

Soil Pitting for Revegetation



by David A. Bainbridge

Pitting Is

In areas where water is scarce all year (or seasonally), surface modification to retain precipitation should be considered an essential part of a restoration program. Surface modification techniques like pitting increase infiltration and surface storage, reduce runoff, increase soil water content, and improve vegetation establishment and growth. Soil pitting is a low cost, practical and proven surface modification treatment, and this technique is not limited to use in desert areas.

Pitting can double rainfall absorption rates and that can make the difference between success and failure in plant survival. A disk pitter that spaces pits about 16 inches apart provides almost 1,000 cubic feet of water storage per acre. Changes in the physical properties of the soil due to pitting are also effective in controlling runoff and increasing infiltration of water into the soil.

On sandy loam, moisture penetration reached 24 inches on pitted sandy loam vs 5 inches on untreated land; 15 inches on pitted loam vs 7 inches on untreated; and 11 inches on pitted clay vs 2 inches on untreated. Pits also capture blowing litter, seeds, and fine dust, and protect seedlings from wind and

sand blast. The increased availability of water in and around the pits provides suitable niches for plant establishment and stimulates plant growth; but seed germination and plant establishment at the very bottom of the pit can be impaired if water remains for more than a week. In one of our research plots survival of transplants in pitted plots was 76%, while imprinted plot survival was 63% and the control was only 52%.

Determining the size and shape of the pit to be prepared will depend on the soil type, rainfall variation, species type, seeding method, and equipment availability. Large, shallow sloped pits provide a wide range of conditions for seeds to germinate. Where seeds germinate in a given year will depend on rainfall amounts, timing and temperature.

Pitting is a simple process, but like most dry land treatments it involves a complex set of relationships and uncertainties. Success in any given year will depend on the weather, timing of pitting, seeding, and rainfall. Pit effects may persist for many years. One of our treated desert plots finally got rain after 3 years — and 31 species established in these degraded soils versus only 21 on undisturbed natural land nearby.

Mechanical pitting

Pitting implements may use disks, tines

or scrapers. Disk pitters are best suited for light textured soils or may be appropriately used in heavier soils in areas where they can be used with rippers working ahead of the disks. Tine pitters are suitable for a wider range of soil types. The typical pitter used in Western Australia has four disks or tines producing four rows of pits with each pass. These break the hard surface crust which often forms on flat, overgrazed and degraded rangeland. These pitters make pits that are 3 feet long (1 m long), 6-8" wide (15 to 20 cm wide) and 4-5 inches (10 cm) deep. Scrapers and blades can also be used to create pits in any size.

Several types of disk plows have been used as pitters, but most are modified one-way disk or brushland plows. The standard disks are cut and half of the disks removed. The brushland spring-mounted disks are preferable on more difficult sites.

A custom-made pitting disk plow has a cut-out side on each end of two axles placed in a shallow V-shaped configuration. Disk pitters can also be made by offsetting the axle location in the disk, creating an eccentric rolling motion, leaving alternate pits.

Disk pitters can work with a wide variety of soil types from hard clays to loams, assuming that some topsoil is present. Disk plows are not effective in dense sod. Furrows formed in sandy soil may fill in rapidly unless they are large. The disk pitter can smear the surface of wet clay-rich soils which can decrease the infiltration rate.

While most disk pitters are designed for tractor operation, the Camel disk pitter manufactured in Australia by the Australian Revegetation Corporation is a light two disk pitter designed for use with a two or four wheel drive truck. Ranch operators have found this to be desirable because it permits them to treat large areas of land during lulls in normal ranch operation.

Pitting can also be done with a tined implement with a drive mechanism or linkage that raises and lowers the implement to produce basins. Even a small tractor with hydraulics to the hitch can be used to make pits with a box scraper and adjustable tines. These are more effective on clay soils where a disk may cause more smearing. They are more easily damaged than a disk pitter and cannot be used on rocky or brushy ground.

A blade or scraper can be used to make pits. A blade that can be tilted and lowered below the tracks or wheels is most effective

for pitting. We have used a road grader to make pits when that was the only implement available. It worked.

Hand Pitting

Pitting is relatively easy to do with hand labor and is less noticeable in the landscape because the pattern can be varied easily and checkerboard patterns that can develop with mechanical treatments can be avoided. McLeods or large hoes are the best tools for the job. A team of people working their way down slope can pit a large area in a day.

Treatment

The low value of most dry lands commonly makes treating the entire area of disturbance uneconomical. Fortunately, treating only 10 to 20 percent of an area with strips of contour oriented pitting may be enough to trigger recovery. Soil pitting should be done before the most likely seed establishment period if possible.

Pitting is not easily adapted to rocky soils and brushy sites. It may not work very well on high clay content soils unless they are ripped first, and may not be needed on coarse sandy soils with high infiltration rates.

