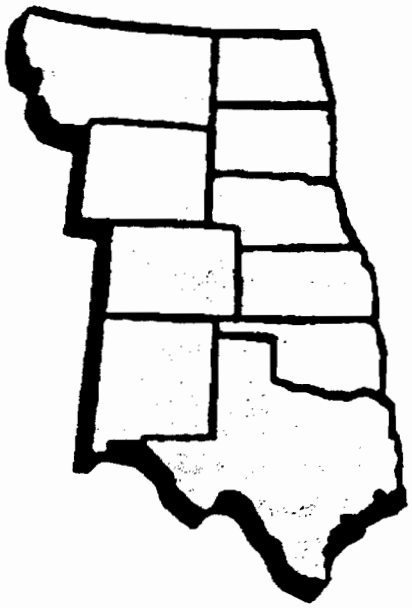

A Future Using Residue Management

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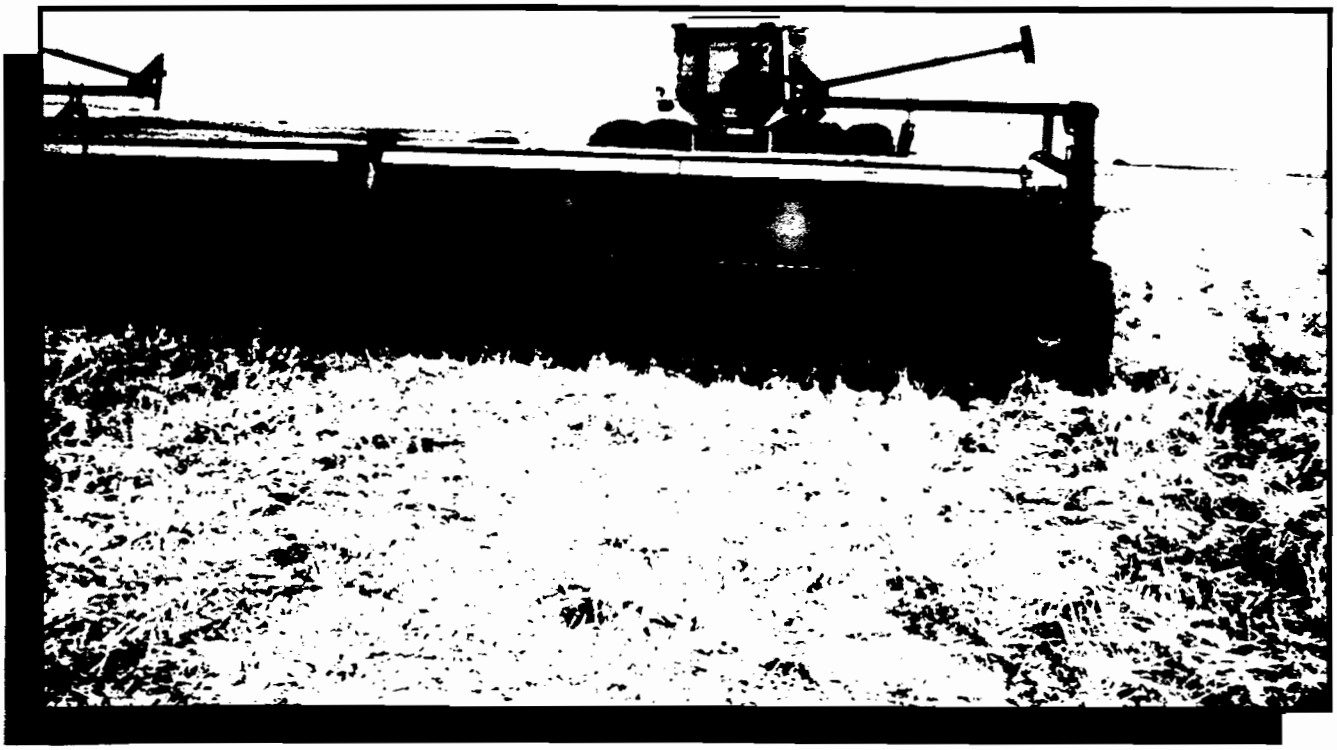

1. How surface-residue amounts are affected by the sequence of initial and subsequent tillage operations (disk (D) vs chisel (C) vs sweep (S)).

2. How surface residues in no-tilled plots change over time as compared to tilled plots.

METHODS

This study was conducted during 1992 and 1993 at the Central Great Plains Research Station near Akron, Colorado on a Weld silt loam (fine, montmorillonitic, mesic Aridic Paleustolls). Residue mass and percent cover were measured between April and September on irrigated-corn residues grown in plots 40 by 60 feet (12.2 by 18.3 m) in size. In both 1992 and 1993, all tillage plots were tilled four times during the April to September period. Residue cover (line intersect method) was measured before tillage and then after each tillage operation. Residue mass was measured before tillage in both years, and after the first and third tillage operations in 1993. In 1992, the tillage operations occurred on April 23, June 12, July 15 and August 10th. In 1993, the tillage operations occurred on May 20, June 28, July 29 and September 29th. The tillage-sequence treatments used in 1992 were:

1) SSSS - sweep-plow only, 4 operations
2) DDDD - disk only, 4 operations
3) DSSS - disk once, then 3 sweep-plow operations
4) CDDD - chisel-plow once, then 3 disk operations.

