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Soil & Tillage Research 66 (2002) 93–94

Soil & Tillage Research

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Introduction

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The set of manuscripts in this special issue was assembled following presentation in July 2000 at the 15th meeting of the International Soil Tillage Research Organization held in Fort Worth, TX. A common theme of several presentations was the stratification with depth of soil properties that develops under conservation tillage systems. The reduction in soil disturbance that allows crop residues to remain at the soil surface under conservation tillage systems enriches the soil surface with organic matter. Soil organic matter is a central factor controlling many other soil properties, which are important to long-term productivity, ecological stability, and environmental quality.

Stratification with depth of soil properties is a common feature in native and naturalized ecosystems, as well as under conservation tillage systems. Quantifying the rate and development of depth stratification of soil properties in different ecoregions should lead to a better understanding of how conservation tillage systems might contribute to agricultural sustainability. Increased stratification is likely to: (i) improve water efficiency by reducing runoff and increasing retention in soil, (ii) improve nutrient cycling by slowing mineralization and immobilizing nutrients in organic fractions rather than losing them in runoff and leachate, (iii) resist degradative forces of wind and water erosion and mechanical compaction, (iv) improve soil biological diversity, and (v) enhance long-term productivity of soils.

This set of manuscripts should be considered a staging ground for developing studies to further describe the ecological impacts of conservation tillage on soil functions. These functions need to be quantitatively described in order to develop management strategies that effectively improve soil quality and agricultural sustainability. The first paper by Franzluebbers describes how stratification ratios are calculated and how they are related to aggrading ecosystems with high retention of soil organic C and N pools in three ecoregions. Results indicate that biologically active soil C and N pools are more sensitive than total C and N to differences in tillage management. The paper by Kay and VandenBygaart reviews the changes in porosity and soil organic matter under conservation tillage management in temperate ecosystems. Of particular interest are the dynamics of pore-size distribution and the improved soil water availability to plants grown under conservation tillage. The paper by Mrabet reviews the effects and potential for further development of conservation tillage in Africa. Some of the low-technology, high-labor input traditional farming systems can be considered conservation tillage systems with positive impacts on soil properties. The paper by Hernanz et al. describes the long-term effects of conservation tillage on cereal yield, soil organic C, and aggregation in a semiarid environment in Spain. Cereal yield was unaltered, but soil properties were improved with no tillage in the long term. The paper by Salinas-Garcia et al. describes the long-term effects of conservation tillage on soil organic C, N, and P pools in four ecoregions in Mexico. Higher levels of soil organic C and N, microbial biomass C and N, potential N mineralization, and extractable P at the soil surface under conservation tillage were directly related to surface residue accumulation. The paper by Zibilske et al. illustrates detailed depth

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0167-1987/02/$ – see front matter. Published by Elsevier Science B.V.
PII: S0167-1987(02)00017-X

distribution changes in long-term soil organic C, N, and P pools under no, ridge, and plow tillage in the hot, semiarid region of the southern USA. Readily oxidizable C was low in all systems suggesting that surface accumulation of soil organic C with conservation tillage was composed more from humic substances. The paper by Diaz-Zorita and Grove describes the temporal changes in soil organic C and P stratification under maize cropping in a humid region of the USA. Increasing the duration of no tillage resulted in a thicker accumulation of organic C at the soil surface. The paper by Bauer et al. compares P, K, Ca, Mg, and soil pH changes with depth under disk and no tillage in a warm, humid region of the USA. Little change in soil nutrient stratification occurred when switching from wide- to narrow-row crop production. The paper by Düring et al. describes the depth distribution and bioavailability of organic and heavy-metal pollutants under conservation tillage in two soils in Germany. Enrichment of surface soil organic C with reduced and no tillage provided a sink for pollutants, thereby buffering the environment from leaching and potential uptake by food crops. The last paper by Franzluebbers separates the influence of the depth distribution of soil organic C from the quantity of soil organic C on water infiltration, soil aggregation, and porosity. The stratification ratio of soil organic C could be used as a simple diagnostic tool to identify land management strategies that improve soil water properties.

I thank the reviewers that helped to improve and critically evaluate the significance of these manuscripts, including M.A. Arshad, N.T. Basta, P.J. Bauer, W.J. Busscher, C.R. Crozier, M. Diaz-Zorita, R.F. Follett, D. Ginting, F.M. Hons, D.L. Karlen, R. Lal, R.J. Lascano, D.R. Linden, M.J. Lindstrom, S.D. Logsdon, D. McGarry, R. Mrabet, K.N. Potter, F.E. Rhoton, G.B. Triplett, B.J. Wienhold, and L.M. Zibilske.