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Article in *American Journal of Plant Sciences* · January 2013

DOI: 10.4236/ajps.2013.410247

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Depletion of the Ozone Layer and Its Consequences: A Review

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Received July 11th, 2013; revised August 12th, 2013; accepted September 12th, 2013

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ABSTRACT

Ozone (O₃) is a stratospheric layer that plays important role in providing support to humans for their survival. It is an essential factor for many global, biological and environmental phenomena. The ultra-violet (UV) rays emitted from sun are captured by ozone and thereby provide a stable ontological structure in the biosphere. Various anthropogenic activities such as emissions of CFCs, HCFCs and other organo-halogens lead to the depletion of ozone. The ozone depletion resulted in secondary production of an ozone layer near the ground (terrestrial ozone layer), which is responsible for adverse effects on plants, humans and environment with increased number of bronchial diseases in humans. The mutations caused by UV rays result in variation in morphogenic traits of plants which ultimately decreases crop productivity. However, UV radiation is required in optimum intensity for both plants and animals. This review takes into an account the wide ranging effects of ozone depletion with a majority of them being detrimental to the plant system.

Keywords: Ozone Depletion; Ultra-Violet Radiation; Chlorofluorocarbons; Plants; Ecosystem

1. Introduction

Some 2 billion years ago, rising atmospheric oxygen concentrations helped Earth's atmosphere to build up ozone and gradually led to the formation of the stratosphere. The photo-dissociation of oxygen molecules by high-energy solar photons (175 - 242 nm) in the stratosphere results in the production of ozone. This process leads to the release of single oxygen atoms which later combine with intact oxygen molecules to form ozone [1].

Ozone (O₃) forms a protective layer present in the earth's atmosphere and it is found in the lower portion of stratosphere, which is ~12 to 50 km above earth's surface. Discovered first by Charles Fabry and Henri Buisson in 1913, its properties were explored by G. M. B. Dobson. This layer acts as a shield to protect the earth against harmful ultraviolet (UV) radiation from the sun [2,3]. UV radiation is part of the solar electromagnetic spectrum, with wavelengths shorter than those of visible light, but longer than X-rays, and is widely known as a geno-

toxic environmental agent that affects ecosystem and human population [4]. Ozone, a variant of oxygen is a poisonous gas; and its formation and destruction is a continuous phenomenon. Ozone occurs at two levels, the stratospheric ozone and the tropospheric ozone. The tropospheric (ground) ozone varies with the daylight variations. Ozone near-ground is a pollutant and its production is enhanced due to air pollutants, like, nitrogen oxides (NO_x) and volatile organic compounds (VOCs). The increase in terrestrial ozone particulates results in their enhanced scattering and improved absorption of UV-B radiations, which contributes to global warming by acting as a greenhouse gas and also shows harmful effects on both animals and plants. An increase in the UV-B radiation is one of the major causes for enhanced production of carbon monoxide from dead organic matter and release of nitrogen oxides. The ground ozone along with carbon monoxide is responsible for acid rain which causes damage to lung tissue and its long-term exposure can cause permanent tissue damage. Tree leaf and needle losses are linked to acidification and high percentage of

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Manuscript Title: Depletion of the Ozone Layer and Its Consequences: A Review

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Volume: Vol.4 No.10, October 2013 in *American Journal of Plant Sciences*

Publication Date: October 9, 2013

Pages: 1990-1997

DOI: <https://doi.org/10.4236/ajps.2013.410247>

Publication Link: <https://www.scirp.org/journal/paperinformation?paperid=37672>

The manuscript is accepted following the undergo strict and comprehensive peer-review. The review process is double blind.

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