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Bio-Efficacy Evaluation of Ethephon 39% Sl on Tomato (*Solanum Lycopersicum* L.) Fruits

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ABSTRACT

The present experiment was undertaken to study the effect of ethephon 39%SL on post-harvest quality of Tomato fruits (*Solanum lycopersicon* L.). The mature green tomato fruits were subjected to aqueous solution of ethephon 39%SL @ 1500, 2000, 2500, 3000 and 3500 ppm to record the data on colour development of fruit. Colour of fruits was observed to be improved with ethephon applications and maximized yellow colour development was noticed from 5th day of ripening period. The weight loss higher with concentration of ethephon and ripening interval. Upto 7th day of treatment fruit not showed any symptoms of rotting. But fruit firmness gradually reduced with advancement of storage in the treatments and at 3500ppm ethephon 39%SL treatment. The quality of fruit especially lycopene and TSS content increased with advancement of ripening period. Treatment with ethephon 39%SL @ 2500 ppm resulted in adequate ripening of fruits with uniform red colour, acceptable quality and better than all treatments of ethephon.

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Introduction

Tomato is one of the commercially grown vegetable crop stands third position after potato and sweet potato, occupying an area of 4.81 million hectare with an annual global production of 163.02 million tonnes [5]. It is also popular in India and occupies an area of 8.82 lakh hectares with a production of 18.74 million metric tonnes with an average yield of 21.2 metric tonne per hectare [7]. In West Bengal total area under tomato cultivation is 56,500 ha, production is 11, 41,500 tones and productivity is 20.2 [7].

Tomato contains wide range of flavonoids/phyto-chemicals, carotenoids and phenolic compounds

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especially lycopene, vitamin A, vitamin C. The lycopene imparts red colour to fruits and serves as anti oxidant, β-carotene serves against free radical chain reaction and vitamin C is the efficient scavenger of free radicals[9]. The fruits harvested at suitable stage influences nutritional quality and storage life. The fruits picked at mature green stage remained best to reduce injury in post-harvest handling. The fruits attain desirable flavour, quality, colour, palatable nature and other textural properties while in storage. Ripening is associated with change in composition i.e. conversion of starch to sugar. Additional to normal ripening process, it can be attained by application of ethephon[21]. Shelf life is supreme aspect in terms of reduce in post-harvest losses. The tomato fruits treated with several chemicals and growth regulators to improve shelf life, uniform ripening and quality parameters like carotenoids and total phenol content[19].Ethephon or ethrel (2-chloroethylphosphonic acid) is known as a plant growth regulator which stimulates uniform ripening of fruit and reducing post-harvest damage[16].The suggested ethephon residue level is 2 mg/kg of tomato fruits[2]. The ethephon available in different commercial forms is being used for ripening of mature green tomato fruit. In fact information regarding minimum quantity of ethephon for ripening and storage of tomato fruit is still inadequate.

Table 1: Effect of ethephon 39%SL treatment on percent physiological weight loss of tomato fruit

	Treatment	Concentration (a.i ppm)	Initial fruit weight (kg)	Per cent fruit weight loss after 20 days
T1	Ethephon 39% SL	1500	2.869	12.598
T2	Ethephon 39% SL	2000	2.852	14.735
T3	Ethephon 39% SL	2500	2.855	18.581
T4	Ethephon 39% SL	3000	2.862	21.661
T5	Ethephon 39% SL	3500	2.835	28.136
T6	Untreated control	-	2.805	11.397
	S.E. +			-0.08
	CD (P=0.05)			-2.61

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Table 2: Effect of ethephon 39%SL treatment on tomato fruit abscission (rotting)

	Treatment	Concentration (ai ppm)	Per cent fruit rotting before treat-ment	Per cent fruit rotting (days after treatment)						
				1	3	5	7	10	15	20
T1	Ethephon 39% SL	1500	0	0	0	0	2.5	3.75	6.25	7.5
T2	Ethephon 39% SL	2000	0	0	0	0	1.25	3.75	6.25	8.75
T3	Ethephon 39% SL	2500	0	0	0	0	0	1.25	5	10
T4	Ethephon 39% SL	3000	0	0	0	0	1.25	5.75	6.25	10
T5	Ethephon 39% SL	3500	0	0	0	0	0	2.5	7.5	12.5
T6	Untreated control	-	0	0	0	2.25	6.25	7	9.5	11.75
	S.E. +						-1.25	-1.39	-1.55	-1.22
	CD (P=0.05)						-3.78	-4.2	-4.68	-3.7

Figures in additions are angular renovated ethics (x + 0.5)

Keeping this view in perspectives, the present experiment was conducted to standardize the bio efficacy of ethephon 39% SL on tomato fruits.

Materials and Methods

The present experiment was undertaken to study the effect of ethephon 39% SL on post harvest quality of Tomato (*Solanum lycopersicon* L.)cv. Pan 1286at Dept. of Vegetable Crops, Faculty of Horticulture, BCKV, Mohanpur. The crop has grown during winter season by following standard and recommended package of practices for cultivation of the crop uniformly in all the plots. The product was applied as postharvest treatment for uniform ripening and to increase market value. Required concentrations of ethephon 39% SL @ 1500, 2000, 2500, 3000 and 3500ppm were prepared before treatment by diluting 1% stock solution prepared in 4.00 litres of water in clean and fresh beaker for dipping the fruits uniformly.