In 1993, an additional tillage treatment was added to the 4 above:

5) CSSS - chisel-plow once, then 3 sweep-plow operations.

Tillage treatments were replicated 4 times in a randomized-complete-block design. Sweep-plowing was done at a depth of 3 inches (7.6 cm) with 30-inch (76 cm) sweep blades on a seven-blade implement, traveling at 5 mph (2.24 m/s). Mulch treaders were not used on the sweep-plow. Disking was done at a 4-5-inch depth (10.2 to 12.7 cm) using a 14-foot (4.3 m) wide offset disk with 19-inch (48 cm) diameter disks, traveling 5 mph. Chisel-plowing was done at a 10 inch depth (25.4 cm) with shanks spaced 12 inches (0.3 m) apart, with 2-inch wide, non-twisted points, traveling at 3 to 4 mph (1.3 to 1.8 m/s).

In 1992, corn residue from one corn hybrid, Pioneer 3714, was used. In 1993, corn residues from three hybrids, Pioneer 3540. 3902 and 3732 were planted in individual plots, harvested and used in place (mention of trade names implies no endorsement by USDA-ARS). Tillage was conducted and measurements were made on separate plots planted to the individual hybrids. In 1993, no-tilled plot areas were maintained by spraying with burn-down herbicides to kill weeds. Percent-residue cover was measured by the line-intersect method (PRC-LI) using a 50 foot (15.2 m) long, 1/16 inch (1.6 mm) steel cable that had 5/16 inch (7.9 mm) by 1/8 inch (3.2 mm) brass tabs pressed onto the cable every 6 inches (152 mm), for a total of

100-measurement tabs. The cable was laid in a straight line over the top of the corn residue. One end of the tab was selected to determine 100 "points". The total number of these points with residue under them determined the PRC-LI.

Residue mass was determined by collecting the surface-corn residue from within a 39.4-inch square (1 sq. meter) metal frame. The residue was then placed in a plastic-mesh bag with 1/16 inch (1.6 mm) openings. The bag and residue were then submerged in a tub of water and gently agitated to remove soil from the residue. The bag and residue were then dried at 60°C (150°F) for 3 days, and then weighed to obtain residue-dry mass.

RESULTS AND DISCUSSION

After the first tillage operation, PRC-LI was much less after disking than after using a sweep (Compare DSSS and SSSS in Fig. 1). However, after three subsequent operations with the sweep-plow, PRC-LI was about the same in DSSS and SSSS plots. Residue levels after the first operation with a chisel-plow (CSSS or CDDD) were only 5 to 15% less than that for the first sweep-plow operation (SSSS). The hybrid 3540 had 25% less PRC-LI after the first tillage in CDDD plots than in the SSSS plots.

With subsequent tillage with the sweep-plow, the DSSS plots had PRC-LI amounts similar to that of the SSSS plots. In 1993, PRC-LI in the CSSS plots was similar to the SSSS plots after the second tillage. In order for the DSSS and CSSS PRC-LI levels to converge with that of the SSSS plots, the reduction in PRC-LI for the second through fourth tillage operations in the DSSS and CSSS plots must have been less than typical for a sweep-plowing operation (Fig. 1). After an initial chisel-plowing, subsequent tillage with a disk (CDDD) had PRC-LI amounts that were much lower than CSSS or SSSS or DSSS plots where sweep-plowing was the second through fourth tillage operation. A disking operation after the initial chisel-plowing brought PRC-LI in the CDDD plots down to levels similar to those in the disk only (DDDD) plots, and continued to be similar after the third and fourth tillage operations. It appears that subsequent tillage operations with the same implement tend to converge toward similar PRC-LI levels.

The USDA-SCS in Colorado has published a Technical Note (5) showing percent-residue reduction for primary (first) tillage operations, and then separate values for secondary tillage. In that Technical Note (5) secondary tillage values are defined differently if the first tillage inverts the soil (disk, moldboard plow etc.) than if the first tillage does not invert the soil. This provides an improved estimate of residue reduction for singular tillage operations. However, defined reduction levels for two tillage sequences may not be sufficient for tillage sequences with some implements. For the 3714 and 3902 hybrids, PRC-LI still differed by a magnitude of 10 to 20% between the CSSS, DSSS and SSSS plots after the third tillage operation (Fig. 1).

