OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER

Long-term Tillage and Crop Rotation Impacts on Accumulation and Distribution of Carbon and Nitrogen in Corn and the Soil Profile

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ABSTRACT

To evaluate the impact of tillage and crop rotation on accumulation and distribution of carbon (C) and nitrogen (N) in corn (*Zea mays* L.) and the soil profile, we analyzed biomass C and N content in plant tissues and grain of corn at harvest and in the soil profile after long-term (50 yr) of continuous tillage and crop rotation management at two experimental sites (Wooster and Hoytville, Ohio). The tillage management included no-tillage (NT) and chisel-tillage (MT), and the crop rotation included continuous corn (CC) and corn after soybean (CS). Total aboveground biomass C and N accumulation in corn is greater under CS than under CC. Soil C concentration in the top soil layer (0-20 cm) is higher under NT than under CT at Hoytville. This study indicates that application of CS and NT can effectively accumulate C and N in corn and topsoil.

INTRODUCTION

Studies indicate that tillage and crop rotation practices impact the accumulation of C and N in corn and the soil profile. However, most work has focused on comparing traditional inversion plow tillage with conservation tillage. As the plow is becoming less used, a comparison of the more common conservation tillage practices, such as chisel tillage, with no-tillage is considered more relevant. With the advent of greater use of corn as a feedstock for biofuels production and traditional uses, corn is increasingly being continuously grown without rotation with other crops. Soil properties such as texture are known to affect the accumulation of C and N in corn. Information on C and N accumulation in corn and the soil profile under long-term tillage and crop rotation is needed. In this study we evaluated the effects of long-term crop rotation and tillage on the accumulation of C and N in corn and the soil profile in two contrasting soils (i.e. a silt loam and a silty clay soil) in Ohio.

METHODS

Two long-term (50 yr) tillage and crop rotation experimental sites at Wooster (silt loam soil) and Hoytville (silty clay soil), Ohio were used for this research. The tillage management included no-tillage (NT) and chisel-tillage (CT), and crop rotation included continuous corn (CC) and corn after soybean (CS). Biomass C and N content in plant tissues and corn grain at harvest and in the soil profile after long-term (50 yr) of continuous tillage and crop rotation management were analyzed. Total C and N were determined by CN analyzer.

Table 1. Corn yield, and C and N accumulation as affected by tillage and crop rotation.

Site	Treatment	Stalk DW	Stalk C	Stalk N	Grain DW	Grain C	Grain N	Harvest index
		--			kg ha^{-1}	----------------------------		
Wooster	CC	4980	2190	35.9	10100	4480	130	0.61
	CS	5740	2540	42.9	10900	4840	144	0.60
	NT	5250	2320	32.2b	9710 b	4280b	115 b	0.59
	MT	5570	2460	48.7a	11500 a	5150 a	164 a	0.62
Hoytville	CC	4770	2120	22.6	8630	3800	108	0.58
	CS	5290	2360	24.2	10100	4450	119	0.60
	NT	5510	2460	27.1	10300	4560	130a	0.59
	MT	4540	2020	19.8	8400	3700	97.0b	0.59

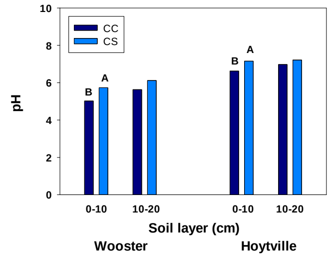

Figure 1. Soil pH as affected by crop rotation.

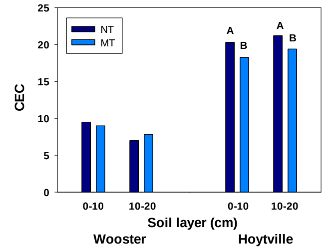

Figure 2. Soil CEC as affected by tillage.

RESULTS

Total aboveground biomass C and N accumulation in corn is greater under CS than under CC at the two sites (**Table 1**). Total aboveground biomass C and N accumulation in corn is greater under NT than under MT at the Hoytville site but not at the Wooster site (**Table 1**). Soil pH is decreased in the 0-10 cm soil layer by CC compared with CS at the two sites (**Figure 1**). Soil CEC is increased in the 0-20 cm soil layer by NT compared with MT at Hoytville (**Figure 2**). Soil C and N concentrations in the 0-10 cm soil layer are higher under NT than under CT at Hoytville (**Figures 3 and 4**).

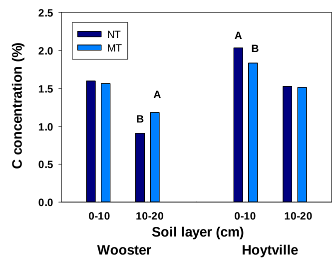

Figure 3. Soil C concentrations as affected by tillage.

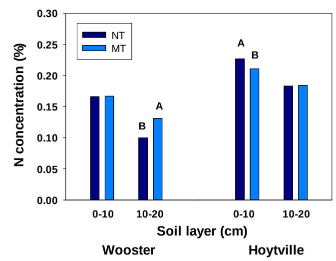

Figure 4. Soil N concentrations as affected by tillage.

Experimental fields

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