J. Range Manage.
57:399-401 July 2004

Gully seeder for reseeding rangeland and riparian areas

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Abstract

Traditional methods of reseeding degraded arid and semi-arid rangeland are expensive and frequently unsuccessful due to high rates of seed predation and seedling mortality. A runoff-based method is described that protects seeds from predation and degradation until soil moisture is available, then deposits them in favorable microsites for germination and establishment. Seeds are placed in three, 2 cm-diameter x 8 cm PVC tubes. The small tubes are capped with crepe paper and glued inside of a 7.5 cm-diameter x 15 cm-long tube which is capped with hardware cloth. The tubes are placed in small rills, gullies, arroyos or riparian areas and the seeds are released sequentially from the 3 tubes as flow depth increases. Seeds are deposited beneath piles of litter where soil moisture and temperature are more favorable for seedling establishment.

Key Words: revegetation, land degradation, remediation, restoration, seeding methods

Resumen

Métodos tradicionales de resiembra de áreas de pastizal árido y semiárido degradadas son costosos y frecuentemente no exitosos debido a altas tasas de depredación de semillas y muerte de plántulas. Un método basado en el escurrimiento superficial del agua de lluvia es descrito para proteger las semillas de la depredación y degradación hasta en tanto la humedad del suelo requerida este disponible, depositándose por consiguiente las semillas en micrositios favorables para su germinación y establecimiento. Las semillas son colocadas en tres tubos de PVC de 2 cm de diámetro y 8 cm de longitud. Los tubos pequeños son sellados con papel crepe y adheridos a la superficie interna de un tubo de PVC de 7.5 cm de diámetro y 15 cm de longitud, los cuales son protegidos en los extremos con una malla. Los tubos son colocados en pequeños canales, cárcavas o arroyos. Entonces las semillas son liberadas secuencialmente en los tres tubos conforme el nivel del escurrimiento aumente. Las semillas son depositadas bajo acumulaciones de mantillo lo cual coincide cuando la humedad y temperatura son más favorables para el establecimiento de plántulas.

Many of the techniques developed for rangeland revegetation result in soil erosion due to short-term loss of surface cover and disturbance of the soil surface. In addition many of these strategies are expensive and often yield low seedling establishment (Ethridge et al. 1997). Mechanical seedbed preparation is an effective option but erosion risk is significantly increased particularly in areas with steep slopes and high rainfall intensities (Evans and Young 1987), and weed establishment is facilitated. Consequently, these modified environments frequently need additional investment in maintenance and weed control (Wiedemann 1987). The combination of high land preparation, seeding and maintenance costs together with low seedling establishment rates often make rangeland reseeding uneconomic (Ethridge et al. 1997).

Factors that commonly limit seedling establishment in rangelands include extreme temperatures, and low and erratic soil moisture availability during the growing season (O'Connor 1996, Ethridge et al. 1997, Peters 2000). Seedling establishment can be increased by modifying the microclimate around the germinating seed, limiting temperature extremes and increasing the quantity of water in soil surface horizons and the length of time it is available. Soil pitting, brush dams, and contour dikes and terraces have all been used to ameliorate soil surface temperatures and reduce evaporation by increasing infiltration and litter cover (Abernathy and Herbel 1973, Roundy and Biedenbender 1996, Whisenant 1999). The success of these labor-, energy- and machinery-intensive treatments is highly variable (Roundy and Biedenbender 1996, Rango et al. 2002) costs are high, and soil surface disturbance can be a problem (Herrick et al. 1997). One of the most significant problems is that rainfall is extremely difficult to predict. Seeds dispersed at the beginning of a relatively dry period are often lost to predation by ants or small mammals (Whitford 2002), or they germinate following small rainfall events when soil moisture is insufficient for establishment.

Simple, low-cost seeding techniques are required that increase the probability that seeds will germinate in locations favorable for seedling establishment at times when near-surface soil moisture is more likely to be available for extended periods. In much of the southwestern US and northern Mexico, these conditions are most likely to be met during the summer monsoons (Branson et al. 1981, Bailey 1998). This period is characterized by relatively high-intensity storms that generate overland flow in many parts of the landscape, feeding rills, gullies and arroyos, and causing streams to overflow their banks.

Based on this observation Barrow (1992) proposed a method of natural rangeland reseeding that takes advantage of these over-

Jerry Barrow, Dick Dunlop and other members of the Jornada Range assisted with the development of earlier designs. Jeff Parham prepared the figure. The senior author was supported by a grant from the Mexican government.

Manuscript accepted 6 Dec. 03.

land flow events to disperse seeds and, in theory, deposit them in and under new concentrations of plant litter. This method consists of a post supporting an inverted bottle containing grass seeds. The base that supports the bottle is connected to a vane resting in a small channel, perpendicular to the water flow path. The vane is moved during runoff events, releasing and dispersing the seeds. Although this method has some potential, it is relatively expensive and very vulnerable to livestock impact as the post attracts animals which rub against it.

