17b-Estradiol mineralization under field and laboratory incubations

Mineralization studies of natural steroid hormones (e.g., 17b-estradiol, E2) are performed in environmental incubators, usually under a constant temperature such as 20□C. In this paper, we present a microcosm protocol that quantified the mineralization of E2 in soils under field temperatures. The nine agricultural soils tested had a wide range of soil organic carbon (1.1 to 5.2%) and clay (9 to 57%) contents. The calculated time over which half of the applied E2 was mineralized (E2-1/2) ranged from 299 to 910 d, and total E2 mineralization at 48 d (E2-TOT48) ranged from 4 to 13%. In subsequent laboratory incubations, the same soils were incubated under a constant temperature of 20□C, as well as under cyclic temperatures of 14.5□C (14 h) and 11.5□C (10h), which was within the temperature extremes observed in the field microcosms. E2-1/2 ranged from 157 to 686 d at 20□C and from 103 to 608 d at the cyclic temperatures, with the E2-TOT48 ranging from 6 to 21% at 20□C and from 7 to 30% under cyclic temperatures. Despite the overall 6.75□C lower mean temperatures under the cyclic versus constant temperatures, E2 mineralization was stimulated by the temperature cycles in three soils. Regardless of the incubation, the same loamy sand soil always showed larger E2 mineralization than the other eight soils and this loamy sand soil also had the smallest E2 sorption. Current modeling approaches do not take into consideration the effects of temperature fluctuations in the field because the input parameters used to describe degradation are derived from laboratory incubations at a constant temperature. Across the eight soils, E2-1/2 was on average 1.7 times larger and E2-TOT48 was on average 0.8 times smaller under field temperatures than under a constant 20□C. Hence, we conclude that incubations at 20□C give a reasonable representation of E2 mineralization occurring under field conditions to be expected in a typical Prairie