Global Warming and Maize

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***Abstract*—Maize breeding and improved options have made remarkable progress in increasing crop yields in novadays. However, global warming and climate change projections offer much yield losses will be occur in many regions. So global warming is an integral part of the maize production and because they are still prone or vulnerable to the effects of global warming is clear. Many researches showed that effects of global warming on plant mostly "physiological traits" and these were also reflected about its production. In this study, we examined the effect of global warming on maize physiology and explained with relevant examples.**

***Index Terms*—global warming, maize, physiological changes, maize production, heat stress, yield**

I. Introduction

Global warming is a dynamic process which affects global air temperature, oceanic temperature, rainfall, wind and quality of incoming solar radiation. Global Warming is the increase of Earth's average surface temperature due to effect of greenhouse gases, such as carbon dioxide emissions from burning fossil fuels or from deforestation, which trap heat that would otherwise escape from Earth. This is a type of greenhouse effect. Global circulation models estimate 1.4 to 5.8 °C rise in global temperature because of projected increase in the concentrations of all greenhouse gases by the end of the 21st century (Intergovernmental Panel on Climate Change [1]. Near-term climate change policies could significantly affect long-term climate change impacts. Much of this increase in average daily temperature is projected to be due to an increase in NT. Higher temperatures and other climate changes decrease the amount of rain and water plants receive, as well as elevating sea temperatures.

What is global warming? Global warming begins with sunlight. When sunlight reaches the Earth, about 30 percent of it is reflected back into space by clouds, atmospheric particles, reflective ground surfaces, and even ocean surf. Plants can easily be affected by even a gradual increase in temperatures. Small shifts in climate changes can harm a number of plant species. Especially, the plants of the mountain and Polar Regions are especially at harm from global warming. The remaining 70 percent of the light is absorbed by the oceans, air, and land, heating the Earth's surface and atmosphere and making life on Earth possible. Solar energy does not stay bound up in Earth's environment forever. Instead, as the rocks, the air, and the sea warm, they emit thermal radiation, or infrared heat. Much of this thermal radiation travels directly out to space, allowing Earth to cool [1]. Radiation is reabsorbed by water vapor, carbon dioxide, and greenhouse gases in the atmosphere and is then re-radiated back toward the Earth's surface. On the whole, this re-absorption process is good. If there were no greenhouse gases or clouds in the atmosphere, the Earth's average surface temperature would be a very chilly -18 °C (0 °F) instead of the comfortable 15 °C (59 °F) that it is today.

According to many researcher climate change is a result from emission of greenhouse gases (e.g. CO_2, CH_4, & N_2O, etc.) in the past century that will cause atmospheric warming [1]. Its effects have been particularly obvious over the last 30 years in the natural environment and climate change will affect all level of life, from the individual, population species community and ecosystem.

According to many scientists have been staded that the chief reason behind climate change is the rise in CO_2 level. It has been stated carbon dioxide is the main greenhouse gas which is usually emitted due to several anthropogenic activities apart from being naturally present in the atmosphere. After industrial revolution, increased activities by people has become chiefly responsible for the increase in the concentration of CO_2 and other greenhouse gases. Carbon dioxide is also added to the atmosphere from a variety of other related sources [2]. Researchers have stated concern about the possible climatic chances of current and future concentrations of carbon dioxide in the atmosphere [3]. The increased carbon dioxide concentrations has been said to be responsible for global warming. This condition is indicating global rise of temperature. Carbon dioxide persists in the atmosphere for a long time due to its very slow transfer to the ocean sediments [4].

Agriculture and farming practices in each particular location is strongly influenced by the long-term mean climate state the experience and infrastructure of local farming communities are generally appropriate to particular types of farming and to a particular group of cereals which are known to be productive under the current climate [2]. Higher growing season temperatures can significantly indicate their impact on agricultural productivity, farm incomes and food security [5].

Global warming results reveal a real threat to our food supply in the coming decades. It turns out that maize yields decrease significantly for every day when temperatures climb over around 32 °C, and that heat stress

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has been as important an influence on maize yield as variation in rainfall since the turn of the century.

II. Global Warmimg and Its Impact on Maize Production

High or low temperatute and long- and short-term episodes of heat stress are predicted to occur more often as a result of global warming, affecting many aspects of maize plant growth and development, reducing grain yield and decreasing grain quality. Most studies have reported the impacts of long- and short-term temperature stresses on crop production. However, most of the studies assume no difference in the influence of day versus night temperature [6]. This is known to decrease yield in several cereals like maize (Zea mays L.). The other research reported that an increase in temperature of 2 ℃ would result in a greater reduction in maize yields within sub Saharan Africa than a decrease in precipitation by 20%.

Additionally an analysis of more than 20,000 historical maize trial yields in Africa over an eight year period combined with weather data showed for every degree day above 30 ℃ grain yield was reduced by 1% and 1.7% under optimal rainfed and drought conditions, respectively [7].

