THREE YEARS OF CONSERVATION TILLAGE RESEARCH IN MASSACHUSETTS

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Conservation tillage in the New England area has been rather limited when compared to other production regions. In Massachusetts, of the 98,103 arable acres only 2,348 (2.4%) were reported in some form of conservation tillage in 1983. The beneficial effects of conservation tillage on soil and wind erosion control are beyond question. The acceptance by the Massachusetts farmer however, depends on its suitability in New England and whether or not this method results in larger financial returns as compared to conventional tillage.

Over the past three growing seasons, tillage research at the University of Massachusetts Experiment Farm in South Deerfield has experienced several variations of 'typical' New England weather. The summer quarterly precipitation for 1981, 1982 and 1983 was 24.2 cm (9.53"), 40.1 cm (15.78") and 18.1 cm (7.11") respectively. Table 1 shows the yield data for the past three years. Yields were consistently, although not statistically, higher for the moldboard plow treatment compared to other tillage treatments. Research into the influence of various tillage treatments on physical and chemical properties of the soil, suggests that different treatments can significantly affect plant growth.

Table 1. Tillage influence on corn yields for three consecutive years.

Treatments	1981		1982		1983	
	Silage*	% Ears*	Silage	% Ears	Silage	% Ears
Moldboard plow	58.0	59	46.0	43	56.3	54.3
Double disk	57.6	55	44.1	42	52.9	56.0
Chisel disk†	56.4	55	41.6	41	54.3	60.0
No-till	57.1	56	40.1	43	53.4	54.3

* tons/ha

† treatment in 1981 was a single pass with the disk

After spring tillage differences in bulk density between the tillage treatments are only found at 3 cm (1") and 15 cm (6"), respectively (Fig. 1). Even though the 30 cm depth is below the active level of any tillage implement, the bulk density for this depth is consistently greater than the value for the 60 cm depth. Further examination of the soil using a penetrometer suggests that the

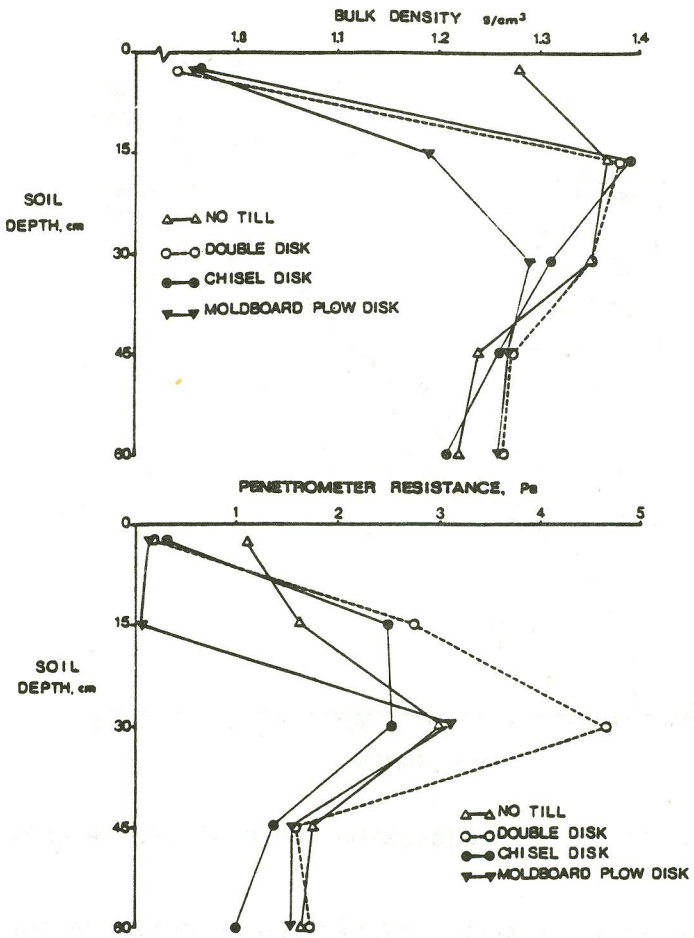

Figure 1. Comparison of bulk density and penetrometer resistance for selected depths after tillage.

30 cm depth has been subjected to compaction by the moldboard plow. This relic plow pan was found to limit vertical, root extension and to modify rooting patterns by forcing root expansion closer to the soil surface.