It is particularly well suited for crusted, degraded soils. Machine pitting is often confined to flat and gentle slopes and should be done on the contour if possible. Hand pitting can be done on much steeper slopes.

Pitting without seeding has led to mixed success in the Southwestern United States. In degraded areas with limited seedbanks, seeding should be done along with the pitting. A broadcast seeder may be mounted on the pitting implement or the site can be broadcast seeded by hand. These methods do not allow precise seed placement and many seeds may be misplaced and fail to germinate.

The Australian pitters often have a seeding mechanism driven by the pitting disk, synchronized to release seed only into the pits, optimizing seed delivery. The seed mix for pitting should include a range of native species to fit the soil, revegetation or restoration goals, and possible rainfall events (i.e. spring, summer, fall, and winter germinators).

Results and Observation

Few pitting studies have been done in the United States and very few have been

done in the desert or in the west with predominant winter rain and very dry summers. However, from other studies and our field experience and trials in other areas of the world, we feel this is one of the most

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effective, low cost methods of starting degraded dry lands on the way to recovery. Studies in other areas of the western U.S. have found similar results. Pitting was found to be superior to all other treatments for improving shortgrass range in Wyoming where soil pitting allowed 32% more sheep to be carried per acre, with a 50% increase in perennial grass left at the end of the year.

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Double the number of western wheatgrass plants existed 10 years after pitting. In another study, pitting with an eccentric disk pitter increased foliage production 32-68% on deep soils in Wyoming.

A comparison study of pitting, sowing, and conventional tillage sowing systems on degraded rangeland in western Australia showed that pit sowing was much more effective, and seeding establishment increased markedly. Soil pitting also improved plant vigor, regrowth after a late rain, number of pods per seedling, and pod weight per seedling. Days to flowering were also reduced.

A comparison of conventional pitting with intermediate sized pits which removed the surface soil showed average production for 4 years was 138 pounds per acre on untreated land, 253 pounds per acre on conventionally pitted land, and 690 pounds per acre on larger intermediate pits.

Experiments at Roodeplaat, South Africa on a silty clay loam showed that pitting was beneficial in reducing surface runoff; maintained higher plant evapotranspiration rates and yields than the control treatment;

and cultivation costs were low.

The effectiveness of pits declines as they fill in with blown or washed soils and debris. Pits in sandy soil in a high wind environment were largely filled in after one season at Anza Borrego Desert State Park, but plant establishment clearly showed the pit pattern. The increased fertility of the pits due to the capture of fines, litter, seeds, and microsymbionts may still provide a significant advantage for plant establishment.

Pitting should be more commonly selected as an effective method for treating large areas of degraded lands and construction impacted soils. On crusted semi-arid and arid lands it will often be the best treatment. Pitting can also reduce dust production and may prove useful for PM<10 dust control. Under good conditions, a large tractor and wide pitting disk could treat 200+ acres per day. If these represent 10% of a project area, then effectively 2,000 acres per day could be started on the road to recovery. Seeding is desirable in areas where pitting is most effective; crusted and barren soils with few seed sources. Adding compost, mulch, organic matter, or fertilizer may be

advantageous in some cases. Transplants can also be placed in some of the pits to provide improved chances for on-site seed production.

Insufficient economic data is provided on most of these studies to determine if pitting can be justified for grazing return. It can more easily be justified for revegetation and restoration of a wide range of situations including, streambanks, floodplains, and roadsides, erosion control (wind and water), flood reduction and habitat improvement.

Suppliers are rare - you may have to make your own, but try: (Bernie) Domries Equipment, 12281 Rd. 29, Madera, CA 93638, PH (209)673-9143, website: www.domries.com or G.N. Scranton, Box 229, Lamar, CO 81052, PH (303) 336-5317 or Australian Revegetation Corporation, 51 King Edward Road, Osborne Park 607, Western Australia, PH (09) 446-4377. **L&W**

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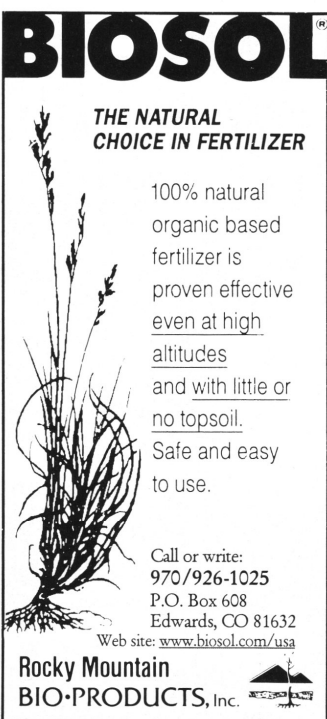
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