Local Dust Emission Factors for Agricultural Tilling Operations

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Abstract: Dust emission factors for regional- and local-scale simulations of particulate matter with diameters less than or equal to 10 μm (PM10) dispersion from agricultural operations are not generally available. This article presents a modification of the U.S. Environmental Protection Agency AP-42 approach to better calculate aerosol emission factors of PM10 for agricultural tilling operations. For the modification, we added the variables soil moisture, operation type, and crop type based on experimental and literature data to estimate local emission factors. Field experiments to measure the PM10 emissions from rolling, disking, listing, planting, and harvesting cotton (Gossypium hirsutum L.) were conducted. Data from these field experiments plus literature data were used to isolate the effects of soil moisture and operation type on the emissions. Literature data were then used to add different crop and operation types.

Key words: Agricultural operation, AP-42, emission factor, PM10, source strength, tilling.

MATERIALS AND METHODS

In 2005 and 2008, field experiments were conducted to quantify airborne particle emission factors from different agricultural operations (rolling, disking, listing, planting, and harvesting) in cotton fields at New Mexico State University Leyendecker Plant Science Center in Las Cruces, NM (32.2°N, 106.8°W; elevation, 1,180 m). To supplement the experimental data, literature data from Holmén et al. (2001) and Cassel et al. (2003) were also used.

Experiments

Rolling, listing, planting, and disking operations were conducted in March and April of 2005, and disking operations were repeated in March of 2008 in Experimental Field 1 (100 m × 246 m) in the experimental cotton fields shown in Fig. 1. The operation sequence was deliberately conducted as normal and the same as that used every year at the New Mexico State University farm, which mimics the most common sequencing in the Mesilla Valley region of New Mexico. On November 7, 2005, a harvesting operation was conducted in Experimental Field 2 (80 m × 210 m). The soil types for both fields were a mixture of Armino clay loam (fine, Montmorillonitic, Thermic Typic Torrerts) and Harkey loam (coarse-silty, mixed [calcareous], Thermic Typic Torriffloids) (the fraction of >75-μm particles, 0.43; the fraction >2-μm and <75-μm particles, 0.23; the fraction of ≤2-μm particles, 0.34) (USDA, 2005).

A three-dimensional sonic anemometer (CSAT3, Campbell Scientific Inc, Logan, UT) was located at 1.5 m height at the field edge and measured, at 20-Hz sampling rates, the wind component velocities and air temperature. From these data, average...