (2) disking, broad-

cast seeding, and cultipacking; (3) disking, broadcast seeding, and harrowing; (4) broadcast seeding and disking; (5) broadcast seeding and harrowing; and (6) broadcast seeding without site preparation. In 1946 half of the 1945 seedings were replanted and an additional 21 range species were planted in mulched rows. All plantings were made in June.

By September 1945 Boer and Lehmann lovegrasses¹, bush muhly, and hooded windmillgrass had emerged in plots which were disked and cultipacked (Table 1). Plains bristlegrass and Rothrock grama had emerged in row plantings. In 1946 the only plants surviving were under the brush mulch. Several plots protected from grazing had approximately four times the plant density and double the plant height of those in grazed plots.

In 1947 the two lovegrasses main-

¹Scientific names of plants seeded are given in Table 1.



Fig. 1. Chaparral planting site, 1945.

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The authors wish to express deep appreciation to Dr. David R. Patton, wildlife biologist, Rocky Mountain Forest and Range Experiment Station, Tempe, for reviewing the manuscript and offering helpful suggestions.

Manuscript received April 7, 1975.

Table 1. Survival of species planted in four vegetation types.

Common name	Scientific name	Sites ¹ planted in 1945				Species survival							
						1965				1975			
		1	2	3	4	1	2	3	4	1	2	3	4
Grasses and grasslike plants													
Crested wheatgrass	<i>Agropyron desertorium</i> (Fisch.) Schult		x	x	x			x	x				x
Intermediate wheatgrass	<i>A. intermedium</i> (Host) Beauv.				x	x							
Western wheatgrass	<i>A. smithii</i> Rydb.		x	x	x				x				
Pubescent wheatgrass	<i>A. trichophorum</i> (Link) Richt.				x	x							
Cane bluestem	<i>Andropogon barbinodis</i> Lag.	x	x										
Turkestan bluestem	<i>A. ischaemum</i> L.				x	x				x			
Little bluestem	<i>A. scoparius</i> Michx.				x	x				x			
Curly mitchellgrass	<i>Astrebala lappacea</i> (Lindl.) Domin.	x	x										
Sideoats grama	<i>Bouteloua curtipendula</i> (Michx.) Torr.				x	x							
Black grama	<i>B. eriopoda</i> Torr.				x	x	x						
Slender grama	<i>B. filiformis</i> (Fourn.) Griffiths				x	x			x				
Blue grama	<i>B. gracilis</i> (H.B.K.) Lag.						x	x					
Hairy grama	<i>B. hirsuta</i> Lag.				x	x							
Rothrock grama	<i>B. rothrockii</i> Vasey	x	x										
Smooth brome	<i>Bromus inermis</i> Leyss.						x	x					
Indian sandbur	<i>Cenchrus biflorus</i> Roxb.	x	x										
Hooded windmillgrass	<i>Chloris cuculata</i> Bisch.	x	x										
Uruguay chloris	<i>C. berroi</i> Arech.	x	x										
Bicolor lovegrass	<i>Eragrostis bicolor</i> Nees				x	x							
Boer lovegrass	<i>E. chloromelas</i> Steud.				x	x			x	x			x
Weeping lovegrass	<i>E. curvula</i> (Schrad.) Nees				x	x	x	x			x		x
	<i>E. echinochloidea</i> Stapf.				x	x							
	<i>E. intermedia</i> Hitchc.						x	x					
Plains lovegrass	<i>E. lehmanniana</i> Nees	x	x	x				x	x				x
Lehmann lovegrass	<i>E. lehmanniana</i> Nees	x	x	x				x	x				x
Wilman lovegrass	<i>E. superba</i> Peyr.	x											
Sand lovegrass	<i>E. trichodes</i> (Nutt.) Wood						x	x					
Tanglehead	<i>Heteropogon contortus</i> (L.) Beauv.						x	x					
Curlymesquite	<i>Hilaria belangeri</i> (Steud.) Nash				x								
Wolf tail	<i>Lycurus phleoides</i> H.B.K.						x	x					
Bush muhly	<i>Muhlenbergia porteri</i> Scribn.	x							x				
Deergrass	<i>M. rigens</i> (Benth.) Hitchc.						x	x					
Smilgrass	<i>Oryzopsis miliacea</i> (L.) Benth. and Hook						x	x					
Blue panicgrass	<i>Panicum antidotale</i> Retz.				x				x				x
Vinemesquite	<i>P. obtusum</i> H.B.K.						x	x					
Sand paspalum	<i>Paspalum stramineum</i> Nash	x	x										
Buffelgrass	<i>Pennisetum ciliare</i> (L.) Link	x	x										
Plains bristlegrass	<i>Setaria macrostachya</i> H.B.K.	x											
Sand dropseed	<i>Sporobolus cryptandrus</i> (Torr.) A. Gray	x	x						x				x
White tridens	<i>Tridens albescens</i> (Vasey) Woot. and Standl.				x	x	x		x	x			
Rough tridens	<i>T. elongatus</i> (Buckl.) Nash				x	x	x						
Slim tridens	<i>T. muticus</i> (Torr.) Nash	x	x	x									
Arizona cottontop	<i>Trichachne californica</i> (Benth.) Chase	x											
Shrubs													
Fourwing saltbush	<i>Atriplex canescens</i> (Pursh) Nutt.	x	x	x	x								
Spiny saltbush	<i>A. confertifolia</i> (Torr. and Frem.) S. Wats.	x	x										
Showy menodora	<i>Menodora longiflora</i> A. Gray	x	x										
Rough menodora	<i>M. scabra</i> A. Gray	x	x						x				x
Broom menodora	<i>M. scoparia</i> Engelm.	x	x										
Australian sheepbush	<i>Pentzia incana</i> (Thumb.) O. Kunze	x	x										
Antelope bitterbrush	<i>Purshia tridentata</i> (Pursh) D C.				x	x							

