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Research Article

Post harvest quality of tomato (*Lycopersicon esculantum* mill.) as influenced by drip irrigation scheduling in changing climatic scenario

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Abstract: A field experiment was conducted at Sabajpura farm, ICAR research complex for eastern region, Patna on post harvest quality of tomato as influenced by drip irrigation scheduling. The experiment was conducted in split plot design with irrigation water equivalent to 100, 80 and 60% ET (Evapo transpiration) in main plots and water as per daily, alternate days and once in three days schedule in sub-plots. Observations regarding TSS (0 Brix), acidity and fruit firmness (Kg/m^2) was undertaken. These parameters showed better response at 80% ET when plant received irrigation once in two days which was at par with once in three days irrigation. Highest TSS in tomato fruit was recorded under irrigation scheduling once in two days (3.430 Brix). However, Lowest acidity was associated with 100% irrigation (4.00) followed by 60% irrigation (5.21). Irrigation scheduling with once in two days proved maximum firmness of tomato fruit (3.53) which was at par with once in three days irrigation scheduling (3.39 Kg/cm^2). Drip irrigation is an effective adaptation technology to maintain quality of vegetables like tomato in warmer climate in future time periods.
Keywords: drip irrigation, evapo-transpiration, post harvest quality, tomato.

INTRODUCTION

Tomato is a major solanaceous crop next to potato considered as remunerative vegetable crop in India. It is a rich source of minerals, vitamins and organic acids, used as raw in salad, fetch greater demand in processing industry for making ketchup, sauce and puree. The post harvest losses in tomato are high and can go up to 60 per cent [1].

Agriculture sector depends on climate and climatic resources leading to the special stress upon the need to study impacts of climate change on agricultural production at local, regional, national as well as on global scales. Elevated CO_2 and changes in temperature, besides affecting the crop affects the environment which in turn may have either beneficial or damaging effect on agricultural production. Due to increase in temperature even by 1°C, fruit set and quality of vegetables like tomato may be affected [2]. Loss of quality includes the physiological and chemical changes associated with ripening resulting in changes in appearance, taste, texture and development of off flavours. Development of colouring pigment lycopene is hampered above 27 °C.

Food and energy security of India are crucially dependent on favourable weather and the timely availability of adequate amount of water. Air temperature and precipitation are principle elements of weather systems, so for the prediction of future climate conditions, level of variability of these two weather elements must be examined. According to the estimates by IPCC (2007) earth's linearly averaged surface temperature has increased by 0.74°C during the period 1901-2005 [3]. Increasing trends of rainfall and minimum temperature in Gangetic plains of Bihar was observed [4; 2010a]. Weather generators can be used to generate long term weather data wherever data is not available for impact studies. One such generator is LARSWG which was used and produced similar observations of rainfall and temperature as actual weather data for Bihar in eastern India [5; 2010b]. Although increase in CO_2 is likely to be beneficial for crops, yet associated temperature and rainfall variability may change the food production situation. Simulation studies are useful in predicting future climate scenario based on changing trends in temperature, CO_2 and rainfall etc [6 (2010c); 7 (2012a)]. Climate change impacts on cereal crops are studied in detail, however scarce information is available about impacts on vegetables and fruits. Cereal crop like wheat in Patna and Ranchi showed a declining yield trend due to increased temperature (thermal stress) coinciding with grain filling stage of crop [8]. Simulation studies performed for different time periods using HadCM3 factors at four centres located in three different agroecological zones showed that simulated yield of wheat may decline in future time periods [9(2013a),10].Simulation studies showed that long duration rice varieties are more prone to yield decline under future climate scenarios [11 (2010d); 12 (2012); 13(2012b)]. Climate change will affect future water supplies. Development of production systems geared towards improved water-use efficiency and to mitigate the effects of hot and dry conditions in vegetable production systems are top research and development priorities in changing climatic scenarios. There is wide scope for enhancing irrigation efficiency through adoption of drip irrigation systems and other water-conserving technologies [14, 15]. Drip irrigation system has proved its superiority over other conventional methods of irrigation, especially in fruit and vegetable crops owing to precise and direct application of water in the root zone. 20 litre waterper day was ideal for cocoa in mixed cropping system with arecanut [16]. Sujatha and Haris,2000 [17] reported that ferti-drip and drip irrigation in arecanut increased number of feeder roots four fold and two fold respectively compared to basin irrigation indicating increased root activity. It also influences post harvest quality of fruits and vegetables manifold. Therefore, it is necessary for the vegetable growers to know how effectively drip irrigation system enhances productivity and post harvest quality of tomato. Higher yield under drip irrigation at 80% ET once in 3 days in tomato and once in 2 days in cabbage and daily in okra, is reported [18; 19(2014a), 20(2014b)]. Since, drip irrigation saves 30-40% fertilizer/chemical with enhanced quality of produce as compared to surface irrigation and also helpful in reducing labour cost, salt concentration in the root zone and disease incidence. Therefore, an effort has been laid out keeping all these in view to study the post harvest quality of tomato as influenced by drip irrigation scheduling.

