Range Reseeding Success on The Tonto National Forest, Arizona

B. IRA JUDD
Professor of Agronomy, Arizona State University, Tempe.

Highlight

Longevity of range plantings is important to those interested in range restoration by this means. An analysis of plantings of 1945 and 1946 through 1965 provide information on longevity for four different environments on the Tonto National Forest of central Arizona. Protective brush mulch was highly important for stand establishment under the conditions of these tests.

Many rangelands in Arizona can be benefited by reseeding to perennial grass. A basic consideration for reseeding is the discovery of long-lived, palatable and otherwise adaptable species. This study reports on perennial grasses that have survived 16 years or more under arid conditions on the Tonto National Forest of central Arizona. Planting trials, methods, and longevity of species are appraised for four different growing conditions.

Revegetation of range lands in Arizona, as elsewhere, was an early undertaking of research. Griffiths (1907) concluded that reseeding on an economic basis is applicable to those areas where requisite moisture occurs. Sampson (1913) and Glendening (1937a, 1937b, 1938) stressed the importance of soil treatment, covering seed and protecting seeded areas until establishment occurred. Glendening (1937c) advocated the use of mulch to establish stands. Cassady (1937) listed general suggestions on reseeding incorporated in the original plans. Crider's (1945) evaluation of the three introduced lovegrasses proved of value in deciding where each species was used. This report supplements the preliminary publication by Judd (1948) on this study.

Study Areas

The Tonto National Forest of 2,960,567 acres is located in central Arizona. It includes the

Sierra Ancha, Mazatzal, and Superstition mountain ranges, as well as parts of the watershed basin of the Salt River. Much of the mountain country supports forests of ponderosa pine *(Pinus ponderosa* Lawson), Douglas fir *(Pseudotsuga menziesii* (Mirb.) Franco), and white fir *(Abies concolor* (Gord. & Glend.) Lindl.); lower, semi-desert country includes areas of brush or grass covered foothills. This more open country is in the Tonto Forest at the request of the U.S. Reclamation Service for protecting the Salt River Valley Irrigation Project.

Four principal planting sites, each representative of a major ecological situation on the Tonto Forest, were chosen for study (Fig. 1). These sites were: Black Hill, Cave Creek, Pine Creek (near Young), and Buckhead Mesa between Payson and Pine.

F. Lee Kirby, former supervisor, Tonto National Forest, initiated this reseeding program in 1945, with the author in charge of the project. Personnel of the Rocky Mountain Forest and Range Experiment Station, U.S. Forest Service, and the Soil Conservation Service assisted with the project plans.

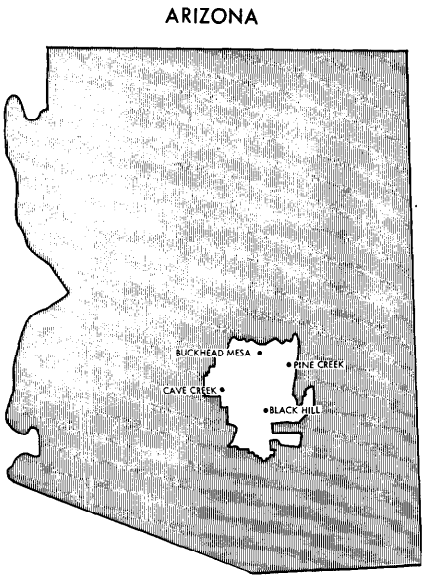

FIG. 1. The four revegetation sites on the Tonto National Forest, central Arizona.

I wish to express deep appreciation to Hudson G. Reynolds and Fred Lavin for reviewing the manuscript and offering many helpful suggestions.

Black Hill

Environment. — This area is about 1.5 miles south of the Salt River arm of Roosevelt Lake and some 6 miles southeast of the town of Roosevelt. It 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 covering of woolly indianwheat *(Plantago purshi* Roem. & Schult.) with some annual grasses. The elevation is approximately 2,100 feet. Although the precipitation varies annually from 8.31 to 25.08 inches and is highly erratic, the average annual total is about 16 inches. Fig. 2 shows mean monthly temperature distribution. This site represents a difficult environment to reseed because of low temperatures, high temperatures and evaporation rates, and surface-sealing of soils.

Methods. — The large plots were generally 1 x 2.5 chains in size and were replicated and randomized in a modified Latin square in so far as possible. Strip plots were 1/6 x 2.5 chains.