Corn PRC-LI was measured on the 1993 no-till plots on day 139 and day 147, then later in the year on day 221 (August 9th), (Fig. 1). Only one measurement was made late in the

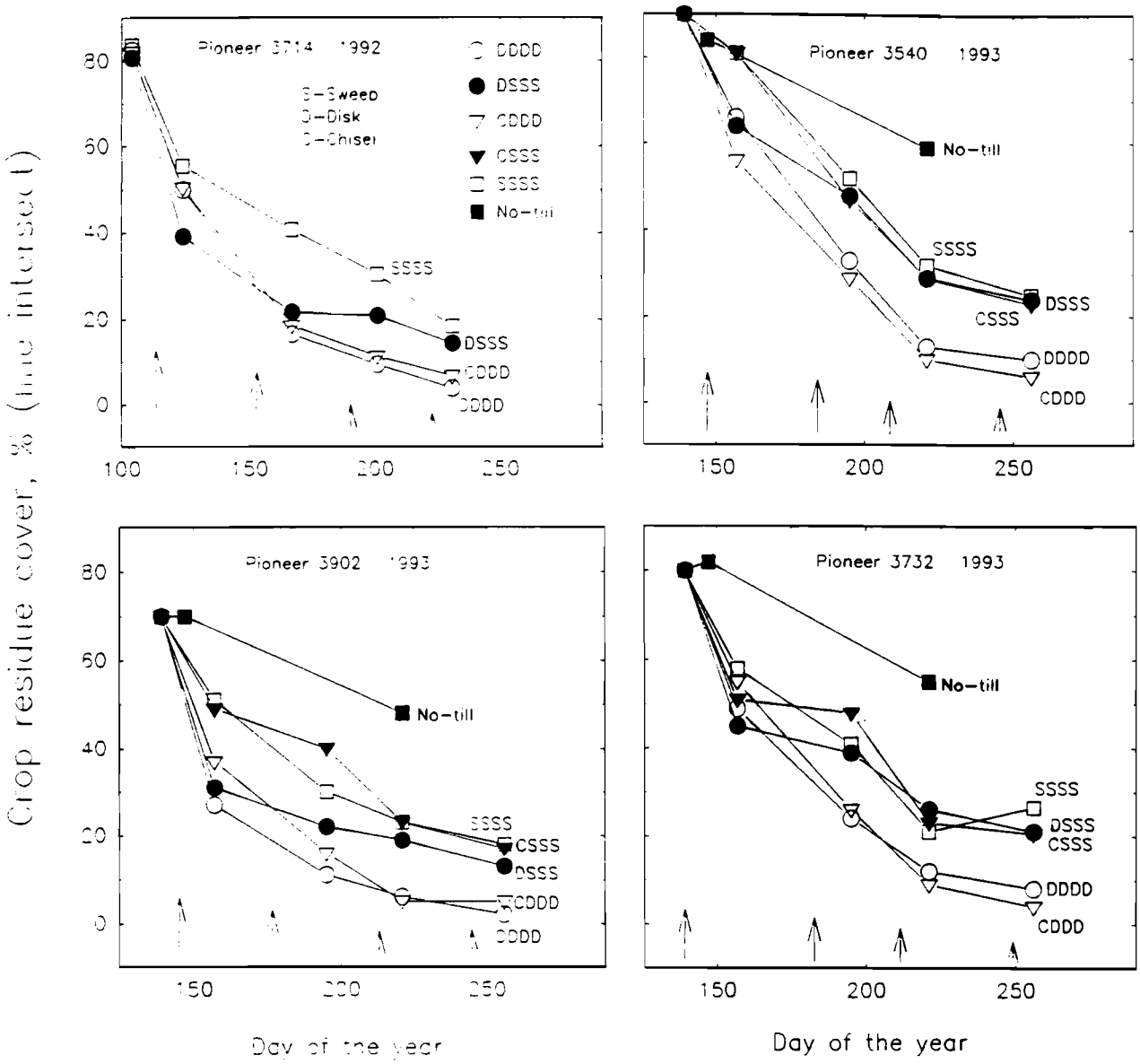

Fig 1. Percent crop residue cover of corn hybrids as affected by tillage tool and sequence. Arrows indicate tillage events.

summer because it wasn't anticipated that no-till PRC-LI would decline appreciably. However, residue cover declined by an average magnitude of 25% over this 82-day period.Loss of primarily leaf material by wind and possibly grazing by deer or rodents are attributed for this decline.

The relationship between corn residue mass and PRC-LI in this study can be described by the fitted equation: Mass=527 +90(PRC-LI) where Mass is the residue mass in lb/acre and PRC-LI is the percent-residue-cover as measured by the line-intersect method. This fitted equation (n=34) could describe 89 percent of the measured variability in residue mass as a function of the line- intersect methods residue-cover measurement. The R^2, RMSE, and F of regression for this equation are 0.891, 985.6, and 262.4 respectively. This equation is based on a limited set of data and should be tested. However, this equation is a predictive tool for persons interested in relating PRC-LI measurements with actual crop-residue mass.

CONCLUSIONS

These results show that the residue-cover reductions for a single operation of a specific implement cannot be directly multiplied together to predict PRC-LI for all sequences of tillage where the sequence consists of different tillage implements. These data indicate that it is not enough to just research the residue reductions from single tillage operations, and that the sequence of tillage is important. These data also provide a predictive relationship between PRC-LI and corn-residue mass.

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CONFERENCE NOTES