USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

Resource Concerns

Air

Ozone Precursors

Air Quality Impacts - Ozone Precursors

Emissions of ozone precursors - NOx and VOCs - resulting in formation of ground-level ozone that cause negative impacts to plants and animals.

What is it?

Agriculture can be a source of ozone precursor gases, oxides of nitrogen (NOx) and volatile organic compounds (VOCs), which chemically react in the atmosphere producing ground-level ozone (O_3) that can cause negative impacts to plants and animals. Ozone is not directly emitted into the atmosphere. It is formed in the atmosphere through chemical reactions of NOx and VOCs in the presence of sunlight. Biological organisms emit VOCs naturally. The breakdown or decomposition of biological materials such as manure, feed, or mortalities can produce VOCs (through incomplete breakdown/decomposition) and NOx (mainly from the nitrification/denitrification processes). Combustion in on-farm equipment or the burning of biological material produces NOx, and VOCs. Pesticide application can also emit VOCs.

Why is it important?

Although ozone in the upper atmosphere forms a layer that provides protection from ultraviolet radiation, ozone in the lower atmosphere and at ground level can be harmful. Since ozone is an allotrope of oxygen, its similar structure allows it to displace oxygen in the lungs, causing respiratory issues. Ozone is also an eye irritant causing red, itchy eyes. Plants are also affected by ozone. During the gas exchange process, ozone enters the leaves, causing chlorosis and necrosis. This reduces the plant's photosynthetic ability and can result in yield reductions.

What can be done about it?

Activities associated with integrated pest management decrease the use of chemical pesticides and resulting VOC emissions. New or retrofitted engines that offer more complete combustion of fuel can reduce NOx and VOC emissions. Fuels, chemicals, and pesticides should be properly stored. Prescribed burning can be implemented to minimize NOx and VOC emissions from incomplete combustion of fuels, to manage fuel load, and to prevent or reduce wildfires. Alternatives to burning will also reduce VOC and NOx emissions. A comprehensive nutrient management plan can be used to reduce emissions of nitrogen oxides. For animal operations, implementing housecleaning techniques, maintaining moisture content in open lot surfaces, using a liquid manure management system, covering the surface of storage piles, and using feed management or feed additives to minimize intestinal and manure VOC production can reduce the production and emission of ozone precursor gases.

Ozone Precursors at a Glance

Problems / Indicators - Engines, pesticides, burning, tillage, and animal operations	
Causes	**Solutions**
• Chemical storage and application • Combustion (engines, burning) • Animal operations • Manure handling	• Proper chemical storage and integrated pest management • Engine replacement and retrofit • Prescribed burning and alternatives, wildfire risk reduction • Animal housing and surface lot moisture maintenance • Liquid manure systems, manure covers, feed management • Comprehensive nutrient management planning

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