In 1945, planting methods tested were: disk-broadcast seed-cultipack-mulch with native brush; disk-broadcast seed-cultipack; disk-broadcast seed-harrow; broadcast seed-disk; broadcast seed-harrow; and broadcast seed without site preparation. In 1946 half of the 1945 seedings were replanted; an additional 21 range species tested in replicated mulched row plantings. All plantings were made in June. Species planted by various methods are listed in Table 1.

Germination and survival.— By September 1945, Boer and Lehmann lovegrasses, bush muhly and hooded windmillgrass had emerged in plots which were disked and cultipacked. Plains bristlegrass and the Rothrock grama had emerged well in row plantings.

By 1946 the only survival was under the brush mulch. Plots

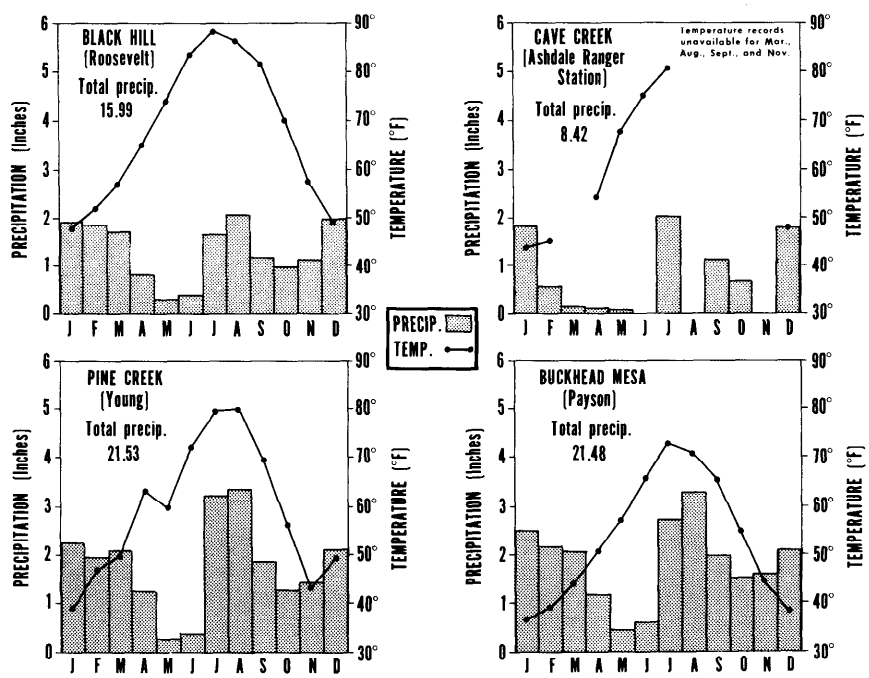

FIG. 2. The average monthly precipitation and mean temperatures for the four study plots.

Table 1. List of species used by study area and method.

