MASTER COPY
SRCRC # 31

# DEEP PLOWING . . .

# For Improving "Slick Spot" Soils

by W. W. Rasmussen

*Snake River Conservation Research Center*

FARMERS are rapidly accepting deep plowing— 30 to 36 inches—as a management practice for soil improvement and for reclaiming unproductive areas of saline-sodic "slick spot"* soils. Such soils infest large areas of irrigated land in southwestern Idaho and southeastern Oregon.

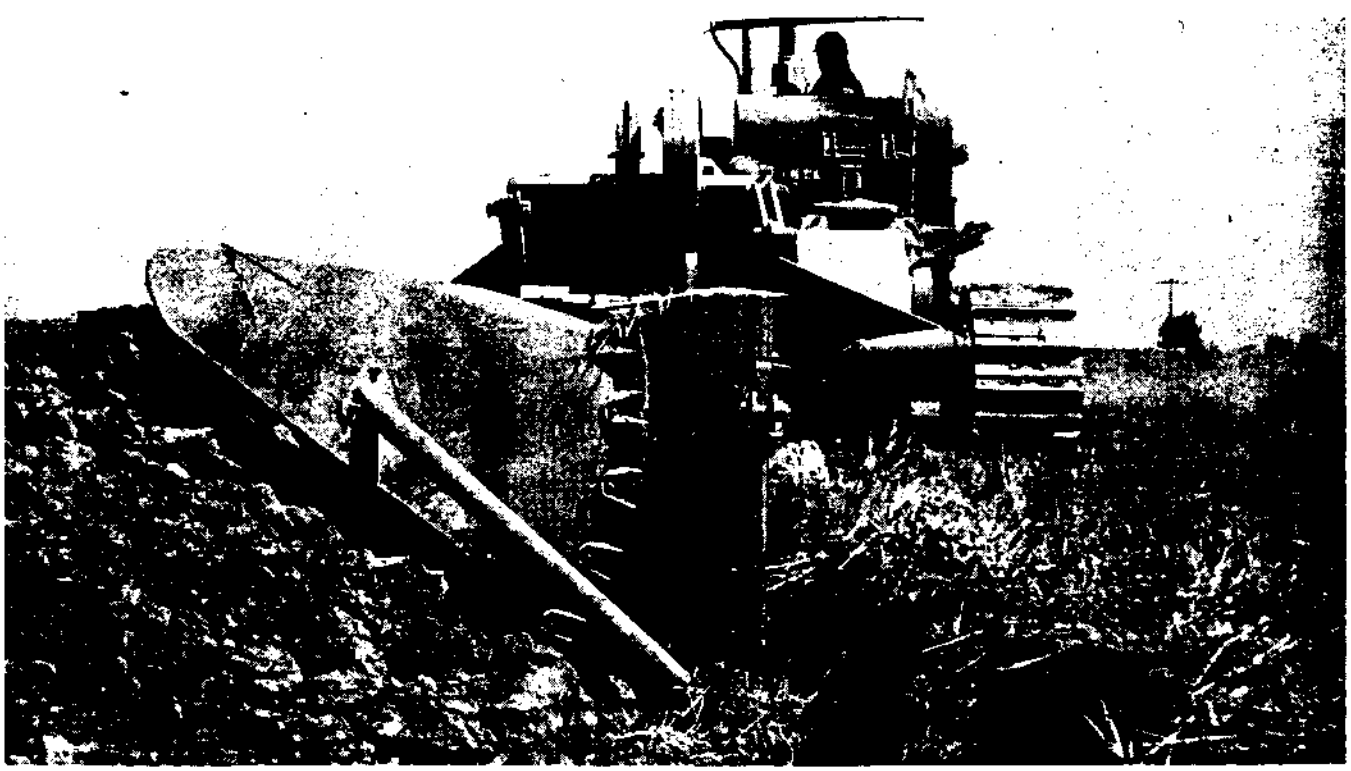
The "slick spots" are small scattered areas of Solonetz-like soil containing excessive exchangeable sodium, soluble salts, and frequently cemented hardpan silica-lime layers in the lower profile. The affected soils have extremely low water-intake rates and are resistant to normal soil improvement procedures.

Slick spot soils occur in complexes with nonsalt-affected soils with similar profile characteristics and inherently poor structure. Also, some associated soils may have cemented hardpan and compact soil layers that limit water infiltration and restrict root penetration. In this region the slick spots occur principally in association with medium-textured, high silt soils with the surface soils generally derived from or influenced by loess soil.

Several "kinds" of slick spot soils are recognized. Considerable variation in morphological and chemical characteristics may occur in separate slick spot areas within a single kind.

Soil improvement studies are limited to two general slick spot soil complexes in this area. First, the Sebree series (slick spot soil) is described as a solodized-Solonetz soil occurring in complexes with less or nonsalt-affected soils of the Chilcott and related Sierozem soils. Second, an unnamed complex consisting of slick spots which appear to be eroded or mixed areas of typical solodized-Solonetz

**Plowing to a depth of 30 inches on irrigated farmland containing numerous areas of unproductive "slick spot" soil greatly improves the physical and chemical conditions of the soil. This 4-foot moldboard deep-plow, pulled by a single 175 hp crawler tractor, mixes the horizons and breaks up hardpan and cemented layers.**



soils occurring in complexes with Sierozem soils of the Greenleaf and related series.