A "Gully Seeder" was designed as an alternative method. It also releases grass seeds during the best environmental conditions for seedling establishment, but at a much lower cost and without the other disadvantages of the post-based system.

Gully Seeder Design

The gully seeder (Fig. 1) is constructed from 7.5 cm diameter white PVC pipe. Three shorter 2.0 cm diameter tubes are glued with silicone inside the large tube at 120° intervals. Each of the smaller tubes can hold up to 25 ml of seed (approximately 0.76 g of spikelets containing 1,000 sideoats grama (*Bouteloua curtipendula* (Michx.) Torrey) caryopses). The small tubes are capped by crepe paper attached with UHU glue (Saunders, Readfield, Maine)[1]. The seed-containing tubes are protected from small mammals by 1.27 x 1.27 cm mesh hardware cloth which is attached to the large tube with silicone glue.

This design keeps the seeds relatively cool and dry. Seed germinability and viability after a year of storage in the tubes in the field were as high as for seeds stored in an air conditioned laboratory (Gutierrez 2000). The total cost for materials is approximately US$0.75.

Gully Seeder Placement and Operation

The gully seeder was designed to be used in flow paths, rills, gullies and arroyos. Short stakes (e.g. re-bar) are used to anchor it at the lowest point in a rill or flow path, preferably just above an area where the rill divides or widens. In gullies, arroyos and riparian areas, the seeder is anchored on the side of the channel above the bottom so that it is only activated during relatively large events. When water flows through the seeder, it removes the seed container caps and disperses the seeds, depositing them in piles of litter (Gutierrez 2000). Seeds are removed sequentially from each of the 3 tubes as the water level rises, increasing the probability of more extensive spatial dispersal of the seeds. A related study showed that 90–100% of the seeds are dispersed during runoff events and most are associated with litter in microsites where moisture and temperature conditions are more favorable for seedling establishment (Gutierrez 2000).

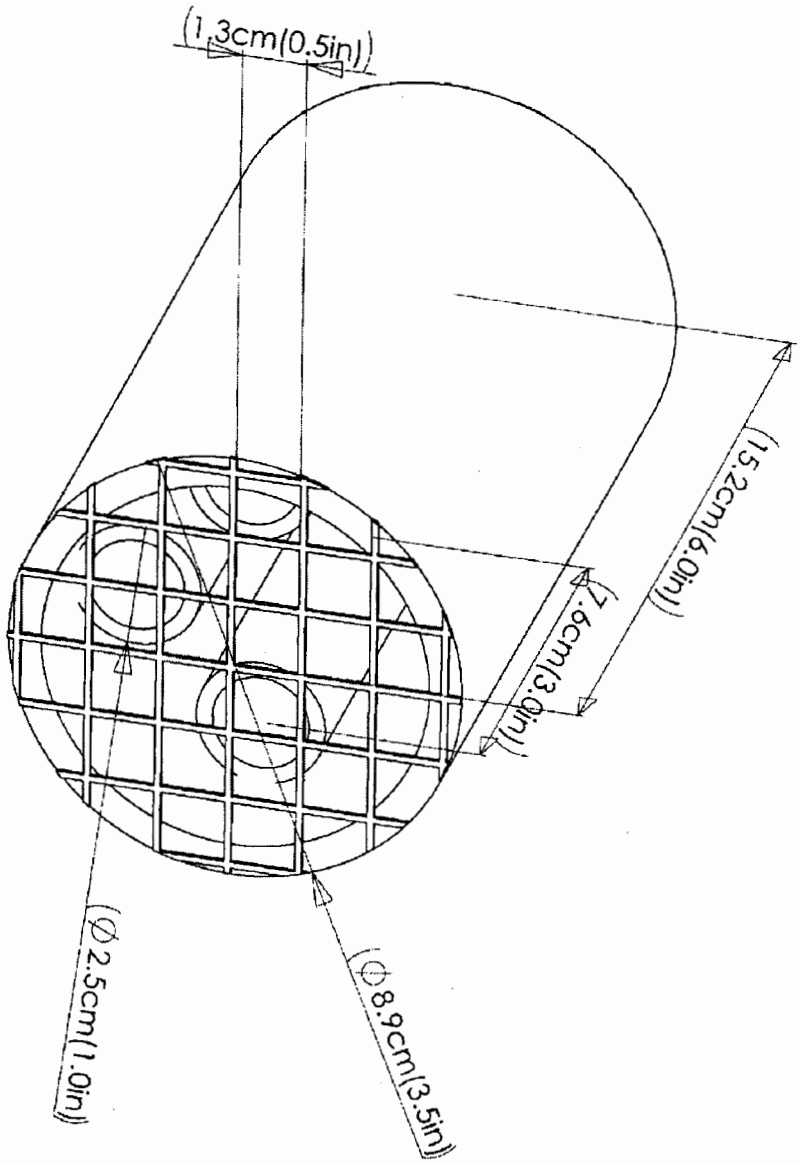

Fig. 1. Gully seeder design.

[1]Reference to a particular product or manufacturer does not imply endorsement by the USDA or any of the authors.

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