SLIT–TILLAGE FOR COMPACTED SOILS

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The plowpan is generally recognized throughout the world as a problem in compactible soils that are intensively tilled (2, 8, 10). This form of soil compaction, most severe on coarse–textured soils containing nonswelling clays, impedes root growth into the subsoil. The compacted soil in plowpans has reduced pore size and total porosity, and develops high strength as it dries (3). When a plowpan is wet, a large percentage of its pores is filled with water, so soil oxygen supply is inadequate for good root growth. Low soil oxygen when wet, and high soil strength when dry, are the primary factors limiting root growth in compacted soil (3,9).

It was hypothesized that a narrow, vertical slit cut through a plowpan, from which water would rapidly drain, would eliminate both low soil oxygen and soil strength as barriers to root growth (4). The slit substitutes for the macropores that are missing in the compacted soil. In 1979, 'Hutton' soybeans were grown on a plowpan soil with the following treatments: (1) no-till; (2) no-till with a narrow slit cut beneath the row to a depth of 15 inches; and (3) complete tillage of the plow layer. Yields for treatments 1, 2, and 3 were 18 bu./acre, 29 bu./acre, and 25 bu./acre, respectively. During a 6–week drought, the no–till beans wilted severely and the beans with complete tillage showed water stress each afternoon. The slit–tilled beans showed no drought stress. Roots of no–till and completely tilled beans were restricted to soil above the plowpan. Roots of the slit–tilled beans grew down the slit, extending to a depth of 39 inches and spreading 20 inches to each side of the row beneath the plowpan. Experiments with glass–fronted boxes and in the field have shown that the slit must be narrow enough to provide good root–to–soil contact (6). Roots do not grow well in a void.

An experiment with soybeans double–cropped with wheat is in its fourth year of comparing slit–till to no–till, to complete tillage, and to chiseling under the row (7). Yield averages for the first 3 years for soybeans following wheat for grain were slit–till - 29 bu./acre, chisel under the row - 27 bu./acre, no-till - 24 bu./acre, and complete tillage - 26 bu./acre. Slit–till was superior to other tillage treatments in promoting rapid growth of soybean roots through the plowpan and into the subsoil.

Two different subsoiler–planters have been modified for application of slit–tillage in conservation cropping systems (7). The modification consisted of shortening the subsoiler shanks so the subsoiler point runs just above the plowpan, and attaching 5/32 inch–thick blades beneath the subsoiler feet. The blades extend about 7 inches below the subsoiler feet and

cut a narrow slit through the plowpan. For research purposes we made blades from rolling coulters. Indications are that this material may wear out rapidly.

Measurements made at the USDA National Tillage Machinery Laboratory showed a 12 to 43% reduction in force required for operating the slit-cutting implement compared with operating a chisel at the same depth (6). Energy savings depend on soil type, depth to the plowpan, and speed of operation. The most interesting aspect of slit-tillage is its residual effect. Once the narrow slits are cut and filled with plant roots, they remain effective for future crops. We have observed 4-year-old slits functioning as well as newly cut slits. The slits appear to be maintained by organic matter that accumulates from decaying roots of each crop.

Slit-tillage should be considered as a possible management system for plowpan soils. This will require implement development and, perhaps, use of blade material that will not wear out so rapidly. The primary requirement of slit-tillage is that the slit through the plowpan be narrow enough to provide good root-to-soil contact.

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