

## A Micro-Ridge Roller for Seedbed Modification<sup>1</sup>

D. N. HYDER AND R. E. BEMENT

*Range Scientists, Crops Research Division, Agricultural Research Service, U.S.D.A., Fort Collins, Colorado.*

### Highlight

Mechanical methods of seedbed preparation can not be fully developed for some sandy soils without a way to protect the soil from wind erosion. A firm micro-ridge relief is being evaluated for benefits in both soil stability and soil-moisture relations. This paper describes the roller used to prepare a micro-ridge seedbed surface.

An interest in the windbreak effectiveness of a ridged seedbed surface grew out of a series of experiments on seeding methods for sandy soils in the 10- to 15-inch precipitation zone of the central Great Plains (Bement et al., 1961; Bement et al., 1965; Everson et al., 1968; Hyder and Everson, 1968; McGinnies, 1959; 1962). Chemical-fallow methods of seedbed preparation are expensive, and mechanical methods can not be fully developed without some means of protecting the soil from blowing. Furthermore, the full potential for rehabilitation of abandoned croplands can not be realized until seeding procedures have become more uniformly successful. Rapid moisture losses from the soil surface often subject the grass seedlings to severe drouth before the nodal roots have penetrated to a dependable supply of moisture. Thus, ridged seedbeds are being investigated especially for benefits in soil stability and soil-moisture relations.

This paper introduces the subject of ridged seedbeds, and describes the micro-ridge roller used to prepare a micro-ridge relief on the seedbed surface.

### First Micro-Ridge Roller

A concrete roller, having flat sections 4 inches wide for forming row bottoms separated by a pair of sloping sections

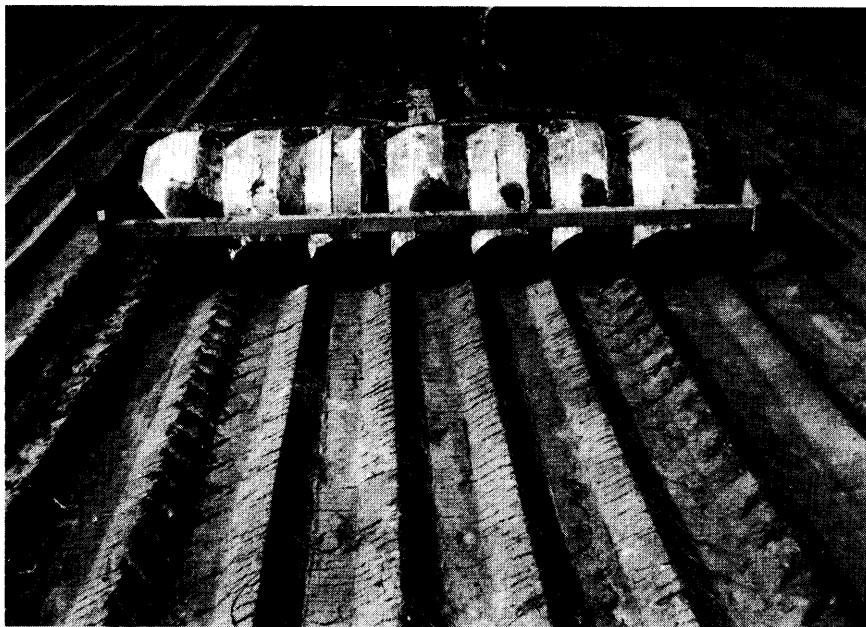


FIG. 1. The first micro-ridge roller.

each 4 inches wide for forming ridges, was constructed in 1965 (Fig. 1). The ridges formed thereby have an elevation of 2.25 inches, a top angle of 120°, and a spacing width of 12 inches. The smallest and largest diameters of the roller sections are 19.5 and 24 inches, respectively. Each section includes a 3-inch i.d. pipe in the center for mounting on an axle.

The 3-inch steel shaft used for an axle is machined down at the ends for roller-bearing surfaces, and is threaded

inside the bearing surfaces to permit clamping the roller sections into a solid unit. With all sections in place, the roller is 7 ft wide and weighs about 2,400 lb.

