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RESPONSE OF MAIZE PLANTS (*ZEA MAYS L.*) TO STRESSFUL TEMPERATURES

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INTRODUCTION

Global warming, driven by the rising of greenhouse gases especially CO_2 in the Earth's atmosphere, could cause many changes to ecosystems of the world. One of the most important changes is the climate change and is a long-term shift or alteration in the climate. Temperature and precipitation are the most important climatic parameters for crop growth. Therefore, scientists have used available climatic data and information into several large-scale models of the atmosphere. These models are used to predict changes in temperature, precipitation, radiation, and other climate variables caused by increased greenhouse gases in the atmosphere.

Temperature increase during 1961 to 1990 has reported in Colombo as 0.0164°C per year and Anuradapura 0.0364°C per year (Fernando and Chandrapala 1995). The average annual temperature for 2050 modeled using General Circulation Model (HadCM3) is predicted to increase by 1.6°C (A2 scenario) and 1.2°C (B2 scenario). The highest mean temperature was predicted in Anuradhapura by 2.1°C (A2), 1.6°C (B2). During the southwest monsoon period (May to September) the overall increase in mean annual air temperature across the island is predicted to increase by 1.6°C (A1) and 1.2°C (B2) (De Silva, 2006). Further the Northeast monsoon rainfall is also predicted to decrease. Therefore the decreased rainfall and increased in temperature will increase the evapotranspiration and soil moisture deficits. Agricultural activities in the dry zone may be affected by predicted climate change in Sri Lanka (De Silva *et. al.*, 2007).. Maize is one of the main crops widely cultivated in the dry zone of Sri Lanka. Mulching can affect the temperature and moisture content of the soil. Therefore this paper analyses the response of Maize with three types of mulches to stressful temperatures

METHODOLOGY

This study was conducted during the October 2010 to May of 2011 in temperature regulated poly tunnels constructed in the agricultural field of the Open University of Sri Lanka, Nawala, Nugegoda and one experimental set outside the tunnels as ambient temperature and One set of two poly tunnels was maintained at 32°C maximum temperature. Another set of two poly tunnel was maintained at 34°C(7m x 9m). An experiment was set up in two twin temperature regulated poly tunnels constructed in the agricultural field Maize (Sampath) seeds were planted in pots filled with compost and reddish brown earth soil mixture. Three types of mulches were used (coir dust, straw, saw dust and no mulch) and the plants were maintained without water stress by applying water at field capacity of the soil moisture level (Table 1).

DATA COLLECTION AND ANALYSIS

Transplant success (survival rate) was estimated by the percentage of plants that showed successful establishment at 3 weeks after planting (WAP). Plant height was measured at weekly intervals up to 12WAP. Yield was collected two times during the growing season and the average of two plucking were taken as yield per plant. Harvesting was started on April 2011 and continued till May 2011. Weights were measured using a digital balance.

Statistical Analysis

The experimental design was Completely Randomized Design (CRD) with factorial treatment structure. Temperature and mulches were taken as factors. Physiological and morphological parameters of Maize were investigated during the growing and reproductive periods.
All extraction runs and analyses were carried out at least in duplicate and in randomized order with the mean values being reported. Analysis of variance (ANOVA) of the results was performed using General Linear Model procedure of Mini tab (Software Version 14).

Table 1: Three different environment at conditions of the experiment

No	***Environmental conditions***
Condition 1 Poly Tunnel	Increased the temperature by 2 ^{0}C more than the average day time temperature of Anuradhapura (32-34^{0}C). Diurnal pattern is considered) Three types of mulches were used on the soil –Maize plants in pots. • **coir dust (M1) /straw (M2)/sawdust (M3)/No mulch (M0)**
Condition 2 Poly Tunnel	Ambient temperature of Anuradhapura (30-32^{0}C) Three types of mulches were used on the soil –Maize plants in pots. • **coir dust (M1) /straw (M2)/sawdust (M3)/No mulch (M0)**
Condition 3 *Open Space*	Ambient temperature Three types of mulches were used on the soil - Maize plants in pots. • **coir dust (M1) /straw (M2)/sawdust (M3)/No mulch (M0)**

RESULTS AND DISCUSSION

Germination Percentage

According to the results, there is no significant difference with temperature and the mulch (Figure 1). Significant variation has shown between mulches. The highest transplanting success was reported from saw dust and coir dust treatment and lowest transplanting percentage was shown from no mulch condition. It shows that saw dust and /or coir dust has reduced the effect of stressful temperature on soil to achieve higher germination percentage in comparable with ambient temperature.

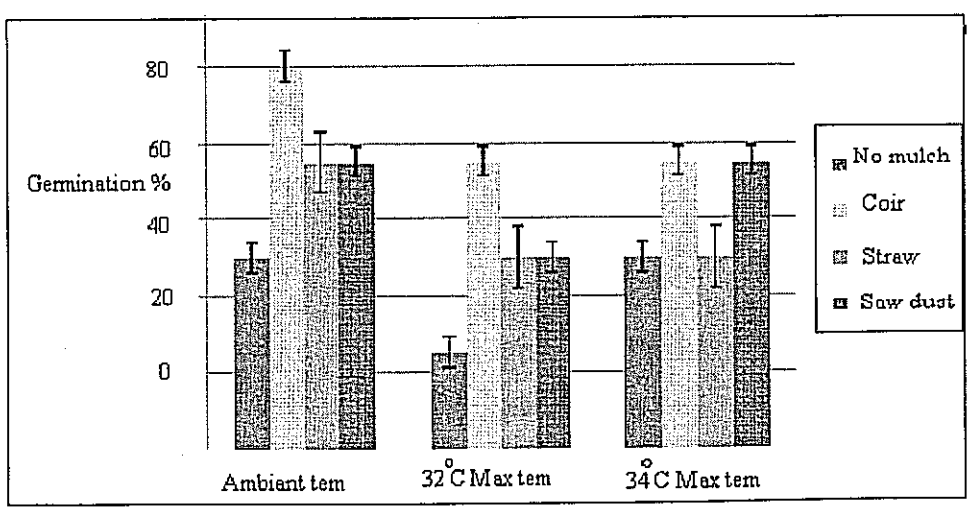

Figure 1. Effect of Coir dust, Straw and Saw dust as mulch on germination

Pod length (cm)

