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EFFECT OF TEMPERATURE STRESS AND MULCH ON GROWTH AND YIELD OF CHILLI (*CAPSICUM ANNUUM L.*)

G.V. Norica Aiome and C.S. de Silva

Department of Agricultural and Plantation Engineering, Faculty of Engineering Technology

The Open University of Sri Lanka

INTRODUCTION

Intergovernmental Panel of Climate Change (IPCC) estimated that the mean global temperature might be increased from1.4°C to 5.8°C (2.52°F –10.44°F) during 21st century. Further, in the past 100 years, the global average surface temperature has increased by 0.6°C (1.08°F) (IPCC 2001). Fernando and Chandrapala (1995) had identified temperature increase during 1961 to 1990 and reported 0.0164°C per year in Colombo and 0.0364°C per year in Anuradapura. Research studies using General Circulation Model (HadCM3) is predicted the temperature to increase by 1.6°C (A2 scenario) and 1.2°C (B2 scenario) in Sri Lanka and the highest mean temperature was predicted in Anuradhapura by 2.1°C (A2), 1.6°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).

High temperature effect on plants is mainly accelerated physiological development, resulting in hastened maturation and reduced yield. 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. Mulching also minimizes the use of N fertilizer (Jones *et al.*, 1977), warms the soil, improves the soil physical condition, and suppresses weed growth (Iruthayaraj et al., 1989) and could account for increased yield (Ravinder *et al.*, 1997).

This study intends to identify a suitable mulch to mitigate the consequences of higher temperature stress on soil by evaluating the growth and yield parameters of Chilli (*Capsicum annuum* L.) variety MI2. Chili is one of the most widely cultivated crops throughout the year in both *yala* (dry) and *maha* (wet) seasons. In this study plants will be applied with adequate water to avoid any water stress according to the results of a previous study results (Gunawardhana *et al*, 2011).

MATERIALS AND METHODS

Growing conditions

This study was conducted during the October 2010 to December 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 poly tunnels(7m x9m). An experiment was set up in two twin temperature regulated poly tunnels constructed in the agricultural field.(Table 01).

The cultivar MI2 of Chilli was used in this study. Chilli seedlings were transplanted (15th November 2010) into individual plastic pots. The pots were filled with a compost and reddish brown earth soil mixture. Plants were grown at 3 different conditions as indicated in the Table 1. Management of the crop, cultural practices and fertilizing were done according to the

recommendations of the Department of Agriculture. All the plants were watered to field capacity level in order to avoid water stress.

The experimental design was Completely Randomized Design (CRD) with factorial treatment structure. Temperature and mulches were taken as factors. Physiological and morphological parameters of Chili 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 SPSS (Software Version 19). Multiple comparison of the various means were carried out by LSD (Least Significant Difference) test at $p = 0.05$ and $p = 0.01$

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

Plants height

Average plant height among the treatments ranged from 44 -74 cm (Figure 01). Generally, height of the plants maintained in 34°C maximum temperature is significantly higher than that of the others. Plant height is lower in plants grown in ambient temperature than the 32°C and 34°C. High temperature induces rapid growth and therefore the plant height is significantly high ($P = 0.01$) in 34°C maximum temperature poly tunnel (Ravinder *et al.*, 1997). Further, height of the plants mulched with coir dust is found to be greater than the other mulch types.

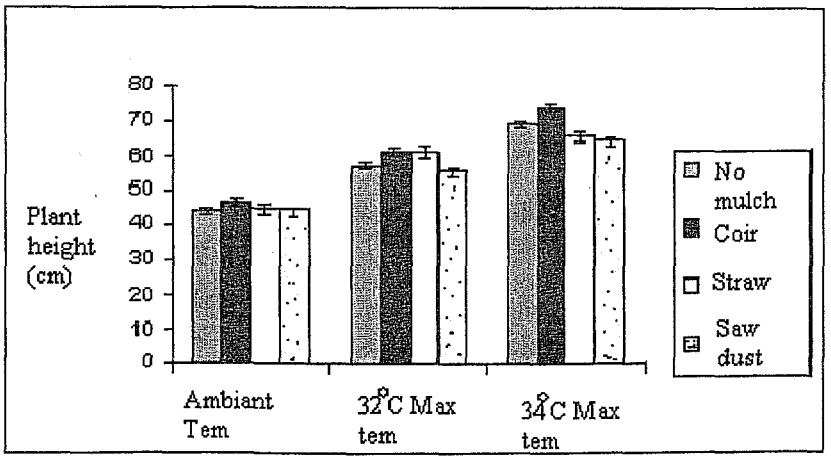

Figure 01: Effect of Coir dust, Straw and Sawdust as mulch on plant height.

Total leaf number

Total leaf number (primary and secondary) was significantly affected by temperature stress. Number of leaves was recorded at 34°C maximum temperature (147 leaves/ plant") is higher than the other temperature treatments. Results showed that there is a significant effect of temperature stress on the number of leaves produced. Higher number of leaves lead to higher photosynthetic resources. Plants mulched with coir dust showed the highest number of leaves (number) ($p = 0.01$) followed by straw and saw dust.

Pod yield

The fresh fruit yield is the most important character when considering the economic importance of this crop. These results showed that individual mulches effect on yield (Figure 02). Present results are in agreement with Strizaker *et al.*, 1989. Saw dust shows a significantly high yield comparing with the other mulches. 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 and Daniel ,1995). But in this study the effect of mulch has improved the soil degradation due to high temperature and saw dust could be used to minimize the soil degradation due to higher temperature stress in natural environment.

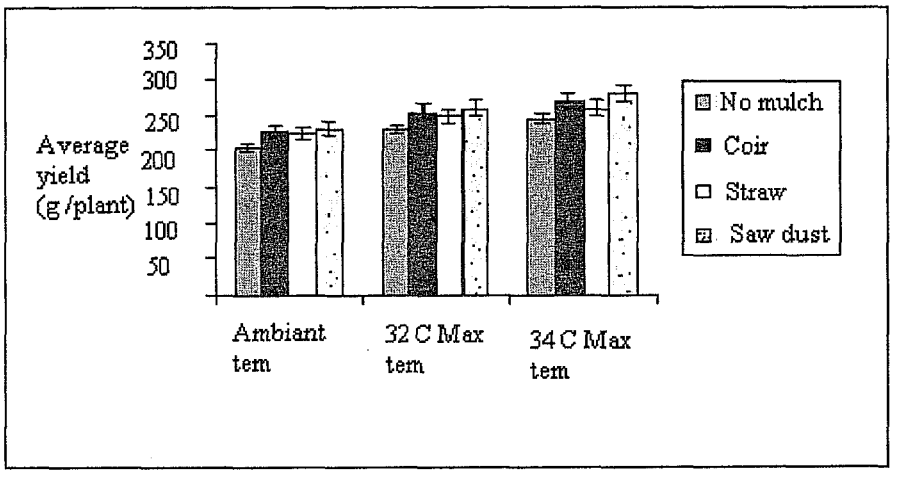

Figure 02: Effect of Coir dust, Straw and saw dust on average pod yield.

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 mulch such as coir dust, straw and saw dust. However there was a significantly high yield under saw dust mulch in Chilli cultivation compared to other mulches and no mulch situation. Saw dust mulch could be easily available for farmers therefore the adverse effects on soil due to high temperature stress could be minimized to ensure food security in Sri Lanka. However this research will be continued for three to four seasons to confirm the results obtained.

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