¹ Sites planted were: 1 = semidesert shrub; 2 = chaparral; 3 = semidesert grassland; and 4 = pinyon-juniper.

tained good stands while bush muhly and hooded windmillgrass had poor stands. Lehmann lovegrass, and plains bristlegrass were surviving in the row plantings. By 1949 survival was confined mostly to mulched plots and to Lehmann lovegrass, Boer lovegrass, bush muhly, and hooded windmillgrass. Hooded windmillgrass and plains bristlegrass did not survive after 1954. The two lovegrasses and bush muhly survived until sometime between 1962 and 1965.

Chaparral

This site is about 50 miles north of

Phoenix, Ariz. It is covered principally with scrub liveoak (*Quercus turbinella* Greene) and broom snakeweed (*Gutierrezia sarothrae* (Pursh) Britt. and Rusby), with a scattering of Utah juniper (*Juniperus osteosperma* (Torr.) Little), pricklypear (*Opuntia* spp.), and curlymesquite (*Hilaria belangeri* (Steud.) Nash). The elevation is near 3,500 feet. Average annual precipitation is about 18 inches.

The area was so rocky that plots were first seeded and then harrowed. Harrowing destroyed from 5 to 10% of the broom snakeweed but little dam-

age occurred to other shrubs. All the seeding was completed in August. By 1949, under juniper slash, there were good stands of Boer and Lehmann lovegrass and white tridens. Since that time there have appeared, intermittently, plants of blue panicgrass, crested wheatgrass, and slender grama. By 1965 the surviving species were Boer lovegrass with only scattered plants of sand dropseed, blue panicgrass, Lehmann lovegrass, white tridens, and rough menodora. All of these species, except white tridens, were surviving in 1975.



Fig. 2. Chaparral planting site, 1975.

Semidesert Grassland

This site is a formerly cultivated and severely eroded area approximately 10 miles north of Young, Ariz. There were existing patches of sod of western wheatgrass, blue grama, and sideoats grama. The approximate elevation is 5,100 feet. Annual precipitation is 21 inches. Treatments were: (1) disking, broadcast seeding, and mulching; (2) disking, broadcast seeding, and cultipacking; and (3) broadcast seeding without seedbed preparation.

