EFFECT OF SUPER ABSORBENT POLYMERS AND DIFFERENT IRRIGATION INTERVALS ON GROWTH AND YIELD OF TOMATO (*Lycopersicon esculentum* Mill) UNDER TEMPEARTURE STRESS CONDITION

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INTRODUCTION

Tomato (*Lycopersicon esculentum Mill*) is one of the most famous vegetable crops and it is mainly consumed as fresh vegetable and provides a considerable amount of vitamin C and A. Tomato is cultivated in almost all parts of Sri Lanka and cultivation is done as an income generation source in many parts of the country. However, the average productivity of tomato in Sri Lanka is much lower than the world average production and it might be due to the climatic variation, which adversely influenced the yield.

Global climatic variations happen rapidly due to various natural reasons as well as due to human activities. The atmospheric temperature is gradually rising almost everywhere in Sri Lanka (Nissanka *et al.,* 2011). Mean surface temperatures show a trend of increasing by 2.6 ^{0}C/100 years on average in annual average maximum temperature (Zubair *et al.,* 2010). And also, the number of consecutive dry days has increased and the consecutive wet periods have decreased (Premelal, 2009). Furthermore, the intensity and the frequency of the droughts have increased during recent times (Imbulana *et al.,* 2006). Increment of global temperature and drought periods impact crop cultivation. Temperature and water are some of the major facts influencing tomato cultivation and high temperature and limited amount of water inhibit the growth and yield of tomatoes (Nahar *et al.,* 2011).

Applications of Super Absorbent polymer (SAPs) is a one of the modern technologies, which used to retain large quantities of water and released as required by the plant to improve the growth and yield with limited water supply under increased temperature conditions.

Thus, the aim of this paper is to review the effect of super absorbent polymers on growth and yield of tomato under increased temperature and longer irrigation interval.

METHODOLOGY

Pot experiment was conducted at The Open University of Sri Lanka to evaluate the influence of increase temperature and longer irrigation interval on tomato and to identify the ability of super absorbent polymer to overcome such impacts on yield. Pot is 25cm in diameter and 28cm in height. The variety *thilina* was used in this study and three weeks old seedlings were transplanted. Reddish brown earth soil was used as the growing media. The experiments were arranged in a completely randomized design with three treatments and three replications. Temperature conditions of 32-33^{0}C and 36-37^{0}C were selected based on IPCC result on global climate (IPCC, 2007) and the Hadcm3 predictions for Sri Lankan air temperature in 2050 for A2 scenario of IPCC (De silva *et al,* 2007 and De silva, 2006).

Irrigation intervals applied as 3days (I1), 5days (I2) and 8days (I3). Application of super absorbent polymer was done at two levels. One was without and other used as 2g of SAPs per pot according to the recommendation. One set of plants kept at the poly tunnel to give elevated temperature condition (36-37 ^{0}C) and other set of plants kept at a net house to give ambient temperature condition (32-33 ^{0}C). The poly tunnel is consisted of a top vent roof structure and it provides natural air circulation and also, automated temperature control unit was installed in there to maintain the temperature at selected levels. When the temperature inside the polytunnel increased beyond the given temperature, automated temperature control unit begins to start and temperature will adjusted to set temperature. And also relative humidity and light intensity were

measured at the polytuunel and net house. However, there was no significant variation in observed data.

Growth parameters (plant height, number of leaves and number of branches) of tomato were measured once per week and yield parameters (number of fruits per plant, fresh weight of fruits) were taken after harvest. All the data were analyzed using SAS 9.3 version and the Duncan multiple range test was used to determine the differences in treatment means at $P < 0.05$.

RESULTS AND DISCUSSION

Growth parameters of Tomato (*Lycopersicon esculentum Mill*)

Plant height (cm)

The statistical analysis showed that interaction effect of temperature, SAPs and irrigation interval had a significant effect on plant height. Application of SAPs showed superior performance in plant height, indicating SAPs had positive effect on the growth and development of tomatoes under both temperature conditions with extended irrigation intervals. The tallest plants were observed in treatments applied with SAPs and three days irrigation interval under ambient temperature conditions (Table 1). However it was not significantly different from the treatments with SAPs, 5 day irrigation interval under ambient temperature condition, treatment with SAPs, three day irrigation interval at increased temperature condition and treatment with SAPs, 5 day irrigation interval at increased temperature condition (T1Z2I2). The smallest plants were observed in treatment without SAPs, 8 days irrigation interval at increased temperature condition. These results strongly agreed with the findings of Sayyari *et al.*, 2012

Number of leaves

All the treatments at ambient temperature have shown higher number of leaves than the treatments at increased temperature condition. However, treatments at increased temperature with SAPs and short irrigation interval have shown higher number of leaves due to mitigation of water stress and temperature stress condition. The effect of water stress in reducing the number of leaves in pepper was reported in Abayomi *et al*., 2012 study that are in agreement with the findings of this study.