Statistical correlation comparing plant dry weight with root dry weight throughout the growing season indicated strong differences in root development between the treatments (Fig. 2). The no-till treatment showed a shallow root system and low brace root development compared to the other treatments. The high r values for the double disk and chisel disk treatments are due to the fact that maximum root density is reached later in the season with less root die-back after corn maturity.

Effect of tillage systems on soil physical properties are even more evident from the soil moisture tension measurements. Figure 3 shows that both the no-till and chisel disk treatments had lower moisture tensions (higher plant available water) than the moldboard plow or double disk treatments.

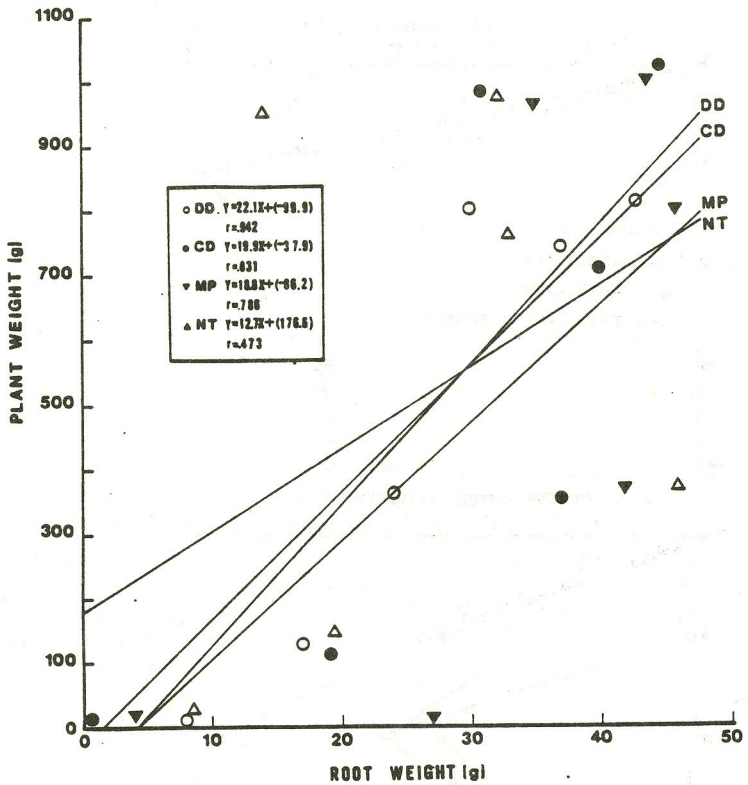

Figure 2. Linear regression for vegetation and root dry weight.

The extra soil moisture usually contributed to conservation tillage and particularly no-till, is not necessarily an advantage in Massachusetts where there is generally adequate moisture to meet crop needs with 470 mm of precipitation throughout the growing season. Plant growth is likely to be negatively affected when higher bulk densities and soil water contents reduce the air filled porosity to less than 10% at 0.005 (mPa) of soil moisture tension. All of the conservation tillage treatments had air filled porosities greater than 10% after tillage. Prior to tillage only the no-till treatment indicated a less than 10% air filled porosity level, but this was at the 30 cm depth, hence did not affect root growth. Changes in air filled porosity did not appear to be a problem during the 1983 growing season. The lack of treatment variation in air filled porosity after tillage would indicate that even during a wetter season, like we had in 1982, or early this year, air filled porosity levels for conservation tillage should not have a negative effect on plant growth in soils of similar texture, as at our experimental site.

When fertilizer incorporation is reduced or eliminated, as in conservation tillage, there may be an accumulation of fertilizer salts at the soil surface that may lower pH. Also organic matter is reported to increase, adding to soil moisture storage capacity, as well as to reducing effectiveness of herbicides. The influence of the 1981 and 1982 tillage studies on selected chemical properties of the plow layer can be seen in Table 2.