There was no plant emergence by the fall of 1945. By 1946 there were fair stands of Lehmann lovegrass,

weeping lovegrass, and crested wheatgrass, and a scattering of western wheatgrass and blue grama. In 1947 only crested and western wheatgrass had good stands, both with and without mulching, on the plots prepared by disking. Row plantings in 1946 had intermediate and pubescent wheatgrass that looked promising. Plants under the mulch were more vigorous. In 1950 tridens began to appear on the mulched areas.

Gradually, all species except tridens, weeping lovegrass, and crested wheatgrass disappeared. By 1965 crested wheatgrass was the most abundant. There were a few plants of

weeping lovegrass surviving. Those plots reseeded to western wheatgrass maintained a heavier stand than those seeded naturally. All plantings made without seedbed preparation failed. Crested wheatgrass and weeping lovegrass were still surviving in 1975.

Pinyon-juniper

This site is located 5 miles southeast of Pine, Arizona. It has a rather dense overstory of juniper and a thick ground cover of broom snakeweed. There was a remnant of sod composed principally of sideoats grama and blue grama. The elevation is approximately 5,000 feet. The average annual precipitation is 21 inches.

One planting area at the site had four treatments: (1) disking, broadcast seeding, and cultipacking; (2) disking, broadcast seeding, cultipacking, and mulching with native brush; and (3) broadcast fertilizing, disking, and broadcast seeding. A second area had: (1) juniper removal, disking, broadcast seeding, and mulching; (2) juniper removal, and broadcast seeding; and (3) no site preparation with broadcast seeding. Disking killed from 25 to 40% of the broom snakeweed.

In September 1945 crested wheatgrass and western wheatgrass were growing well. The species on strip plots were flourishing, particularly under the slash and row plantings had emerged. By 1947 the survival was confined primarily to mulch. Turkestan bluestem and little bluestem were prominent. Intermediate and pubescent wheatgrasses, smooth brome, plains and sand lovegrass, and wolftail had established good stands but stands of black and hairy grama, smilgrass, and vinemesquite were only fair. Tanglehead was established but it was a poor stand.

In 1949 there was an excellent stand of Turkestan bluestem under the mulch and a good stand without litter. Under mulch the stand of weeping lovegrass was good to excellent; that of white tridens, good; and crested and western wheatgrasses, fair. For row plantings there were good stands of intermediate and pubescent wheatgrasses, plains and sand lovegrasses, with fair stands of crested wheatgrass and vinemesquite.

By 1954, under mulch, stands of Turkestan bluestem, weeping lovegrass, deergrass, and crested and western wheatgrasses were good to excellent. Only Turkestan bluestem was in a good stand without mulch. On some plots good stands of crested and western wheatgrasses became established under mulching, both with and without cultivation. Thus mulching may partially compensate for poor seedbed

preparation.

In 1961 and 1965 the outstanding species were Turkestan bluestem, weeping lovegrass, and western wheatgrass. Crested wheatgrass was disappearing. Turkestan bluestem was vigorously spreading in 1965. No species was present in 1975.

Management Implications

After 30 years only six species of grass and one species of shrub remained out of the original plantings. The chaparral planting site was the vegetation type where the most species survived (Figs. 1 and 2). Good stands of Boer and Lehmann lovegrass and menodora are established. Observations indicate that menodora has increased in density from the original planting. Scattered plants of sand dropseed were present and occasional

plants of blue panicgrass. White tridens survived until 1970. Over the years these last two species seem to disappear some seasons but make periodic comebacks. Perhaps this was due to moisture relations.

Of the 48 species planted, 13 (Table 1, 1965) appear to be able to survive for at least 20 years. These species should be good candidates for restoring depleted rangelands in the Southwest, the species used depending on the site. Two wheatgrasses, Turkestan bluestem, three lovegrasses, and rough menodora did well where planted, particularly with site preparation and mulching.

By sites, species surviving which survived the full 30 years are crested wheatgrass and weeping lovegrass in the grassland, and Boer and Lehmann

lovegrasses, blue panicgrass, sand dropseed, and menodora in the chaparral. No species survived in the semidesert shrub and pinyon-juniper sites.

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