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Some Developments Related to Seeding Western Rangelands[1]

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Seeding Western rangelands is generally a difficult undertaking because of limiting climatic, soil, and/or topographic features. The good sites with a favorable climate are in cultivated croplands. Therefore, we are trying to seed and grow range plants where even the hardiest of crop plants are not economically productive and are difficult or impossible to establish.

Original plant productivity has been reduced on millions of acres of Western rangeland by past grazing abuses, brush invasion, droughts, and past attempts to cultivate nonarable land. In many areas the degradation is so complete that seeding is required to restore at least a portion of the former productivity.

It would be impossible for me to describe all of the methods used in seeding Western rangelands. Rather, I will present selected results of recent studies. My colleagues in several states have provided part of this information.

In the inner coastal foothills along the western side of the San Joaquin Valley in California, annual grasses now dominate areas previously covered with perennial grasses. The average annual rainfall of that area is 15 to 38 cm. Cornelius and Burma (1970) have successfully seeded this area by use of contour furrows. Desert saltbush [*Atriplex polycarpa* (Torr.) Wats.] and pubescent wheatgrass [*Agropyron trichophorum* (Link) Richt cv. Trigo] were the best-adapted species.

The conversion of chaparral to grassland in California has been investigated by Cornelius (1966) and Bentley (1967). The steps to successful conversion are: (i) crushing the brush to insure clean, safe

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burning; (ii) burning when danger of fire escape is at a minimum; (iii) drilling seed of adapted perennial grass species in the ash seedbed; (iv) chemical control of brush sprouts and seedlings to prevent increase of brush; and (v) utilization of herbaceous cover by livestock and wildlife to realize forage and fire control benefits.

For about 10 years, an area successfully converted to grass near Grindstone in the Mendocino National Forest in northern California has been moderately grazed at the rate of 2.7 animal unit months per ha. No grazing is possible on the areas infested with brush. The major seeded species are hardinggrass [*Phalaris tuberosa* var. *stenoptera* (Hack.) Hitchc.], big bluegrass [*Poa ampla* Merr.], tall fescue [*Festuca arundinacea* Schreb.], and intermediate wheatgrass [*Agropyron intermedium* (Host) Beauv.]. Additional benefits are increased water yields and fuel breaks for fire protection. The areas infested with brush present a high fire risk and the grassed areas are used to gain quick access to brush fires (Cornelius, 1966).

In Nevada, Eckert (personal communication) and others are reclaiming areas dominated by cheatgrass brome [*Bromus tectorum* L.]. The cheatgrass brome and other broadleaf annuals are controlled by 1.1 kg/ha atrazine applied in the fall. The site is fallowed 1 year. During the fallow year soil moisture remained near field capacity on the treated area, while it was rapidly depleted on the untreated areas.

The nitrate nitrogen level in the 0- to 8-cm depth on the fallowed area was 48 kg/ha and only 8 kg/ha on the unsprayed control. The treated areas are seeded in the fall, 1 year after herbicide application, with a wide furrow drill. This type of furrow removes the 0.05 to 1.45 ppm atrazine residue remaining in the surface soil from the vicinity of the seed. It also improves the microclimate near the seedling. The following spring, the weed control is complete and the atrazine residue is about 0.04 to 0.15 ppm in the surface soil. The density of the seeded Amur intermediate wheatgrass is about a seedling per 10 cm. A 2-year-old stand of the wheatgrass produced 2,200 kg/ha.

Abandoned cropland in the ponderosa pine zone of Colorado may be successfully seeded to Russian wildrye [*Elymus junceus* Fisch.] (W. J. McGinnies, personal communication). After 17 years of livestock exclusion, an area of native range in western Colorado produced only 56 kg/ha of palatable herbage. A similar site nearby was seeded to timothy [*Phleum pratense* L.], smooth brome [*Bromus inermis* Leyss.], and orchardgrass [*Dactylis glomerata* L.]. The seeded area produced about 1,600 kg/ha palatable herbage.

Areas infested with Gambel oak [*Quercus gambelii* Nutt.] in southern Colorado may be rootplowed and successfully seeded with smooth brome and intermediate wheatgrass (W. J. McGinnies, personal communication). Areas infested with big sagebrush [*Artemisia tridentata* Nutt.] in western Colorado are plowed, disked, and seeded with smooth brome, intermediate wheatgrass, or crested wheatgrass [*Agropyron desertorum* (Fisch.) Schult.]. The plowing is necessary to control the brush. Some treated areas are stocked at five times the rate of untreated areas.

