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Effects of Subsoiling to the Non-tilled Field of Wheat-Soybean Rotation on the Root System Development, Water Uptake, and Yield

Yasuhiro Izumi[1)], Tomoharu Yoshida[2)] and Morio Iijima[3)]

1) School of Environmental Science, The University of Shiga Prefecture
2) Graduate School of Bioagricultural Sciences, Nagoya University
3) Faculty of Agriculture, Kinki University

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Abstract: We introduced subsoiling to a field of wheat-soybean rotation where no-tillage practice had been conducted for five years and whose yield tended to decrease or stagnate. By subsoiling a half of each plot just before wheat sowing, treatments of tillage/no-tillage × subsoiling/no-subsoiling were established. Root distribution, shoot growth, water uptake and yield of both crops were examined to elucidate whether the subsoiling improves the productivity such as shoot biomass and yield through the modification of root system development, and how differ the effects of subsoiling between tilled and non-tilled fields. In wheat, roots were less concentrated in surface (0−5 cm) layer in no-tillage, and distributed more in deep (20−25 cm) layer of the soil. Deuterium labeled heavy water analysis revealed that the subsoiling enhanced water uptake from the deep soil layer in the no-tillage field. Both the no-tillage and subsoiling showed positive and significant effect on total biomass and yield. The effect of subsoiling must be related to water supply by deep roots in spring. In soybean no-tillage significantly increased the productivity, but subsoiling did not though distribution of the roots was modified by both practices. Soybean in non-tilled accumulated roots in the surface soil layer, but subsoiling did not significantly modify the root distribution especially in the deep soil layer. Water uptake trend and yield was thus not changed significantly by subsoiling. Subsoiling in the non-tilled field increased rooting depth and showed the possibility of braking yield stagnation in long-term no-tillage cultivation in wheat, but not in soybean.

Keywords: Deuterium, *Glycine max* (L.) Merr., Heavy water, No-tillage, Stable isotope

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