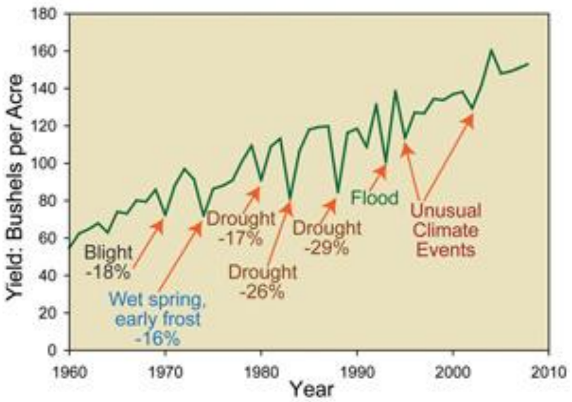

Figure 1. Source: USGCRP (2009)

As you seen graph 1 that increase corn yields, because of global warming extreme climate changes have caused significant yield reductions in some years. Crops are critical for the food supply around the world. U.S. exports supply more than 30% of all wheat, corn, and rice on the global market in the United States [8]. As you seen Fig. 1. Changes in temperature, amount of carbon dioxide (CO_2), and the frequency and intensity of extreme weather could have significant impacts on crop yields [9]. Ocean temperatures and acidity should rise as the oceans soak up more heat and carbon dioxide. Global temperatures are estimated to increase, with the largest temperature increases over land and at the poles. Glaciers and sea ice will melt and sea levels will rise. Our planet is closely monitored for these symptoms by a fleet of satellites and surface instruments.

A result shows that CO_2 released from agriculture to large extent comes from microbial decay or burning of plant residue and organic matter. CH_4 produced during fermentation of organic material, emitted from ruminant animals, stored manure (waste), and rice farming under flooded condition, etc. N_2O generated by microbial transformation of nitrogen in soil, manures and often, enhanced where there is high availability of N,especially under wet condition.

The production of greenhouse gases from agriculture is complex and heterogeneous, but active management of agricultural system can give possibilities for mitigation [1]. Mitigation is an anthropogenic interventionto reduce sources of GHGs or enhance sinks of GHGs.

Thereby reduce impacts of climate change and minimize adaptation challenges. Forest trees, through photosynthesis, remove CO_2 from the atmosphere and store it as organic carbon during life of the tree, but when the tree decay or being burnt most of the carbon will be release back to the atmosphere as CO_2 [1].

Due to increasing world population and industrial development there is an increased emission of GHGs. Use of fossil fuels, deforestation, burning and decay of biomass, etc., leads to higher atmospheric CO_2 concentration and that predicted to increase to roughly 470 – 570 ppm until year 2050.

The level of absorption, emitting and emission of radiation with in the atmosphere, ocean and at the earth surface highly affected by the amount of concentration of atmospheric GHGs, aerosols, soli type and moisture, vegetation and land cover.

They are a cause energy balance (positive or negative change) within the warming system and are driver of climate change [1]. As Earth has warmed, much of the excess energy has gone into heating the upper layers of the ocean. This suspect that currents have transported some of this excess heat from surface waters down deep, removing it from the surface of our planet.

III. Global Warming and Its Impact on Maize Phsiology

An increased incidence of agricultural drought will increase crop water stress. An expansion of irrigation is a likely response in some regions, although many areas lack irrigation infrastructure, and water access can often be curtailed during periods of severe drought. In situations with shallow or medium depth to groundwater, plants may also be able to escape drought by accessing moisture below the surface. In general, though, crop plants will respond to reduced soil moisture by closing their stomates and slowing carbon uptake to avoid water stress, thereby raising canopy T and potentially increasing heat-related impacts. Water stress during the reproductive period of cereal crops may be particularly harmful (9; 23, 25), while changes in the timing of the rainy season, particularly in tropical areas, may confound traditional techniques for farmers to determine appropriate planting dates. Finally, more intense rainfall events may lead to flooding and waterlogged soils, also pathways for damaged crop production.

All plant response can then be evaluated in terms of the causal plant physiological processes such as photosynthesis, respiration, transpiration and translocation. Global warming effects direct or indirect psıologıcal activates on maize plant surely. Many important physilogical, changes and biochemical changes occur in maize plant because of global warming and climatic changes

Pollen viability for maize plant decreases with exposure to temperatures above 35 ℃ [10]-[12]. The effect of temperature is provide under high vapor pressure deficits as pollen viability is a function of pollen moisture content which is strongly rely on vapor pressure deficit [13]. Because temperatures increased to 35 ℃ from 30 ℃ the potential kernel growth rate was reduced along with final kernel size, even after the plants were returned to 30 ℃ [14]. Damaged cell division and amyloplast replication in maize kernels which reduced the size of the grain silk above 30 ℃ and finally yield [15]. Some studies have reported that environmental stress depend on global warming during seed development and maturity strongly alter the chemical composition of the seed membranes.