From northern New Mexico to the State of Washington large acreages infested with big sagebrush have been converted to crested wheatgrass. Much of this is accomplished by plowing and seeding with a one-way wheatland-type plow and seeder.

In Colorado, Hyder and Bement (1969) have developed a system of seedbed preparation that involves moldboard plowing and packing ridges. This eliminates competing vegetation and controls wind erosion on sandy loam soils. Previously, soil erosion by wind prevented the development of reliable methods of seeding grasses on abandoned croplands. Double-disk flexiplanters are attached to the tool bar at the rear of the roller for planting seed in the furrows.

Over the last 5 years the plow, pack, and drill procedure has produced good stands of crested wheatgrass in eight of nine trials. The one failure was caused by a hailstorm that destroyed the ridges and buried the seed the day after planting. By contrast, seedings of the dominant native grass, blue grama [*Bouteloua gracilis* (H.B.K.) Lag. ex Steud.], have always failed.

When planted in moist, warm soil, blue grama emerges quickly and abundantly. The seedlings die, however, at 6 to 10 weeks of age. Hyder (personal communication) studied the morphological differences between seedlings of blue grama and crested wheatgrass to discover why seedings of blue grama fail while those of crested wheatgrass succeed. When both species are planted at a depth of 18 mm, crested wheatgrass initiates adventitious roots at the depth of planting and blue grama initiates adventitious roots at an average of only 2 mm below the soil surface. Adventitious roots usually die in the harsh, dry environment near the soil surface. Thus, blue grama seedlings die as their short-lived primary roots deteriorate.

Blue grama seedlings have an *Avena*-type morphology with an elongated subcoleoptile internode and a short coleoptile; but crested wheatgrass seedlings have a *Triticum*-type morphology that lacks the elongated subcoleoptile internode. Blue grama has but a single seminal root (the primary root), while crested wheatgrass has a seminal primary root and one to five seminal lateral roots. Furthermore, crested wheatgrass has a longer-lived primary root. These morphological differences require different refinements in seeding methods (Hyder, personal communication).

Chaparral is the dominant vegetation on about 1.8 million ha in Arizona. Conversion of chaparral to grass was studied near Prescott by Lavin (personal communication). The average annual precipitation is 46 cm. Rootplowing was effective for control of the sprouting chaparral species. Excellent results were obtained with seedings of weeping lovegrass [*Eragrostis curvula* (Schrad.) Nees] and Lehmann lovegrass [*E. lehmanniana* Nees]. Pond (1967) reported that treated areas produce about 45 kg beef/ha, while the untreated chaparral areas are producing 12 kg/ha. Converting chaparral to grass increases forage yield and is believed to increase water yield for downstream utilization.

Dead brush may be used to protect seedlings during successful seeding of areas infested with brush in the hot, arid Southwest. The effective precipitation occurs in the summer. To complicate matters, virtually all the adapted species have small seed, which means that they must be planted in the surface 1.3 cm. During a typical summer period, maximum air temperature averaged 33 C in a shelter 10 cm above the surface of the ground at the Jornada Experimental Range. Maximum soil temperatures at the 1.3-cm depth under cover of three dead shrubs averaged 36 C; under cover of one head shrub it averaged 49 C; and with no cover it averaged 57 C. On a clay loam site there were 147 mm rainfall during the growing season. There were only 5 days during the 82-day study when soil moisture was available (less than -15 bars water potential) at the 1.3-cm depth on the area with no cover, while moisture was available 42 days on the area with light brush cover. On a sandy loam site there were 121 mm rainfall during the growing season. During the 82-day period there were 23 days when soil moisture was available at the 1.3-cm depth on the area without cover and 40 days on the brush-covered area.

To seed some of these areas infested with brush, a rootplow is used to kill the brush. The seedbed, following rootplowing, is very loose and fluffy. A seeder was designed, patterned after the Oregon Press Seeder (Hyder et al., 1961), which firms the surface soil. Then, Dr. George Abernathy, New Mexico State University Agricultural Engineer, developed a brush conveyor that picks up the brush behind the rootplow and deposits it behind the seeder. In addition, there is a hydraulically operated dozer blade in front of the seeder that forms basin pits. Thus, water is concentrated and shade is provided for part of the seeded area (Fig. 1 and 2). This method was used to seed 12

