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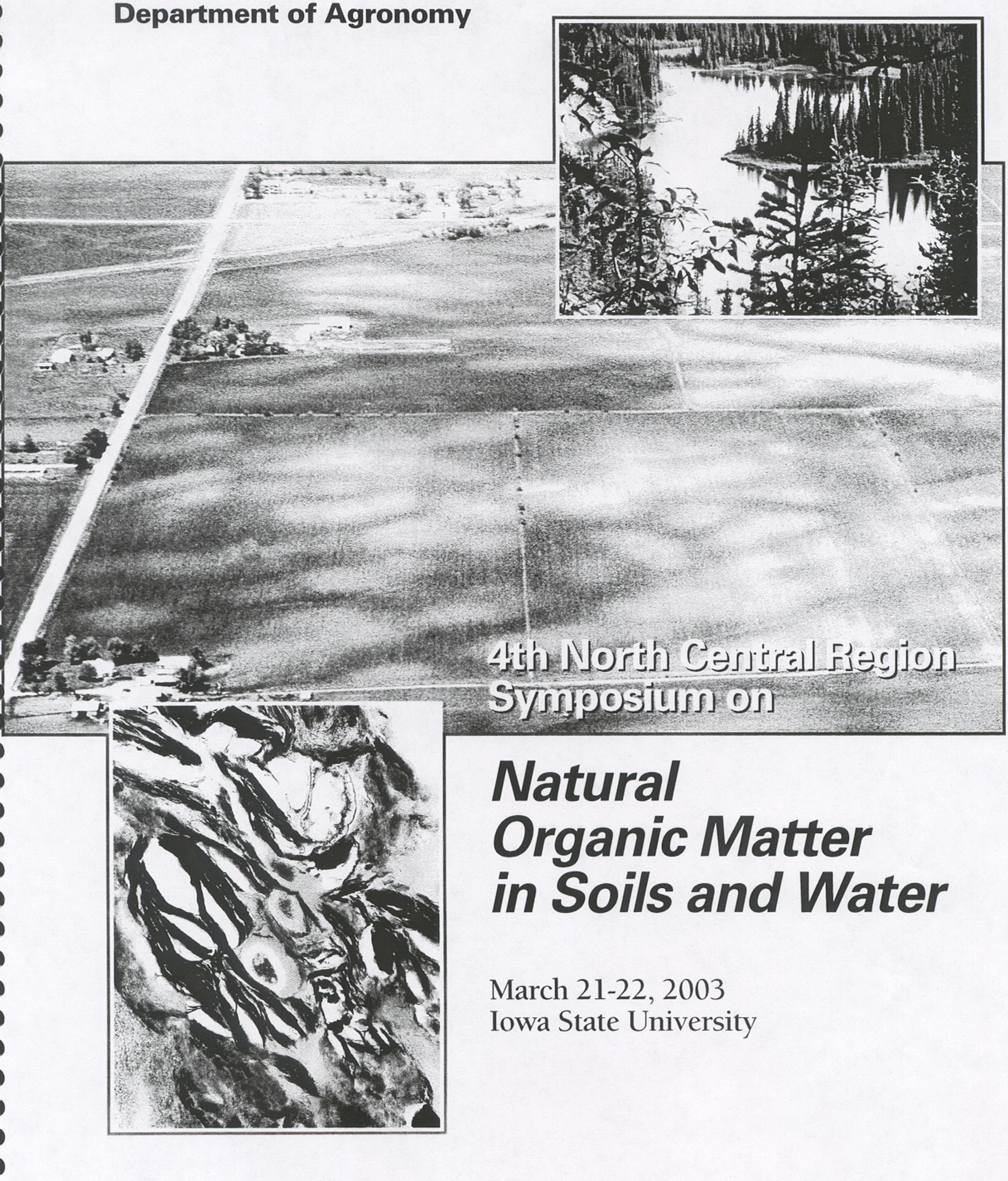

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Humic Acid and Aggregate Stability in Amended Soils

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Corn stover is a potential biofuel, to be used for ethanol production from high-cellulose materials. Part of a life-cycle analysis of using corn stover as a biofuel includes studies that address soil sustainability. After stover has been used for ethanol production, the remaining by-product of fermentation has 60 to 70% lignin, which has been implicated as having a role in soil stabilization. The impact of lignin could be direct or lignin may contribute to the formation of humic acid, which increases soil stability. Aggregate stability is one measure of soil stability. It was hypothesized that humic acid concentration and aggregate stability should increase if lignin inputs were increased. Two soil core incubation studies were conducted. The first used three soils collected from the 0 to 15-cm layer from a Svea catena. The soils were Svea (fine-loamy, mixed, superactive, frigid *Pachic Hapludoll)* from the toe slope with 20 g organic C kg^{-1} soil, Barnes (fine-loamy, mixed, superactive, frigid, *Calcic Hapludoll*) from the back-slope with 17 g organic C kg^{-1} soil, and Langhei (fine-loamy, mixed, superactive, frigid *Typic Eutrudepts*) from the shoulder slope with 3 g organic C kg^{-1} soil. Air-dried and sieved soils were either not amended or amended with either corn stover (3 mm) or an analog of a stover fermentation by-product (712.5 g lignin, 140.0 g cellulose, and 2.5 g hemicellulose kg^{-1} soil). The soil cores were incubated at 60% water-filled pore space (WFPS) at nearly constant temperature (18-22°C) for 60 days. In the second study, only the Svea and Langhei soils were used, and were either not amended or amended with corn stover (3 mm) or stover fermentation by-product (624 g lignin, 125 g cellulose, and 28 g hemicellulose kg^{-1} soil). The cores were brought to an initial WFPS of 60% and allowed to dry to 35% WFPS before watering to 60% WFPS. The air temperature varied from 14 to 32°C during the123-day incubation. After the incubations, the soil was removed and allowed to air-dry. An aliquot of soil was used to extract crude humic acid. After the soil was rotary sieved and soil samples remoistened to near field capacity, the aggregate stability of the 1 to 2-mm aggregates was determined. On the Langhei soil (very low organic carbon), the concentration of humic acid ($r^2 = 0.82$) and aggregate stability ($r^2 = 0.21$) was increased linearly with lignin input regardless of the source of lignin. In addition, aggregate stability increased linearly with the increased humic acid ($r^2 = 0.27$, $P \leq 0.0001$). If observed independently, these relationships were not seen on the Barnes or Svea soils. If all soils were included, a linear model ($r^2 = 0.5$) described the relationship between crude humic acid concentration and aggregate stability, but an exponential model ($y = y^o + ae^{bx}$; $r^2 = 0.58$) gave a better mathematical fit. These models both suggest that a degree of stabilization in soil particles is due to factors that are not biological. The exponential model suggests a rapid increase in aggregate stability with increased humic acid and assumes that after some critical value there would be little gain in aggregate stability with increased addition of soil humic substances.