Average pod length among the treatments ranged from 25 -37 cm (Figure 2). Pod length of the plants maintained in ambient temperature is significantly higher than that of the others. Pod length is lower in plants grown in 34 ^{0}C and 32 °C. However pod length in plants mulched with coir dust is found to be greater than the other mulch types in stressful temperatures.

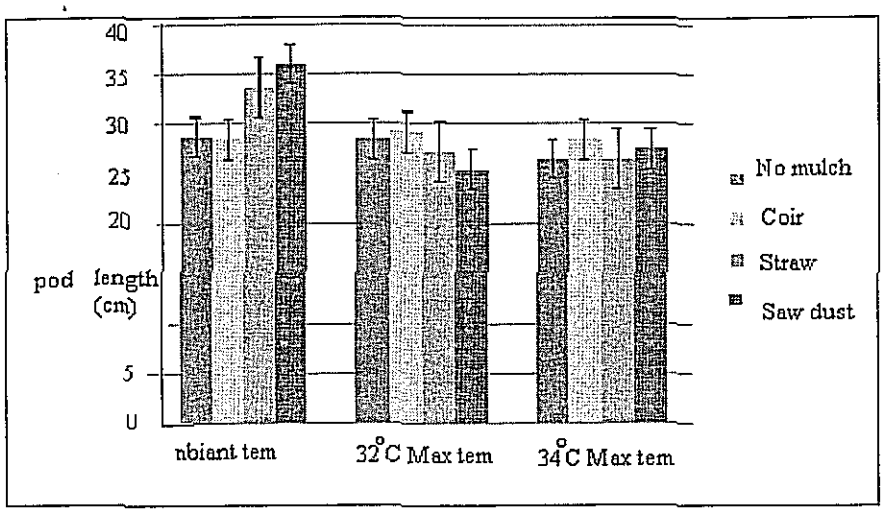

Figure 2. Effect of Coir dust, Straw and Saw dust as mulch on pod length (cm)

Pod yield

The pod yield is the most important character when considering the economic importance of this crop. Coir dust mulch shows a significantly high yield comparing with the other mulches (Figure 3). Higher air temperatures will also be felt in the soil, where warmer conditions are likely to speed the natural decomposition of organic matter and to increase the rates of other soil processes that affect fertility. Further when temperature exceeds the optimum for biological processes, crops often respond negatively with a steep drop in net growth and yield (Cynthia Rosenzweig and Daniel Hillel 1995). But in this study the effect of mulch has improved the soil degradation due to high temperature and coir dust could be used to minimize the soil degradation due to high temperature stress in natural environment. Further the pod weight is highest under all three temperature treatment with coir dust mulches treatment. It shows that coir dust mulch resist for temperature stress on maize yield.

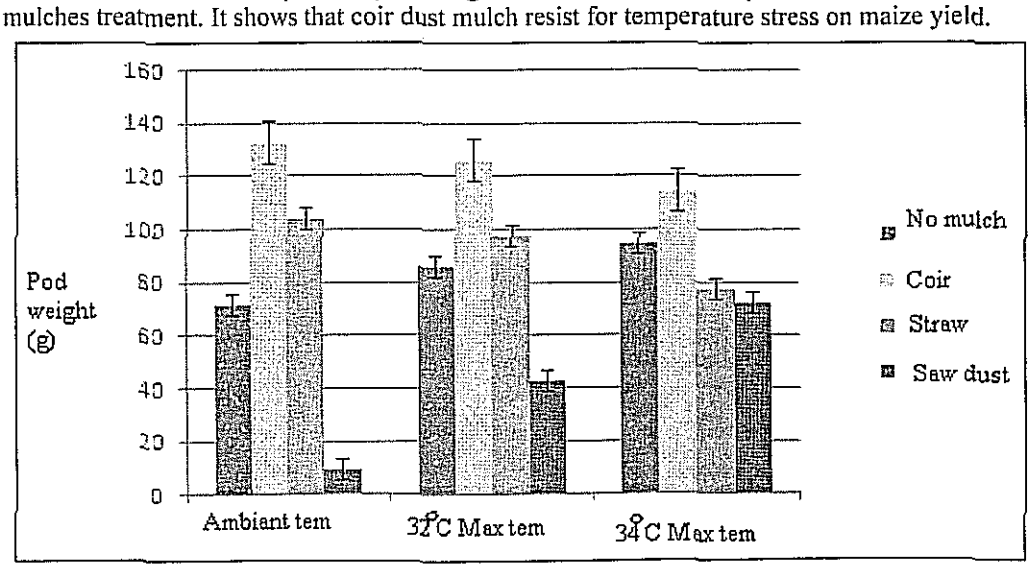

Figure 3. Effect of Coir dust, Straw and Saw dust as mulch on pod weight(g)

CONCLUSION

Results showed that higher temperature stress in natural environment either due to global warming or any other conditions could be minimized by using mulches. According to this temperature simulated field study the adverse effects on soil due to high temperature stress of 32-34°C could be minimized by using mulches especially maize performed well in coir dust mulch grown under stressful temperatures. This study is on progress and these results will be confirmed in performed after conducting the research for 3-4 growing seasons.

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