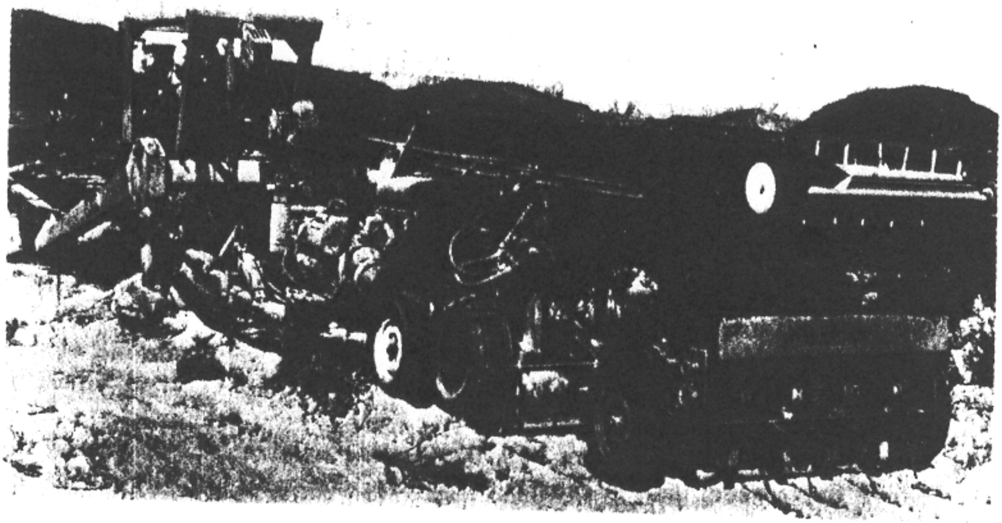

Fig. 1—Rootplow, brush conveyor, pitter, and seeder for converting areas infested with noxious brush to areas producing useful vegetation. The brush is picked up and moved by conveyor flights driven by a hydraulic motor. The height of the pickup unit is hydraulically controlled so that the operator can avoid large rocks or other obstructions. The basin pits are made with a hydraulically controlled bulldozer blade. The press-wheel seeder firms the soil prior to seeding. The brush conveyor and pitter were designed and developed by Dr. George Abernathy, Agricultural Engineering Department, New Mexico State University.

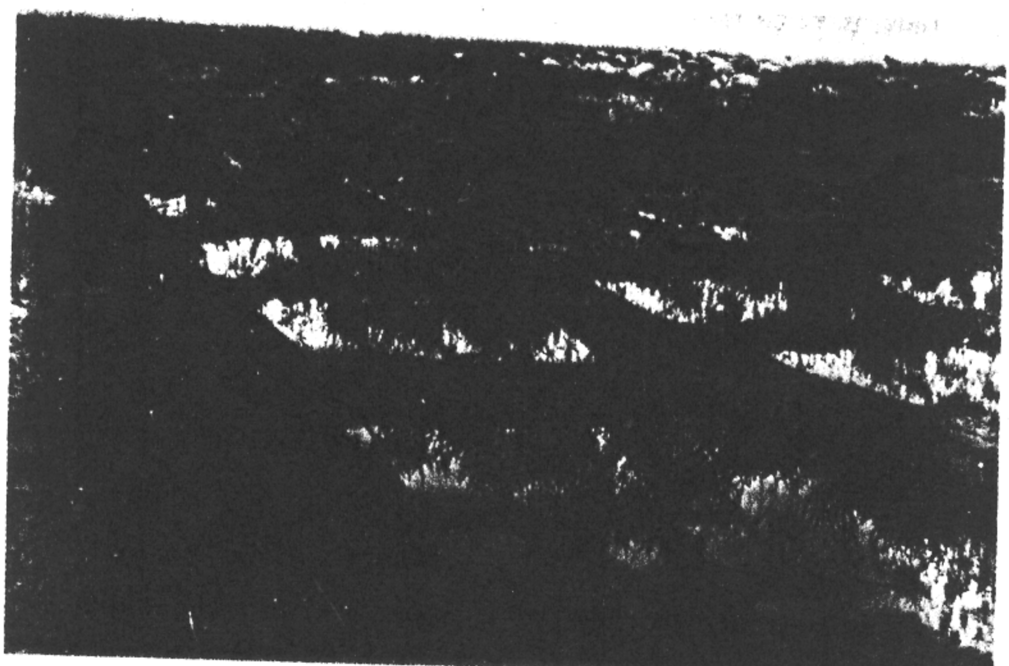

Fig. 2—Basin pits with trapped water and established plants 14 months after seeding. The basin pits were formed with the equipment shown in Fig. 1.

plots across southern New Mexico in 1967-68. Excellent plant establishment was obtained on nine of these plots (Herbel, 1971).

To successfully seed Western rangeland, the right combination of species and method must be used for the various environmental units.

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