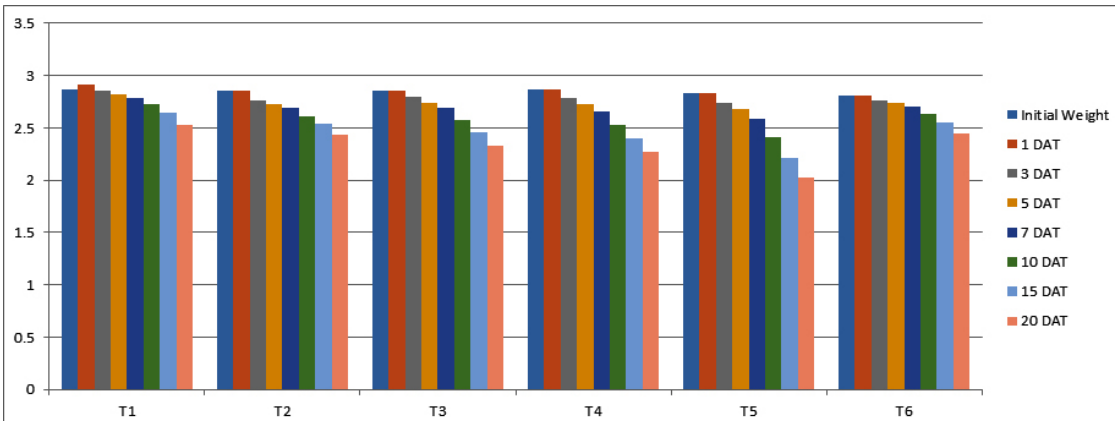

Fig.1: Effect of ethephon 39% SL treatment on physiological fruit weight loss of tomato

Table 3: Effect of Ethephon 39%SL treatment on fruit toughness (softening)

Treatment	Concentration (ai ppm)	Fruit toughness before treatment	Fruit toughness (softening) after treatment (days after treatment)						
			1	3	5	7	10	15	20
T1 Ethephon 39% SL	1500	Firm	Firm	Firm	Softening	Softening started	Soft continued	Soft	Very soft
T2 Ethephon 39% SL	2000	Firm	Firm	Firm	Softening	Softening started	Soft continued	Soft	Very soft
T3 Ethephon 39% SL	2500	Firm	Firm	Firm	Softening	Soft started	Soft	Very soft	Very Soft
T4 Ethephon 39% SL	3000	Firm	Firm	Firm	Softening	Soft started	Soft	Very soft	Very Soft
T5 Ethephon 39% SL	3500	Firm	Firm	Softening	Soft started	Soft	Very Soft	Very Soft	Pulpy and juicy
T6 Untreated control	-	Firm	Firm	Firm	Firm	Firm	Firm	Softening started	Soft

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The fresh, mature green fruits of uniform size were selected each plot and dipped into solution of different concentrations separately for a uniform period of one minute, left for drying at room temperature on clean and dry surface. In case of control treatment fruits were dipped into normal water. All the treatments were replicated four times. There after fruits (treated and untreated) were placed separately for ripening at room temperature of 26+2°C and 70+5% relative humidity. The observations were made visually on randomly selected 10 fruits from each of four replications per treatment after 1, 3, 5, 7, 10, 15 and 20 days of treatment. The parameters taken in to consideration for the study were change in fruit colour, weight of fruit, fruit ripening status, quality parameters like TSS, titrable acidity, lycopene and ascorbic acid content in fruits and effect on shelf life of fruits. The data recorded was analysed statistically where ever required after requisite transformation using OPSTAT. The readings were taken from initial to 20 days for each treatment. The loss in fruit weight was taken for every storage interval on the fresh weight basis. Fruit weight loss was calculated by estimating the percentage ratio between reduction in fruit weight (difference between initial weight and final weight) and initial weight of treated fruits.

The visual observations (shriveled, damaged and rotten) are taken to determine decay or rotting of the stored tomato fruits. The rotting percentage of stored tomato fruits was counted as number of rotten fruits divided by initial quantity of fruits multiplied with 100.The visual appearance of tomato fruit was considered for analyzing firmness of tomato fruits precisely.

The quality parameters like TSS, titrable acidity, lycopene and ascorbic acid were estimated by using standard methods[13, 12, 20].

The trial was conducted using Randomized Block Design (RBD) with four replications. The obtained information have been subjected for analysis of variance (ANOVA) with MSTAT-C. The mean of the treatments was compared for statistical differences at 5%.

