USDA United States Department of Agriculture
Natural Resources Conservation Service

AIR

Ozone Precursors

Emissions of Ozone Precursors

Emissions of ozone precursors—oxides of nitrogen (NOx) and volatile organic compounds (VOCs)—result in formation of ground-level ozone, which can have negative impacts to human, plant, and animal health.

What is it?

Agriculture can be a source of ozone precursor gases, oxides of nitrogen (nitric oxide [NO] and nitrogen dioxide [NO_2], or collectively referred to as NOx) and volatile organic compounds (VOCs), which chemically react in the atmosphere producing ground-level ozone. 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. There are many natural sources of VOCs—vegetation is the largest global source of VOCs—but NOx is more typically the result of combustion, including engines and fire. VOCs can also be emitted during pesticide application and from confinement-based animal production.

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 and cause negative impacts to human, plant, and animal health. Since ozone is an allotrope of oxygen, its similar structure allows it to displace oxygen in the lungs, causing respiratory issues in humans and other animals. 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?

Ensuring efficient combustion and following Basic Smoke Management Practices for all fire events can reduce the potential for nitrogen emissions from fires. Nitrogen emissions from combustion sources such as engines, heaters, etc. can be reduced by ensuring proper maintenance and operation, switching to lower-emitting fuels, or replacing the combustion sources with newer, less-emitting combustion sources or electrical power alternatives. Using integrated pest management to decrease the use of chemical pesticides can decrease VOC emissions. Proper manure management techniques, feed management, and utilizing air filtration devices on enclosed manure storages and animal housing can also reduce VOC emissions.

Emissions of Ozone Precursors at a Glance

Problems / Indicators—Engines, pesticides, burning, tillage, and animal operations	
Typical Causes	**Examples of Typical Solutions**
• Combustion (engines, burning) • Animal operations • Pesticide application	• Smoke management, ensure good combustion for applied fires • Proper engine/combustion unit maintenance and operation • Engine/combustion unit replacement and retrofit • Integrated pest management • Feed and manure management • Comprehensive nutrient management planning • Air filtration on enclosed manure storages and animal housing