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Green house effect and methane emission and its relevance to abiotic stresses

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Abstract
Traditionally, methane (CH4), one of the most significant greenhouse gases, has been viewed as a physiologic inert gas. The finding that CH4 has a variety of biological effects on animals, including anti-inflammatory, antioxidant, and anti-apoptosis effects, has, however, called into question this viewpoint. Since the physiological processes of plants are multifaceted, it will undoubtedly be challenging to predict and generalize how the increased concentration of carbon dioxide (CO_2) and other greenhouse effect gases will affect plant growth, production, and fruit quality. These changes will also result in climate change, increased levels of ultraviolet (UV) radiation, and changes in the hydrological cycle. A statistically significant change in either the condition of the climate or its variability that lasts for a considerable amount of time is referred to as a changing climate. Horticulture will be impacted by the considerable shift in climate, both globally and nationally, and this will have an effect on the production systems. The impact of greenhouse gases on fruit crops is discussed in this article. It would be reasonable to suppose that the effects of methane emission from fertilizer application will last for a very long period and have a significant impact on the lives of many people. The main influence on the bacteria that produce methane gas during anaerobic digestion processes has been thought to be nutrients. This study evaluated the nutritional makeup of several fruit wastes, including mango (M), watermelon (W), and pawpaw (P), as well as their effects on the formation of methane gas and the associated energy values.

Keywords: Green house effect, methane emission, abiotic stress, etc.

Introduction
Climate change is a shift in the weather over a comparable time period that is caused by human activity that modifies the composition of the atmosphere on a global scale. Over the past century, the earth's surface's global mean temperature has risen by around 0.74 °C. The fluctuation in surface temperature showed that the 1990s were the millennium's warmest decade, with 1998 being the warmest year. The alarming rise in the quantity of greenhouse gases in the atmosphere, including CO_2, CH4, N_2O, and chlorofluorocarbons, is mostly attributable to an increased rate of industrialization. According to estimates, the carbon dioxide concentration in the atmosphere in 2100 will be 100% higher than it was in the pre-industrial era. It is doubtful that this agro-climatic parameter would remain stable given that global temperatures are predicted to increase by up to 6 °C by the end of the twenty-first century in comparison to pre-industrial levels (Singh, 2010) [23].

A significant amount of the total trash produced worldwide is made up of organic wastes, such as materials derived from plants and animals. Additionally, the conventional techniques used to maintain organic wastes (such as dumping or incinerating) are neither economical nor environmentally friendly (Elhaggar and Omar, 2017) [10].

Digestible wastes that are dumped in landfills eventually undergo microbial breakdown, frequently without the presence of molecular oxygen, which leads to the production of landfill gas. In this instance, the gas would eventually blend into the atmosphere and contribute to local pollution, which will exacerbate existing global environmental issues (Vazoller *et al.*, 200l) [27].

The gas from the dumpsite can be captured, converted, and used as a crucial source of energy rather than being allowed to escape into the atmosphere. Anaerobic digestion is the best technology to use when managing organic wastes in the environment, such as fruit residues with a high water content (Asquer *et al.*, 2013) [5].

Because methane-forming microorganisms have several enzyme systems that require trace mineral elements that are different from those of other bacteria, the type of raw material added to anaerobic digesters determines the amount of methane gas that is produced during the anaerobic degradation of biological material (Bouallagui *et al.*, 2003) [8]. (Gerardi, 2003) [14].

Emission of CH_4

Abiotic or biotic mechanisms can both create CH4. About 1% of the total quantity of CH4 emissions worldwide are thought to come from the three main abiotic processes (volcanic activity, geothermal systems, and water-rock interactions) (Emmanuel and Ague 2007; Fiebig *et al.* 2009) [11-12]. On the other hand, microbial creation of CH4, which accounts for more than 70% of CH4 global production, and the breakdown of organic compounds account for almost 99% of the CH4 in the atmosphere (Wang *et al.* 2013b) [29]. In contrast to bacteria and eukaryotes, methanogenic microorganisms are obligate anaerobes that create CH4 as a byproduct of metabolism in anaerobic environments. Wetlands, rice paddies, landfills, oceans, and the stomachs of both people and animals frequently contain methanogens (Liu and Whitman 2008) [19].