As you seen, Fig. 2b) in maize plant cells which was exposed under global warming conditiions enlarged apparently.

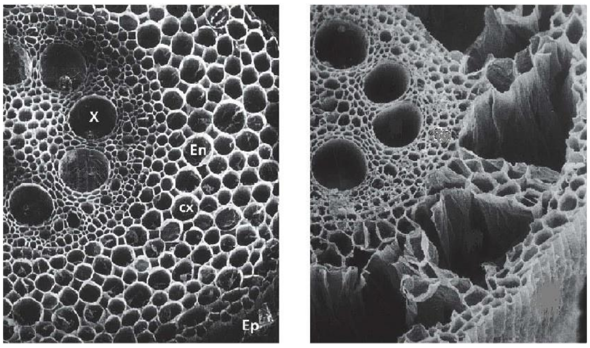

Figure 2. a) maize cells; b) maize cells (under global warming condıtıons)

Whole grain set for maize need the production of viable pollen, interception of the polen by receptive silks, transmission of the male gamete to the egg cell, initiation or maintenance of the embryo and endosperm development [11].

High temperature that is above 35 ℃, maize leaf elongation rate, leaf area, shoot biomass and photosynthetic CO_2 assimilation rate decreases [16].

Additionall, according the other research, elongation of the first internode and overall shoot growth of maize has been suggested as the most sensitive processes of the vegetative stage to high temperatures [17].

The most significant factors involve in maize yield reductio include shortened life cycle, decreased light interception and increased sterility [18].

IV. Conclusion

To access to develelopment of improved germplasmş there is an urgent need to strengthen breeding strategies to offset assumed both yield declines and to realize predicted yield incresas [19]-[21]. Weather anticipation systems have significant role in targeting breeding programs by predicting regions of vulnerability, targeting germplasm movement and identifying future climates for agricultural production environments. Therefore, anticipated vulnerable regions should become a focus of maize breeding efforts to increase adaptive capacity. The prediction of future climates will also allow the identification of current spatial analogues of these climates which can be used to facilitate germplasm exchange for breeding [19], [21]. Breeding strategies for developing climate-adapted germplasm must take into account the predicted and significant regional variation in regions with high temperatures. While the overall crop yields in Africa may fall by 10–20% by 2050 due to higher temperatures and reduced rainfall [22]. And this situation masks regional variation. In some areas crop reductions will be greater (northern Uganda, southern Sudan, and the semi-arid areas of Kenya and Tanzania) while in other areas crops yields may increase (southern Ethiopia highlands, central and western highlands of Kenya and the Great Lakes Region) [20], [21].

Warming trends were estimated to have lowered wheat and maize yields by roughly 6% and 4%, respectively, over the 29-year period, with relatively small impacts of P trends. Global soybean and rice yields were deemed to be relatively unaffected by changes so far [7]. This research showed yields for barley, maize, and wheat all increased substantially since 1980, but not as much as they would have if climate had remained stable. Yields for a counterfactual of no climate and no CO_2 trend are also shown, illustrating the benefit of higher CO_2 for C3 crops [7], [23].

If global warming that is ecological and climatic changes are now being detected when the globe has warmed by an estimated average of only 0.6 8C, many more far-reaching effects on species and ecosystems will occur in response to changes in temperature to levels predicted by IPCC, which run as high as 6 8C by 2100. The escalating rise in average global temperatures over the past century has put numerous species in danger of plant extinction.

Many factors will shape global food security over the next few decades, including changes in rates of human population growth, income growth and distribution, dietary preferences, disease incidence, increased demand for land and water resources for other uses (i.e. bioenergy production, carbon sequestration, and urban development), and rates of improvement in agricultural productivity. This latter factor, which we define here simply as crop yield (i.e., metric tons of grain production per hectare of land), is a particular emphasis of the plant science community, as researchers and farmers seek to sustain the impressive historical gains associated with improved genetics and agronomic management of major food crops. [7], [23].

Ultimately, global warming will impact life on Earth in many ways, but the extent of the change is up to us. Since greenhouse gases are long-lived, the planet will continue to warm and changes will continue to happen, but the degree to which global warming changes life on Earth depends on our decisions [24], [25].

Additionally, global warming affects the extent of plant diseases and insect pests both the presently occurrence and infestation, introduced of the new species. As a result of these changes, a number of diseases, pests and weeds, preventing actions needed to reduce the effects on human health and ecosystems. Because of the effect of global warming on plants, the food supply for many humans and animals can start to diminish from the harm done to plants. As the temperatures rise, more and more plant species will begin to be threatened. This will cause a chain reaction for all aspects of the planet. The severity scale of global change will depend on how much the Earth's surface warms over the next century.

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