Common name	Scientific name	Black Hill 1945-1946		Cave Creek 1945-1946		Pine Creek 1945-1946		Buckhead Mesa 1945-1946		Plot	Row
GRASSES AND GRASSLIKE PLANTS											
Crested wheatgrass	*Agropyron desertorum* (Fisch.) Schult.			X	X	X		X		X	
Intermediate wheatgrass	*A. intermedium* (Host) Beauv.						X		X		X
Western wheatgrass	*A. smithii* Rydb.			X		X		X		X	
Pubescent wheatgrass	*A. trichophorum* (Link) Richt.						X		X		X
Cane bluestem	*Andropogon barbinodis* Lag.	X	X		X					X	X
Turkestan bluestem	*A. ischaemum* L.					X	X	X		X	X
Little bluestem	*A. scoparius* Michx.					X		X		X	X
Curly mitchellgrass	*Astrebla lappacea* (Lindl.) Domin.	X	X		X					X	X
Sideoats grama	*Bouteloua curtipendula* (Michx.) Torr.					X	X	X		X	X
Black grama	*B. eriopoda* Torr.			X			X	X		X	X
Slender grama	*B. filiformis* (Fourn.) Griffiths			X	X				X	X	
Blue grama	*B. gracilis* (H.B.K.) Lag.					X		X		X	X
Hairy grama	*B. hirsuta* Lag.			X			X			X	X
Rothrock grama	*B. rothrockii* Vasey	X	X		X						X
Smooth brome	*Bromus inermis* Leyss.						X		X		X
Indian sandbur	*Cenchrus biflorus* Roxb.		X		X						X
Hooded windmill grass	*Chloris cucullata* Bisch.	X			X					X	
Uruguay chloris	*C. berroi* Arech.		X		X						X
Bicolor lovegrass	*Eragrostis bicolor* Nees		X		X						X
Boer lovegrass	*E. chloromelas* Steud.	X	X	X	X					X	X
Weeping lovegrass	*E. curvula* (Schrad.) Nees	X	X	X	X	X	X	X		X	X
	E. echinochloidea Stapf.		X		X						X
Plains lovegrass	*E. intermedia* Hitchc.						X		X		X
Lehmann lovegrass	*E. lehmanniana* Nees	X	X	X	X		X			X	
Wilman lovegrass	*E. superba* Peyr.		X								X
Sand lovegrass	*E. trichodes* (Nutt.) Wood						X		X		X
Tanglehead	*Heteropogon contortus* (L.) Beauv.						X		X		X
Curlymesquite	*Hilaria belangeri* (Steud.) Nash			X						X	
Wolftail	*Lycurus phleoides* H.B.K.						X		X		X
Bush muhly	*Muhlenbergia porteri* Scribn.	X								X	X
Deergrass	*M. rigens* (Benth.) Hitchc.					X	X	X		X	X
Smilograss	*Oryzopsis miliacea* (L.) Benth. & Hook.						X		X		X
Blue panicgrass	*Panicum antidotale* Retz.			X						X	
Vinemesquite	*P. obtusum* H.B.K.						X	X	X		X
Sand paspalum	*Paspalum stramineum* Nash		X		X						X
Buffelgrass	*Pennisetum ciliare* (L.) Link		X		X						X
Plains bristlegrass	*Setaria macrostachya* H.B.K.	X									X
Sand dropseed	*Sporobolus cryptandrus* (Torr.) A. Gray	X	X	X	X					X	X
White tridens	*Tridens albescens* (Vasey) Woot. & Standl.				X	X	X	X	X	X	X
Rough tridens	*T. elongatus* (Buckl.) Nash			X				X	X	X	X
Slim tridens	*T. muticus* (Torr.) Nash	X	X		X	X	X			X	X
Arizona cottontop	*Trichachne californica* (Benth.) Chase	X									X
SHRUBS											
Fourwing saltbush	*Atriplex canescens* (Pursh) Nutt.		X		X		X		X		X
Spiny saltbush	*A. confertifolia* (Torr. and Frem.) S. Wats.		X		X						X
Showy menodora	*Menodora longiflora* A. Gray		X		X						X
Rough menodora	*M. scabra* A. Gray		X		X						X
Broom menodora	*M. scoparia* Engelm.		X		X						X
Australian sheepbush	*Pentzia incana* (Thunb.) O. Kuntze		X		X						X
Antelope bitterbrush	*Purshia tridentata* (Pursh) DC.						X		X		X

protected from grazing had approximately four times the plant density and double the plant height.

On plots in 1947 the two lovegrasses maintained good stands while bush muhly and hooded windmillgrass had poor stands. Lehmann lovegrass, and plains bristlegrass of the row planting were surviving. By 1949 survival was mostly confined to mulch plots and the species of 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.

Cave Creek

Environment and Methods. — The Cave Creek site is about 50 miles north of Phoenix, (approximately 18 miles beyond Cave Creek at fork of Lookout Mountain and Cave Creek roads). 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), prickly pear *(Opuntia* spp.), and curlymesquite *(Hilaria belangeri* (Steud.) Nash). The elevation is near 3,500 feet. Average annual precipitation is about 18 inches (Fig. 2). Removal of competing vegetation and rocky character of the soil were the limiting factors in successful reseeding of this site.

The area was so rocky that plots were first seeded and then harrowed. Harrowing destroyed from 5 to 10% of the broom snakeweed but damaged other shrubs little. The major plots in four replications were planted under fence. Strip plantings were 8 ft. x 1 chain. All the seedings here were completed in August.

Germination and Survival. — By 1949, under the juniper slash, there were good stands of Boer and Lehmann lovegrasses and white tridens. Since that time there have appeared, intermittently, plants of blue panicgrass, crested wheatgrass, and slendar grama. By 1965 the principal surviving species was Boer lovegrass with only scattered plants of sand dropseed, Lehmann lovegrass, white tridens and rough menodora.