Effect of GHGs on horticultural crops

Effect of methane

A common, flavorless, odourless, and volatile gaseous molecule is methane (CH4). This gas is typically regarded as a significant greenhouse gas with the potential to significantly affect the climate of the planet. Animals are not naturally harmful to CH4, although at high concentrations, it can cause suffocation and headaches (Boros *et al*. 2015) [7]. Methane is a powerful greenhouse gas at the center of new rules and initiatives proposed at a major U.N. climate summit in Glasgow, Scotland. While carbon dioxide is more abundant and longer-lived, methane – the main component of natural gas – is far more effective at trapping heat while it lasts. Over the first two decades after its release, methane is more than 80 times more potent than carbon dioxide in terms of warming the climate system Akman *et al*. (2015) [1-4]. In agriculture, paddy fields release a large amount of methane. Researchers have looked at methane production from tomato plant remains both separately and in co-digestion (Jagadabhi *et al.* 2011; Akman *et al.* 2015. Jagadabhi *et al.* 2011) [16, 1-4, 17] focused on studying the reactor configuration to improve methane production, while the impact of plant silage was examined by Oleszek *et al*. in 2016. The evaluation of different plant proportions with other substrates was the main topic of Akman *et al*. (2015) [1-4] and Li *et al*. (2016) [18]. Regarding the utilization of the pepper plant, several ratios of the plant were assessed in co-digestion with bovine dung (Akman *et al.* 2015) [1-4], and another study on the impact of silage in the production of biogas was carried out by Guil-Guerrero *et al*. (2016) [15] using a predictive analysis. The temperature range in all of these investigations was 35 °C to 37 °C, and the yields of methane produced ranged from 130.3 mL/g VS to 415.4 mL/g VS. None of these research examined how the S/I ratio, temperature, or TS content changed over time.

The alarming increase in methane draws attention to managing those emissions for climate change mitigation. While most mitigation efforts have focused on carbon dioxide, the more common greenhouse gas, methane's warming potential is about 28 times greater on a 100-year horizon, and its lifespan in the atmosphere is much shorter. In other words, it can do major damage, but getting it under control could tip the climate change equation relatively rapidly. Methane presents the best opportunity to slow climate change quickly," said Jackson. "Carbon dioxide has a longer reach, but methane strikes faster.

Plant tolerance against abiotic stress

There is plenty of proof that shows how CH4 protects plants from a variety of challenges. Reduced oxidative stress has been suggested to be a mediator of the protection provided by CH4 in animals (Boros *et al*. 2012; Wang 2014) [6, 28]. Abiotic stressors cause a rapid overproduction of ROS, which leads to lipid peroxidation and oxidative damage (Mller *et al*. 2007) [20]. Plants have defence mechanisms that include antioxidant enzymes such as superoxide dismutase (SOD), ascorbate peroxidase (APX), CAT, and POD to combat these harmful stress metabolites. Additionally, non-enzymatic elements including glutathione (GSH), glucose metabolism, and AsA could detoxify ROS to increase plants' resistance to stress (Foyer and Noctor 2011; Noctor *et al*. 2012; Uzilday *et al*. 2011) [13, 21, 26]. It has been discovered that exposure to CH4 correlates with an increase in antioxidant enzyme activity as well as their gene expression, leading to the restoration of redox equilibrium (Cui *et al*. 2015, 2017; Zhu *et al*. 2016) [9, 30].

Reducing uncertainties of methane

Natural sources of methane, which account for 40 percent of all methane emissions, are more uncertain than human-driven ones. Examples include methane leaking out of natural faults and seeping on the ocean floor, and the potential for increased emissions as permafrost warms. Another research area includes studying the short-lived radicals that destroy methane in the atmosphere. Because of the evolving nature of this knowledge, the international group of scientists behind the study plans to update the methane budget every two years. The effort is under the umbrella of the Global Carbon Project, an initiative headed by Jackson that releases an annual global carbon budget. The group's most recent carbon budget shows concentrations of carbon dioxide have been largely flat for the past three years – a finding that reinforces the importance of methane management.

Working toward solutions

Possible solutions for agriculture include breeding rice to require less flooding, altering feed for livestock to lessen intestinal processes that create methane, promoting less meat-intensive diets and deploying more farm bio-digesters. Opportunities in other areas include venting and flaring of methane in coal mines, detecting and removing natural gas leaks from oil and gas drilling operations and covering landfills to capture methane emissions. There is urgent attention to quantify and reduce methane emissions, stressing mitigation's rapid climate benefits and economic, health and agricultural co-benefits.

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