Arid Land Seeder Development

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A major problem confronting range managers in arid and semiarid climates is the need to find new initiatives for improving rangeland. In the western and plains States, approximately 836 million acres are used primarily for livestock grazing and for wildlife habitat. Of this acreage, only 170 million acres are classified in good condition. The remaining acreage has been taken over by undesirable brush. Much of this rangeland can be improved, or converted from brush to desirable grass and forbs, through recent equipment development efforts. This can be accomplished by rootplowing or plowing with the Brushland Plow and then seeding with the Rangeland Drill. However, in the very arid areas of less than 11 inches of rainfall per year, conventional methods and equipment have not been economical or successful enough to justify or encourage their use.

Background

The USDA Agricultural Research Service (ARS) at the Jornada Experimental Range location near Las Cruces, N. Mex., has researched methods since 1960 for the restoration of arid, low, or nonproductive rangeland. This research has shown that by properly placing uprooted, undesirable shrubs over seeded rangeland, more favorable temperature and moisture conditions are provided for grass to germinate, emerge, and cope with drought conditions. The microclimate created by the brush covering lowers the maximum daytime soil temperature during the summer rainy season and increases the available soil moisture. This has been demonstrated both in the laboratory and the field.

In 1965, the Agricultural Engineering Department of New Mexico State University (NMSU) at Las Cruces designed demonstration equipment for arid rangeland seeding based on the ARS research. This equipment, towed behind a standard rootplow, picks up the plowed brush from the ground, forms large basins, firms the soil, plants seeds, and then deposits the brush on the seedbed as a cover. By 1971, this equipment, in various stages of development, has seeded 23 experimental plots ranging in size from 3 to 6 acres in the arid southern New Mexico area. The plantings were considered successful on 14 or 61% of the plots planted.

Development

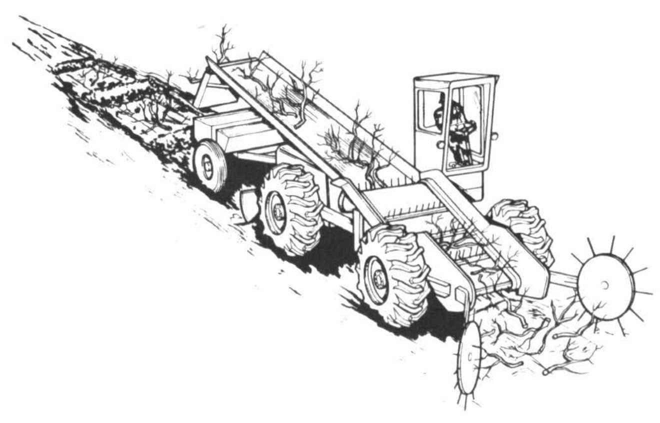
The NMSU demonstration model arid land seeder validated that a machine could pick up rootplowed brush, form basins, firm and pack the seedbed in the basins, plant the seed, and place the rootplowed brush on the seedbed to cover and protect the seeds. Also validated was that the brush cover created an improved microclimate, resulting in a marked increase in the success ratio for grass stand establishment in the arid southern New Mexico area.

While the NMSU equipment did useful work and performed the functions desired, this equipment was not designed or assembled with the intent of doing large-scale projects or of being duplicated. The objective of the NMSU equipment was to demonstrate and validate in the field the concepts learned from the ARS research. The reliability (how often breakdowns occur) and maintainability (how long to repair after breakdown) of this equipment will not allow it to be operated economically. As a result, the Forest Service, San Dimas Equipment Development Center (SDEDC) was assigned a project in 1973 to develop performance criteria and develop designs for an arid land seeder.

Arid land seeding equipment was investigated; feasibility of developing equipment for establishing the microclimate needed for better seeding survival was determined; performance criteria were developed; 3 alternative designs were developed with one of the designs being recommended by The Arid Lands Seeding Workgroup for development; and additional field planting was accomplished by the NMSU designed demonstration equipment.

Since the performance criteria and design alternatives were developed, the ARS has conducted tests on 120 acres

Best Design: Careful consideration of all advantages and disadvantages led to a consensus by the Arid Land Seeding Workgroup of the Vegetative Rehabilitation Equipment Workshop that the best design for an arid land seeder would be a self-propelled, wheel-mounted unit.



Artist's concept of Arid Land Seeder

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Area successfully treated with New Mexico State University demonstration arid land seeder near Alamogordo, N. Mex. This area was once productive grassland that became infested and overrun with creosotebush. An untreated creosotebush area is seen to the right.

New Mexico State University demonstration arid land seeder treating area near Las Cruces.

Results of the work done near Las Cruces, N. Mex. some 9 years later. Note the sustained grass vigor and height of 3 feet. Before treatment, only creosotebush and some mesquite were growing in this area.

by separating the seeder from the rootplowing tractor and towing the seeder separately with a wheeled log skidder. These tests concluded that both the rootplowing and seeding are accomplished more efficiently and faster when the operations are separate. Towing the seeder with the wheeled log skidder worked, but was not convenient for the operator because of having to look back constantly to observe the seeder operation. Also, while the brush could be picked up after being run over by the prime mover, the brush was easier to pick up when the seeder was towed by the rootplowing tractor. The heavy rubber tires on the log skidder did not prove to be a problem, but the lighter and smaller tire on the towed aird land seeder was somewhat of a problem.

Program to Completion

The concept of an arid land seeder has been demonstrated to be valid and workable by treatment of 335 acres in southern New Mexico. A full-scale engineering development phase is needed to implement the use of the arid land seeder. The most important product of this full scale engineering development effort will be a technical data package from which additional units can be fabricated.

Brush pickup conveyor on New Mexico State University demonstration arid land seeder.

The full-scale engineering development phase can be carried out in several ways to reach the production, use, and product improvement phase of development. The preparation of the technical data package and fabrication of a production prototype to validate the design and technical package could be accomplished by SDEDC or under contract. When the technical data package is completed and validated, additional units can be procured under contract and the production, use, and product improvement phase of development (implementation) will have been entered. Depending on market potential, it may be possible to find a manufacturer who would be willing to take over development and production of an arid land seeder for sale to private industry and government agencies.

By using analogy cost estimating techniques, the cost estimate of a production model arid land seeder would be between \$97,000 and \$140,000 (1981 dollars). By the use of parametric cost estimating techniques to determine an arid land seeder hourly operating cost and the seeding speeds contained in the performance criteria, the cost to seed rangeland (rootplowing and seed not included) using a production arid land seeder, depending on the purchase price, operating rates, and operating efficiency, would be between \$28 and \$57 per acre (1981 dollars). ★