Investigations of the Chilcott-Sebree slick spot soils in southwestern Idaho show they can be improved by several means. The nonproductive saline-sodic Sebree soils were greatly improved by intermixing the layers of the profile to simulate deep plowing, by subsoiling in combination with gypsum, and by deep plowing with a large moldboard plow to depths of 30 to 36 inches alone and in combination with gypsum.

The treatments greatly increased water infiltration rates and increased crop yields several fold. The excessive exchangeable sodium and soluble salts initially present in the slick spot soils were reduced to safe levels in the plant root zone within 2 to 3 cropping years under usual irrigation practices.

Water intake rates on the Sebree (saline-sodic) soils were greatly increased by the application of gypsum alone at rates of 12 to 20 tons per acre, but water and root penetration was still limited to shallow depths by the cemented hardpan layers. Subsoiling to a depth of 28 inches in two directions on a spacing of 21 inches between shanks without adding gypsum did not improve the soils.

The associated Chilcott (nonsaline-nonsodic) soils were also improved by deep plowing. Crop yields, water intake rates, and depth of water and root penetration were greatly increased by plowing these soils to depths of 24 to 30 inches.

The sustained excellent crop yields and the apparent permanency of the improved chemical and physical condition of the soils indicate that the Chilcott-Sebree complex soils can be permanently improved by a single adequate deep plowing treatment.

**Characteristic poor growth of spring wheat on untreated areas of Sebree slick spot soil on the left can be compared to improved growth on deep-plowed Chilcott-Sebree slick spot soil (right) on this Idaho test plot.**

The unnamed series (slick spot) or solonetzic soil, occurring in association with the Nyssa and Greenleaf series and related soils in portions of some irrigated valleys in southeastern Oregon and adjacent areas in Idaho were greatly improved by deep plowing alone and deep plowing with gypsum. Crop yields, water infiltration rates, and water and root penetration were greatly increased. The plant root zone and the effective water holding capacity of the slick spot soils were apparently more than doubled by plowing to the 36-inch depth.

Chemical analyses made to follow the changes in salinity and exchangeable sodium content show that the slick spot soils were effectively reclaimed within 3 cropping years. Soil conditions were not additionally improved by the application of gypsum at rates of 8 to 16 tons per acre in combination with the deep plowing. The application of gypsum alone (without plowing) at rates of 16 tons per acre significantly increased crop yields, water intake rates, and the "apparent" total accumulative water intake on the slick spot soils.

Although "subbing" or lateral movement of soil moisture into the soil from the irrigation furrows was apparently increased by the gypsum treatment, water and root penetration was limited to about the 11-inch depth or depth to the top of the clayey B2 horizon or hardpan layer. Since the depth of the root zone and the effective water storage capacity were not increased, the effectiveness of the gypsum treatment in improving the soil for irrigation is probably limited.

The productivity of the associated soils appears to be increased by deep plowing treatments. Water infiltration rates and crop yields on the nonsodic Greenleaf silt loam and related soils were moderately increased by the deep plowing treatments. Similar increases in crop yields and water and root penetration have been noted following deep plowing on other types of soils with compact and cemented silt lenses and silica and lime cemented layers in the soil profile. The value of deep plowing such soils with unfavorable profile characteristics but not affected by the slick spot condition has not been fully evaluated.

Deep plowing of irrigated farmlands affected by unfavorable solonetzic or slick spot soil areas for general soil improvement and for reclaiming the nonproductive saline-sodic soil areas appears to be a feasible and economical practice. The affected soils can be plowed to adequate depths with a 4-foot moldboard plow at costs varying from $35 to $45 per acre. Where deep plowing is beneficial, supplement with effective irrigation, good fertility, and good soil management practices. ★

---

* The terms "slick spots" and "slick spot soil" are general terms frequently applied to many soil areas which may have poor physical condition resulting from high salt or excessive sodium or sometimes from high clay content in the soil profile. The conclusions reported in this article apply only to the results obtained on Chilcott–Sebree (slick spot) soils and on the Greenleaf (slick spot) soils and associated soil complexes.

Slick spot soils usually have thin silt loam surface horizons and relatively thin silty clay loam to clay loam subsoils underlain with highly calcareous silt loam, loam, or fine sandy loam soil layers beginning at about 16 to 18 inches below the surface. The calcareous soil material is brought up and mixed with the plowed layers by the deep plowing treatment and apparently provides the necessary soluble calcium to reclaim the sodium-affected slick spot soils. The effect of deep plowing "slick spot" or solonetzic soils of differing chemical properties may not be beneficial. Soil improvement and deep plowing investigations on other naturally occurring solonetzic slick spot soils are being continued.


The Author

Warren W. Rasmussen is research soil scientist with the Snake River Conservation Research Center, Soil and Water Conservation Research Division, ARS, USDA, Kimberly (Twin Falls), Idaho. Mr. Rasmussen prepared this article in cooperation with the Idaho and Oregon Agricultural Experiment Stations.



Reprinted from CROPS & SOILS, 677 S. Segoe Road, Madison, Wis. 53711, April-May 1965