Results and Discussion

Effect of ethepon 39% SL on weight loss (PLW(%) of tomato fruit

The fresh fruit weight and further physiological weight loss during storage at specific time intervals (1, 3, 5, 7, 10, 15 and 20 days) have been presented

Table 4: Evaluation of ethephon 39%SL on Quality parameters of tomato fruit

S. No	TSS (0Brix)		TITRABLE ACIDITY (%)		LYCOPENE (mg/100gm)		ASCORBIC ACID (mg/100gm)	
	Imme-Diate After Treat-Ment	20 days after treat-ment	immedia-te after trea-tment	20 days after trea-tment	immedia-te after trea-tment	20 days after tre-atment	immedia-te after trea-tment	20 days after trea-tment
1	5.95	6.875	0.4775	0.112	4.535	4.9325	18.74	16.725
2	5.95	6.8	0.485	0.175	4.5575	5.0075	18.805	16.325
3	5.8	7.325	0.4725	0.1925	4.4375	5.1775	18.6925	15.292
4	6.025	7.3	0.45	0.26	4.435	5.2	18.6575	15.735
5	6	7.65	0.4625	0.27	4.6075	5.5625	18.605	13.647
6	6	6.55	0.475	0.31	4.3825	4.695	18.84	16.34
CD	N/A	0.227	N/A	0.024	N/A	0.456	N/A	1.654
SE(m)	0.128	0.075	0.009	0.008	0.149	0.15	0.559	0.544
CV	4.292	2.109	3.618	7.058	6.632	5.886	5.966	6.937

Figures in additions are angular renovated ethics

in figure-1and table 1. It was observed that there was a progressive weight loss in the fruits irrespective of treatments. However, the rate of weight loss was significantly higher with the treatment of ethephon 39% SL @ 3500 ppm as compared to lower concentrations as well as control treatment and this finding was similar to results obtained by Mahajan *et al.*, (2010). The percent fruit weight loss of was recorded in table-2, after 20 days maximum fruit weight loss percent 28.136% was recorded with the treatment of ethephon 39%SL @ 3500 ppm. The weight loss with the treatments of ethephon 39% SL @ 1500 and 2000 ppm was 12.598% and 14.735%respectively which was more or less comparable to control fruits (11.397).It was observed that there was a progressive weight loss in the fruits irrespective of treatments might be due to dehydration of water from soft tissue[8].

Effect of ethepon 39% SL on abscission (rotting %) of tomato fruit

Effect of ethephon (39%) SL on fruit abscission is considered to be the main parameter of the experiment which had been critically observed during the experiment and showed in table 2. No fruit rotting was observed up to 5 days of treatment in any of the ethephon treatment, however, 2.25%of fruit rotting was recorded in control. In other treatments fruit rotting was recorded from seventh day onwards. On twentieth day fruit rotting percentage increased to 12.50% with the treatment of ethephon 39% SL 3500 ppm followed by its lower doses of 1500, 2000, 2500 and 3000 ppm ranging from 7.50%, 8.75 to 10% respectively. According to other reports rotting percentage of tomato fruits increased with concentration of ethephon (2000-2500ppm)is agreement with present results[3]. The fruit rotting of 11.75%was observed from the control treatment.

Effect of ethephon 39% SL on softening of tomato fruit

The fruit quality in terms of toughness (fruit softening) was also recorded and observations made have been presented in Table 3. The fruits were firm up to 3 days after dipping in the treatments of ethephon 39%SL however, fruit softening started in the treatment of ethephon 39% SL @ 3500 ppm and fruits became soft by 5th day in this treatment. The fruits became soft by 7 and 10 days in the remaining treatments of ethephon 39% SL respectively and very soft by 20 days. The fruits became more pulpy and juicy by 20 days with the treatment of ethephon 39%SL @ 3500 ppm and practically less preferred by the consumers. In comparison, fruits were firmed up to 10 days in the control treatment and turned soft by 20 days. The reduction of soluble pectin due to polygalacturonase resulted into softening of flesh in fruits [4; 3].

Effect of ethephon 39% SL on quality of tomato fruits: The TSS, lycopene, ascorbic acid and titrable acidity content were determine the quality of fruit in general i.e. taste and others characters of the fruit has been presented in table 4. Before imposing the treatments all the quality characters contents were almost similar though there were few differences which may be due to the physiological maturity of individual fruit. After 20 days of storage TSS content of the fruits increased to some extent. The maximum variation of 6 to 7.65 ^{0}Brix was observed under ethepon 39%SL @3500ppm followed by ethepon 39%SL @ 3000ppm and the lowest variation of 6 to 6.55 ^{0}Brix was observed in control fruits. Titrable acidity and ascorbic acid content were also slightly decreased in all the treated fruits including control[10; 15]. The maximum decreasing tendency of titrable acidity and ascorbic acid content after 20 days of storage were also observed under ethephon 39% SL@3000ppm followed by ethephon 39% SL@2500ppm as shown in table 5. The decreasing trends of 18.84-16.34 mg/100g ascorbic acid content of fruit was observed in control plants which was lowest among all treatments[18].Lycopene contents of fruit was also increased to some extent after 20 days of storage it is due to enhanced respiration rate obtained from uniform ripening of fruit [6; 11; 1].The increasing tends of lycopene content was found more under ethephon 39%SL@3500ppm followed by ethephon 39% SL @ 3000ppm i. e. 5.56 and 5.2 mg/100gm of fresh weight and lowest in control plants. As from above results it shows that ethephon 39% SL at 2500ppm was found to be the best for the quality characters.

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