Front and side members of the roller frame are made of 6-inch channel iron (8.2 lb/ft) boxed and welded for sufficient strength. The tongue is made of boxed 8-inch channel weighing 11.5 lb/ft, and the tongue braces are single members of 6-inch channel. A 2.25-inch square tool bar is mounted at the

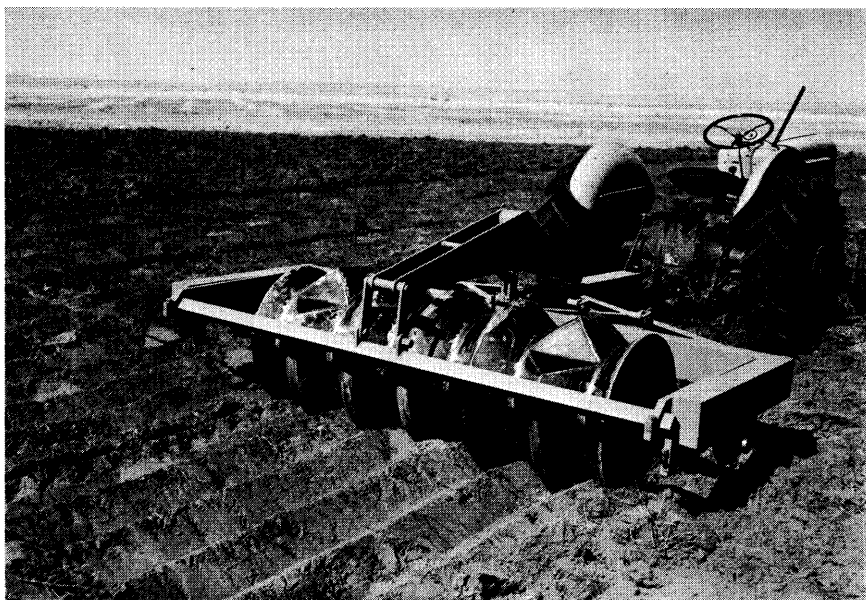


FIG. 2. The second micro-ridge roller.

<sup>1</sup>This paper is the result of cooperative research by the Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture, and the Colorado Agricultural Experiment Station. Published with the approval of the Director, Colo. Agr. Exp. Sta., as Scientific Series Paper No. 1293. Received March 29, 1968; accepted for publication July 8, 1968.



FIG. 3. Ridge-line cleavage and dam features.

rear for planter attachment. The tool bar and planters are raised with a manually operated hydraulic jack by means of an overhead arm. This roller frame weighs about 930 lb, thus giving an equipment total weight of about 3,400 lb.

Roller performance was evaluated after moldboard plowing to a depth of 11 inches in September 1965. When moved at a very slow, steady speed, the roller firmed the soil quite well. At speeds greater than about 1 mph, soil firming was judged inadequate. The ridges were left with a great deal of lateral cleavage at all speeds, but packing 3 times, as in Fig. 1, prepared a smooth, firm relief. Cleavage fissures at the ridge line varied in width up to about 1 inch. Ridge-line cleavage is a mechanical function of this type roller, having a surface of variable circumference. The smaller circumference of 61.3 inches must travel the same distance along the ridge line as the larger circumference of 75.4 inches travels along the row bottom. Consequently, the smaller circumference must be dragged along the ridge line. The amount of ridge-line slippage is calculated to be  $(75.4 - 61.3)/75.4 = 19\%$ . Slippage, and consequently ridge-line cleavage, will vary with other roller dimensions according to the circumference ratio.

Crested wheatgrass (*Agropyron desertorum* (Fisch. ex Link) Schult.) seed was planted in the firmed rows between ridges with a double-disc cone

seeder on September 30, 1965. The seedlings emerged very uniformly by October 11. Subsequent rapid seedling development and lack of wind erosion was encouraging. Therefore, this micro-ridge relief was prepared for wind-tunnel evaluation, which will be reported in a separate paper.

Additional field testing was completed in 1966, when it was concluded that: (a) a steel roller surface might permit ridge-line slippage without excessive soil cleavage; (b) elimination of the 4-inch flat sections might change slippage characteristics as well as mediate wind-current roll over the rows;

and (c) the row-forming sections should include a cut-away for forming dams along the rows.

### Second Micro-Ridge Roller

A steel-surfaced roller was built in the spring of 1967 and mounted in the frame built for the first roller (Fig. 2). This roller was designed to form a succession of adjacent ridges having a height of 4 inches, a slope angle of  $33.7^\circ$ , a ridge-line angle of  $112.6^\circ$ , and a spacing width of 12 inches. Cut-aways in the roller sections were designed to leave dams across the rows between ridges with each rotation (Fig. 3).

The steel shell was cut from 10-gauge steel sheet weighing 5.625 lb/ft<sup>2</sup>, welded into a single unit, and filled with concrete. An axle-access pipe was centered in the shell before filling, and the unit was vibrated during the concrete-filling operation to remove all air traps.

Layout dimensions of the steel-shell sections were determined by projecting a single section to the vertex of a cone (Fig. 4). The layout radii of the pieces to be cut could have been measured as the distance from the cone vertex to the respective edges of the roller section, but were calculated as a sine function of the section radii. Section circumferences defined the lengths of the inside and outside edges of the pieces to be cut. Then, in the third step, layout radii and section circumferences were used to calculate the angle of arc required on the layout pattern.