MATERIALS AND METHODS

A field experiment was conducted at ICAR Research Complex for Eastern Region, Patna on tomato. The tomato seed S-41 (Gotya, a Mahyco hybrid) was sown in nursery during first week of September and transplanted at the spacing of 60x60cm in the first week of October. The experiment was laid out in split plot design with three replications. The treatments as the main plot factors were irrigation level at 100% (I_1), 80% (I_2) and 60% (I_3) ET (Evapo-transpiration) while as the sub-plot factors were scheduling at daily (S_1), once in two days (S_2) and once in three days (S_3). The drip irrigation systems were consisted of 2lph capacity with online drippers. One lateral for one row of crop with one dripper per plant was adopted in each plot. Each sub-plot consisted of ten rows and ninety plants. The daily irrigation was applied in drip treatments at 1kg/cm^2 pressure. The daily pan evaporation was used to compute the daily water requirement of the crop through drip systems. The effective rainfall was computed by considering the pan evaporation and precipitation received during irrigation intervals. Tomatoes were harvested several times and data were added to estimate the TSS, acidity and fruit firmness during experimentation and analyzed using statistical methods [21].

RESULTS AND DISCUSSION

Effect of irrigation scheduling on TSS

The data presented in table-1 indicated that there was no significant difference among the irrigation at 100, 80 and 60% on TSS. Non-significant differences of irrigation treatments on TSS were observed in musk melon [22]. However, significant differences was observed under irrigation scheduling once in two days which recorded highest TSS (3.43^0 Brix) followed by once in three days irrigation (3.31^0 Brix), while, least TSS was observed with daily irrigation scheduling (3.09^0 Brix). However, significant differences was noticed during second year and 60% irrigation recorded highest TSS (4.88^0 Brix) which was on par with 100% (4.80^0 Brix) irrigation. These results are in close conformity with the findings of Joshi *et al.* 2012 [23] in litchi. But no significant differences were observed under irrigation scheduling and interactions. Drip irrigation system improved TSS in banana [24].

Effect of irrigation scheduling on acidity

Irrigation at 100, 80 and 60% with daily, once in two days and once in three days irrigation scheduling showed significant difference in acidity of tomato fruit (Table-1). Lowest acidity was associated with 100% irrigation (4.00) followed by 60% irrigation (5.21) during first year. In the irrigation scheduling daily scheduling noted lower acidity (4.28) than once in two days and once in three days irrigation. However, irrigation at 100, 80 and 60% with daily, once in two days and once in three days irrigation scheduling did not showed significant difference in acidity of tomato fruit during second year. Whereas, interaction was found to be significant and 60% irrigation with once in three days irrigation scheduling noted lower acidity (3.05) followed by 80% irrigation with once in two days irrigation scheduling (3.55). Drip irrigation system lowers acidity in banana was observed [24].

Effect of irrigation scheduling on fruit firmness

Significant difference was noted among the irrigation scheduling but there was no significant difference among irrigation at 100, 80 and 60% ET (Table-1). Irrigation scheduling with once in two days proved maximum firmness of tomato fruit (3.53) followed by irrigation scheduling once in three days irrigation (3.39 Kg/cm^2) during first year of investigation. Whereas, no Significant difference was noted among the 100, 80 and 60% irrigation with daily, once in two days and once in three days irrigation scheduling during second year. But irrigation scheduling with once in two days proved maximum firmness of tomato fruit (6.01 Kg/cm^2) than daily and once in three days irrigation. However, irrigation at two days and three days were at par.

Table-1: Effect of drip irrigation scheduling on TSS, acidity and firmness in tomato

Treatments	TSS (^{0}Brix)		Acidity		Firmness (Kg/cm^2)	
	1st year	2nd year	1st year	2nd year	1st year	2nd year
Main plots						
I_1 (100%ET)	3.23	4.80	4.00	3.19	3.36	5.81
I_2 (80%ET)	3.31	4.51	5.44	3.59	3.49	6.05
I_3 (60%ET)	3.29	4.88	5.21	3.39	3.22	5.97
C.D	**N.S**	**0.24**	**0.17**	**N.S**	**N.S**	**N.S**
Sub-Plots						
S_1 (Daily)	3.09	4.74	4.28	3.26	3.15	5.84
S_2 (2 days)	3.43	4.75	5.06	3.54	3.53	6.01
S_3 (3 days)	3.31	4.69	5.30	3.37	3.39	5.98
C.D	**0.19**	**N.S**	**0.52**	**N.S**	**0.29**	**N.S**
$I_1 S_1$	2.97	4.97	4.73	3.07	3.21	5.95
$I_1 S_2$	3.43	4.97	6.18	3.86	3.52	5.87
$I_1 S_3$	3.30	4.47	5.41	3.23	3.37	5.60
$I_2 S_1$	3.20	4.27	3.36	3.40	3.10	5.58
$I_2 S_2$	3.40	4.52	3.78	3.55	3.79	6.27
$I_2 S_3$	3.33	4.73	4.85	3.82	3.58	6.30
$I_3 S_1$	3.10	5.00	4.76	3.32	3.15	5.58
$I_3 S_2$	3.47	4.77	5.23	3.20	3.29	5.90
$I_3 S_3$	3.30	4.87	5.65	3.05	3.21	6.03
C.D	**N.S**	**N.S**	**N.S**	**0.45**	**N.S**	**N.S**

SUMMARY

Under changing climate scenario yield and quality of most crops are affected due to increasing temperature and decreased water availability. Improved irrigation technologies like drip irrigation are the need of the time to maintain yield and quality of produce especially in vegetables. The result obtained from the experimentation concluded that drip system is very effective and efficient method of irrigation for enhancing post harvest quality of tomato fruit and the scheduling of irrigation once in three days at 80% ET through drip systems was suitable for improving TSS, acidity and firmness of tomato fruits.

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