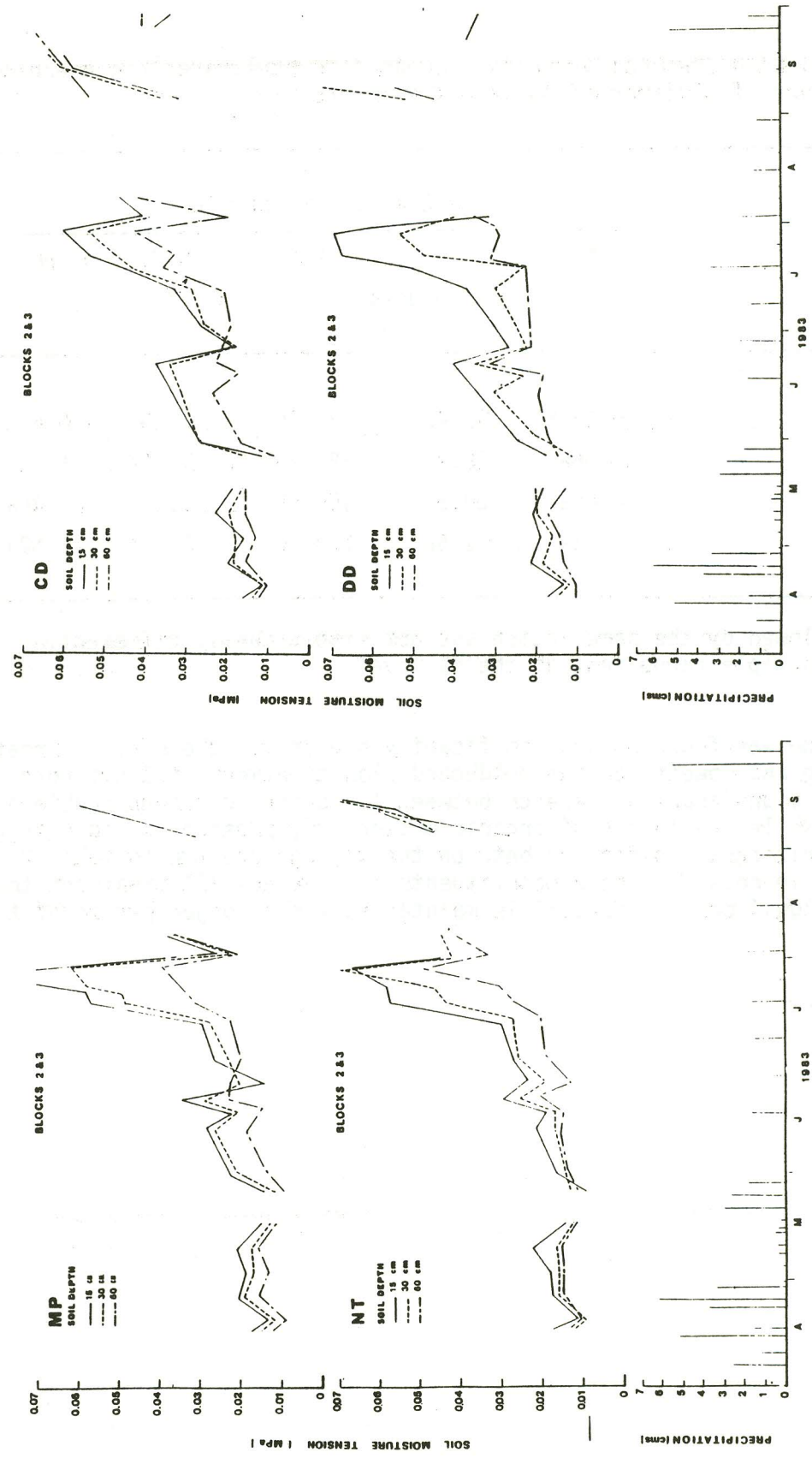

Figure 3. Soil moisture tension for the 1983 growing season for various tillage treatments. MD = moldboard plow; NT = to-till; CD = chisel disk; and DD = double disk.

Table 2. Selected chemical properties (mean of 4 replicates) in the plow layer of 4 different tillage treatments.

Tillage Treatment	Chemical Properties				
	N	P	K	O.M.	pH
	%	— ug/g —		%	
C	0.06a*	27.4a	144.0b	1.59a	6.61a
MP	0.06a	28.9a	126.3a	1.58a	6.42a
DD	0.06a	30.5a	150.6b	1.57a	6.46a
NT	0.05a	31.5a	163.1c	1.67a	6.52a

* Number followed by the same letter are not significantly different. Duncan's multiple range test at the 5% level.

Potassium was found to be significantly higher for the no-till treatment at 163.1 ug/g and lowest for the moldboard plow treatment at 126.3 ug/g. There was no significant difference between the chisel disk and double disk treatments. While the levels of organic matter, pH, phosphorus and nitrogen were not significantly different between the tillage treatments Table 2 does show an increase in these constituents for the no-till treatment that may become significant if no-till is maintained for a longer period of time.