Pine Creek

Environment.—This formerly cultivated, severely eroded site is approximately 10 miles north of Young. There were patches of sod of western wheatgrass, blue grama and sideoats grama. The approximate elevation is 5,100 feet. The annual precipitation is 21.53 inches (Fig. 2).

Methods. — Treatments were disking-broadcast seeding-mulching; disking-broadcast seeding-cultipacking; and broadcast seeding without seedbed preparation on abandoned farmed areas where there was little natural revegetation. The large plots were seeded in 8 replications on both protected and open range. Strip planting plots were ⅓ x 2 chains. All were planted in June.

Germination and Survival. — There was no 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.

By 1947 only crested and western wheatgrasses had made good stands, both with and without mulching, on the plots prepared by disking. There was no evidence of response to the fertilizer. On the 1946 row plantings intermediate and pubescent wheatgrasses looked most promising with plants under the mulch more vigorous than those without. In 1950 the 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 the nonplanted ones. All plantings made without seedbed preparation failed.

Buckhead Mesa

Environment. — Buckhead Mesa is about 5 miles southeast of Pine. The site had a rather heavy 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 21.48 inches (Fig. 2).

Methods. — A method study was incorporated. One area included preplanting treatments of disking-broadcast seeding-cultipacking; disking-broadcast seeding-cultipacking-mulching with native brush; and broadcast fertilizing-disking-broadcast seeding. A second area was treated by juniper removal-disking-broadcast seeding-mulching; juniper removal-broadcast seeding; and no site preparation-broadcast seeding. Disking killed from 25 to 40% of the broom snakeweed.

Six replications of the major plots in the fenced area and one replication on the open range were planted in July. There were 7 replications of the strip plots planted. A 20-foot strip on these plots was mulched.

The 1946 plantings included 8 circular plots 20 ft in diameter where seed was broadcast and raked in. Competition was eliminated on half of the plots; half of each plot was mulched with brush. Three replications were resown by broadcasting and raking.

Germination and Survival. — In September 1945 crested wheat-

grass and western wheatgrass were growing well. The species on the strip plots were flourishing, particularly under the slash (Fig. 3). Row plantings had emerged.

By 1947 the survival was confined primarily to mulch. Crested wheatgrass, western wheatgrass, weeping lovegrass, Turkestan bluestem, and little bluestem were outstanding. The status of row plantings was: intermediate and pubescent wheatgrasses, smooth brome, plains and sand lovegrasses, and wolftail, good stands; black and hairy gramas, smilograss and vinemesquite, fair stands; tanglehead, poor stand.

By 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, Turkestan bluestem, weeping lovegrass, deergrass, crested and western wheatgrasses were of good to excellent stands. Only Turkestan bluestem was in good stand without mulch. On the circular 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 outstanding and was vigorously spreading.

FIG. 3. Persistence of slash after 20 years, Buckhead Mesa.

Summary and Conclusions

Longevity of range planting is important to public land administrators and ranchers who contemplate range restoration by this means. Experimental range plantings on the Tonto National Forest of central Arizona offer information in this respect. An analysis of plantings of 1945 and 1946 through 1965 provides information on longevity for four different environments. Annual precipitation and mean temperatures largely controlled species adaptability at the different sites.

At Black Hill (average annual precipitation 15.99 inches, average annual temperature 67.7 F) Lehmann and Boer lovegrass were the most promising of 25 species tried. At Cave Creek (estimated precipitation 18 inches, average temperature 58.7 F) Boer lovegrass (a cold hardy, drought-resistant species) was outstanding among the 30 species planted. At Pine Creek precipitation 21.53 inches, average temperature 57.8 F) crested wheatgrass and western wheatgrass (cool-season growers), of 23 species seeded, still survived in good stand after 20 years.

At Buckhead Mesa (precipitation 21.48 inches, temperature 52.8 F), of the 20 species seeded, Turkestan bluestem was outstanding without protective mulch and weeping lovegrass survived under a brush mulch.

Under the arid conditions and extensive seedbed preparation of these tests, protective brush mulch was highly important for stand establishment and maintenance.

Other factors may have had an influence on successful establishment of stands. Available moisture during seedling development, protection from grazing, elimination of competition, and adaptability of species no doubt played roles affecting the final results.

Public land managers and

ranchers should be able to effect successful range seeding by choosing species coordinated with the environmental conditions of this study.

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