Section pieces were drawn on the steel sheet according to layout radii and the angle of arc. After cutting, the

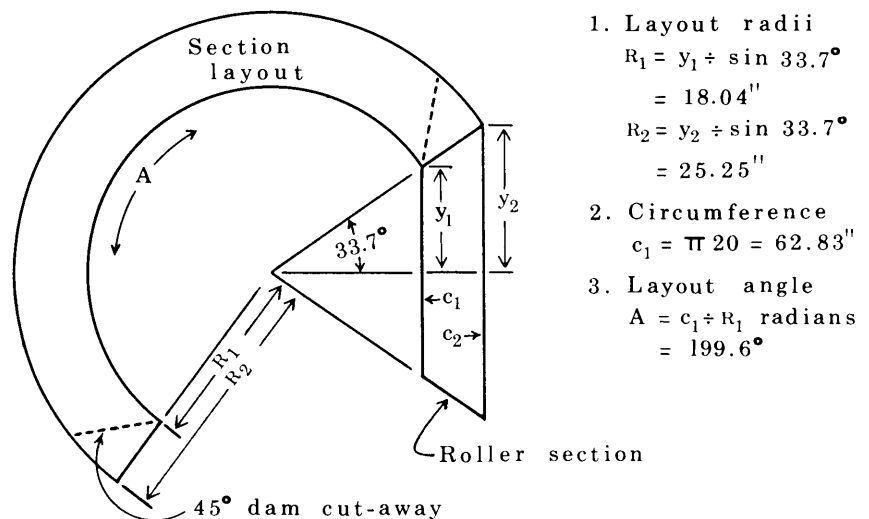


FIG. 4. Layout dimensions of the steel-shell sections.

pieces were rolled into conical sections while cold and tack welded before cutting and facing the dam cut-aways. Welding and polishing were completed before filling the unit with concrete.

With diameters of 20 and 28 inches, and corresponding circumferences of 62.8 and 88.0 inches, this roller has a ridge-line slippage factor of 29%. Ridge-line cleavage, which can be seen in Fig. 3, is about the same as for the first roller, but rolling can now be accomplished at travel speeds up to about 4 mph. The results obtained with this roller will be reported in subsequent papers.

### LITERATURE CITED

- BEMENT, R. E., D. F. HERVEY, A. C. EVERSON, AND L. O. HYLTON, JR. 1961. Use of asphalt-emulsion mulches to hasten grass-seedling establishment. *J. Range Manage.* 14: 102-109.
- BEMENT, R. E., R. D. BARMINGTON, A. C. EVERSON, L. O. HYLTON, JR., AND E. E. REMMENGA. 1965. Seeding of abandoned croplands in the central Great Plains. *J. Range Manage.* 18:53-58.
- EVERSON, A. C., D. N. HYDER, H. R. GARDNER, AND R. E. BEMENT. 1968.

- Chemical versus mechanical fallow of abandoned croplands on the short-grass plains. (In press.)
- HYDER, D. N., AND A. C. EVERSON. 1968. Chemical fallow of abandoned croplands on the short-grass plains. (In press.)
- MCGINNIES, WILLIAM J. 1959. The relationship of furrow depth to moisture content of soil and to seedling establishment on a range soil. *Agron. J.* 51:13-14.
- MCGINNIES, WILLIAM J. 1962. Effect of seedbed firming on the establishment of crested wheatgrass seedlings. *J. Range Manage.* 15:230-234.

**22nd Annual Meeting**  
**American Society of Range Management**  
**Calgary, Alberta**  
**February 10-14, 1969**

PROGRAM SESSIONS

<p>Rangelands North of the Forty-Ninth            Rangeland Hydrology            Northern Range and Pasture Development            Environmental Factors            Grazing Systems            Rangeland Improvements            Marketing Range Cattle</p>	<p>Rangeland Production            Range-Wildlife Relationships            Rangeland Ecotypes            Rangeland Economics            Rangeland Management            Soil-Plant Relationships            Rangeland Physiology</p>
---	--

Special Programs and Activities  
 for Ladies—including an all-day trip to Banff!

REGISTRATION

From 8:00 AM, Monday, February 10 through 12:00 Noon, Thursday, February 13.

Located in southern Alberta—just 157 miles north of the border—Calgary is a modern, sophisticated metropolitan center with a population of over 360,000. The mean elevation is 3,440 ft and the climate is most enjoyable.

Parks, zoological gardens, museums, art galleries, and theaters are just some of the facilities that make Calgary a delightful place to visit—at any time of year.

Don't pass up this opportunity to visit the funland and wonderland of western Canada, to be royally entertained by ASRM's Canadian members, to visit with your professional colleagues, and to enjoy an excellent program.

Calgary is served by several major airlines and railroads. Make your reservations now!