PESTICIDES IN AIR: NEW CHALLENGES IN AGRICULTURAL AIR QUALITY RESEARCH

Laura L. McConnell

United States Department of Agriculture, Agricultural Research Service, Environmental Management and Byproduct Utilization Laboratory, Beltsville, Maryland, USA, laura.mcconnell@ars.usda.gov

As agricultural and urban communities have become more intertwined, and the average size of agricultural production operations have increased substantially, issues of air quality have emerged as an area of increasing regulatory pressure for farmers in many countries. While water and soil issues have dominated agricultural research over the last 50 years or more, the science of measuring emission rates and environmental fate of aerosols/fine particulates, odor, volatile organic compounds, inorganic gases such as ammonia and hydrogen sulfide, green house gases, and pesticides from agricultural operations has increased in importance. Industrial hygiene measurements of these pollutants are much more commonplace, but methodologies for accurate emission-rate measurements under the wide range of agricultural operations with varying climates and topographical settings have not been sufficiently developed. Therefore, regulators and policy-makers are forced to make decisions from a very limited pool of information.

Research activities focused on agricultural air quality topics have increased substantially over the last two decades, but many scientists have primarily focused on one pollutant type or one agricultural production system. In order to accurately identify risks associated with agricultural emissions, a more comprehensive approach is required, considering multiple simultaneous emissions from various components of agricultural operations. These emissions will be widely variable in time and space across each agricultural production operation. In addition, each agricultural operation is surrounded by different land use combinations with the potential for negative effects on residential areas or sensitive wildlife.

Many organochlorine insecticides are global pollutants, and emissions of these chemicals from contaminated soils will continue for many decades to come. Second and third generation pesticides are much less persistent, but they also enter the atmosphere despite extremely low vapor pressures. The efficacy of some currently used pesticides make fugitive residues more dangerous to sensitive species. While pesticide drift is fairly well understood, post-application volatilization from soils/plants is driven by a number of processes which are highly variable, and emissions are more difficult to estimate accurately. In addition, agricultural practices to reduce potential negative effects on non-target species will be different between crops and regions. Many agricultural practices are only examined from water and soil resource perspectives, and air quality is a secondary consideration. Now fumigants have been identified as contributing to ground-level ozone production in California, and solvents associated with pesticide emulsifiable concentrate formulations are also being examined as ozone precursors. Emissions from animal agriculture production (particulates, volatile organic compounds, ammonia, hydrogen sulfide) are under scrutiny, and emissions will now be regulated for large animal operations. What has not been examined closely are future scenarios as the pendulum swings back from very large agricultural operations located far from urban areas towards local production in smaller farms. It is likely that vegetable production, animal production and urban areas will be more closely linked in space and in the co-utilization of waste streams for bioenergy production. Can we extrapolate what we know now to predict how all these emissions will interact from a chemical perspective to effect air quality in the US? Can we design practices to avoid these problems before they occur? Advances in environmental chemistry, analytical chemistry, and simulation models will be required.