Number of branches

According to the analyzed data, interaction effect of temperature, SAPs and irrigation interval has significant influence on number of branches. All the treatments applied with SAPs produced higher number of branches either at the increased temperature or ambient temperature condition due to positive effect of SAPs to mitigate the higher temperature and impact of limited water application. The highest number of branches were shown in treatments applied with SAPs, 3days irrigation interval either at the ambient temperature or increased temperature conditions.

Table 1: Interaction influence of application of SAPs, temperature condition irrigation interval on growth parameters of tomato (*Lycopersicon esculentum Mill*)

Treatments	Plant height (cm)	Number of leaves	Number of branches
T1I1Z1	36^{de}	21^{d}	7^{de}
T1I2Z1	32^{ef}	16^{e}	2^{f}
T1I3Z1	30^{f}	13^{f}	2^{f}
T1I1Z2	62^{a}	34^{a}	17^{ab}
T1I2Z2	59.8^{ab}	29^{b}	12^{c}
T1I3Z2	38^{d}	22^{d}	9^{d}
T2I1Z1	57.2^{b}	30^{b}	15^{b}
T2I2Z1	51^{c}	26^{c}	9^{d}
T2I3Z1	34^{e}	17^{e}	5^{e}
T2I1Z2	64.1^{a}	35^{a}	19^{a}
T2I2Z2	61.8^{a}	33^{a}	18^{a}
T2I3Z2	55.7^{bc}	29^{b}	12^{c}

T1- Increased temperature (36-37 ^{0}C), T2- Ambient temperature (32-33 ^{0}C)
Z1 – Without application of SAPs, Z2 – With Application of SAPs
I1- 3 days irrigation interval, I2- 5 days irrigation interval, I3- 8 days irrigation interval
Different letters indicate significant at the $0.01<P\leq 0.05$ probability level.

Yield parameters of Tomato

Number of fruits per plants

The interaction effects of irrigation interval, temperature condition and application of SAPs have shown significant effect on a number of fruits (Table 2). Treatment applied with SAPs, 3 days irrigation interval has shown higher number of fruits per plant either at the ambient temperature or increased temperature condition. However, they were not significantly different with treatments applied with SAPs, 5 days irrigation interval under both temperature conditions. The lowest number of fruits per plants has shown in treatment without SAPs, 8 days irrigation interval at the increased temperature condition. It might be due to adverse effect of high temperature and limited amount of water to plant. These results can be justified according to the findings of Bagherifard *et al.*, (2021)

Fresh weight of fruits per plant (g)

According to the current study, interaction effect of SAPs, temperature condition and irrigation interval has significant contribution on fresh weight of fruits per plants. Under ambient temperature condition, treatment applied with SAPs, 3 day irrigation interval has shown the highest weight. Treatment applied with SAPs, 3days irrigation interval has also shown higher weight under increased temperature condition while lowest in treatment without SAPs, 8days irrigation interval. However, treatment applied with SAPs, 3 days irrigation interval is not on par with treatments applied with SAPs, 5 days and 8 days irrigation interval treatments at ambient temperature condition and treatments applied SAPs, 5days irrigation interval under increased temperature condition. Therefore, according to this study, application of SAPs has an ability to mitigate impacts generated by increased temperature and limited quantity of water on yield attributes because of its capability to absorb large amounts of water. And also these results can be confirmed according to the findings of Basak (2020).

Table 2: Interaction effect of irrigation interval, temperature condition and application SAPs on number of branches of tomato (*Lycopersicon esculentum Mill*)

Treatment		Number of branches	Fresh weight of fruits per plant (g)	Treatments		Number of branches	Fresh weight of fruits per plant (g)
Increased temperature condition (36-37 ^{0}C) (T1)	I1Z1	11^c	251^c	Ambient temperature condition (32 -33 ^{0}C) (T2)	I1Z1	16^b	600^b
	I2Z1	6^e	110^d		I2Z1	14^{bc}	520^{bc}
	I3Z1	2^e	42^e		I3Z1	8^d	170^d
	I1Z2	19^a	710^a		I1Z2	21^a	784^a
	I2Z2	19^a	704^a		I2Z2	20^a	735^a
	I3Z2	$14b^c$	511^{bc}		I3Z2	18^{ab}	680^{ab}

T1- Increased temperature (36-37 ^{0}C), T2- Ambient temperature (32-33 ^{0}C)
Z1 – Without application of SAPs, Z2 – With Application of SAPs
I1- 3 days irrigation interval, I2- 5 days irrigation interval, I3- 8 days irrigation interval
Different letters indicate significant at the 0.01<P≤ 0.05 probability level.

CONCLUSIONS/RECOMMENDATIONS

In this study, application of SAPs positively increased the growth and yield attributes of tomato either at the ambient temperature or increased temperature condition. All the treatments with SAPs have shown greater performances than treatments without SAPs. And also, increment of irrigation interval resulted in the reduction of growth and yield of tomato. Application of SAPs, with three days irrigation interval was the best treatment to obtain highest yield. However, irrigation interval can be extended to 8 days with SAPs at ambient temperature condition because there is no significant difference with the treatment, which produced highest yield at such condition. At increased temperature condition, irrigation interval can be extended to 5days with application of SAPs.

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