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Effect of different concentrations of ethephon on ripening and quality of tomato (*Lycopersicon esculentum*)

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Abstract
An investigation was conducted at Agriculture Lab, Department of Agriculture, D.A.V College Abohar, and Punjab during the academic year 2018 to study the effect of different concentrations of ethephon on ripening and quality of Tomato. The mature green tomato fruits were dipped in aqueous solution of ethephon at 500, 1000 or 1500 ppm for 5 minutes. The fruits were kept at ambient temperature. The physico-chemical parameters of fruits mature green to senescent stage of maturation were analyzed. The different treatments showed variation in physical and chemical characters. It was observed that maximum change in fruit length and breadth was observed in 500ppm ethephon. The obtained results indicated that there was a gradual increase in TSS values with the advancement in days after treatment. Treatment with ethephon resulted in adequate ripening of fruits after 8 days with uniform red color and acceptable quality. The untreated fruits were hard texture and poor in colour and quality. The ripening with ethephon treatment seems to hold promise in reducing postharvest losses.

Keywords: Ethephon, ripening, tomato, quality

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 (Thapa *et al*) [1]. Tomato is a rich source of vitamin A and C and is referred as "poor man's orange". Among fruits and vegetables, tomato ranks 16th as a source of vitamin A and 13th as a source of vitamin A. Lycopene that imparts red colour to ripe tomatoes is reported to possess anti-cancerous properties. Tomato ripening is characterized by loss of chlorophyll and rapid accumulation of carotenoids, particularly lycopene, as chloroplasts are converted to chromoplasts (Dhall and Singh) [2]. Per 100 g fresh fruit contains 95.5 g moisture, 1.1 g protein, 4.7g carbohydrates, 900IU vitamin A, 23 mg vitamin C, 0.7 g niacin, 13 mg calcium, 27 mg phosphorus and 0.5 mg iron. Tomato is also one of the important sources of lycopene, a powerful natural antioxidant used in pharmaceuticals (Dhaliwal) [3]. Tomatoes are very valuable vegetables due to their nutritional benefits. Tomato fruit quality has been assessed by the content of different chemical compounds such as citric, ascorbic and other organic acids, sugars, minerals, antioxidants and characterized with dry matter. The most important antioxidants in tomatoes are carotenoids, especially Lycopene. Tomato fruit colour is one of the important indices of tomato maturity and quality. It is known that the colour of tomato fruits changes during ripening. The green colour of unripe tomato fruits is due to the presence of chlorophyll and reddish colour due to the accumulation of lycopene (Duma *et al*) [4].

Materials and Methods
The study was carried out on tomato (*Lycopersicon esculentum*) fruits. Fruits were taken from Babbar fruits and vegetable company, Abohar Tehsil, Fazilka (Punjab). Fruits were brought to Agriculture Lab, D.A.V College, Abohar. The objective of the study was to calculate physical characteristics such as change in fruit length, change in fruit breadth, physiological loss in

weight and chemical characteristics such as TSS (Total Soluble Solids) and titratable acidity. The length and breadth of each fruits was measured using vernier's calliper and was expressed in millimeters. The specific gravity of fruits was determined by using formula – Weight of fruit (g)/Volume of water displaced by fruits (ml). The total soluble solids of each fruit were measured by the index of refraction. This was measured by using a Refractometer and is referred as ^{0}Brix. Titratable acidity of each fruit was measure the concentrations of titratable hydrogen ions contained in the fruit juice samples by neutralization with strong base solution at fixed pH.

Treatments

T_1 - 500ppm ethephon
T_2 - 1000ppm ethephon
T_3 - 1500ppm ethephon
T_4 - Control

Results and Discussions

Change in Fruit Length

From the experiment, it has been observed that maximum change was in T_1 followed by T_2 and T_4. Minimum change in fruit length was under T_3, after 8 days and it was par with T_4, T_2 and significantly differ from T_1. T_1 was at par with T_2, T_4. So decrease in fruit length is observed. The findings of this research are similar with that of Bakshi *et al* [5] who concluded that maximum fruit length was observed in 200 ppm i.e. 8.34cm and minimum fruit length was observed in control fruits.

Change in Fruit Breadth

From the experiment, it has been observed that maximum change in fruit breadth was under T_1 followed by T_3 and T_4. Minimum change in fruit breadth was under T_2, after 8 days and it was par with T_4 and significantly differ from T_3.T_1 was at par with T_3, T_4. Similarly, Meena *et al* [6] found that the maximum fruit breadth in fruits treated with T_4 GA_3 @150 ppm.

Specific gravity

The specific gravity of fruits was found markedly decreased with increasing day of ripening. From the experiment, it has been observed that minimum specific gravity was under T_3, after 8 days and it was par with T_2 and significantly differ from T_1. Maximum change was in T_4 followed by T_1 and T_2. T_4 was at par with T_1, T_2. Kaur [7] studied that the fruits treated with 1000ppm ethrel had maximum specific gravity while minimum was recorded in control fruits. Similarly, Gupta *et al* [8] concluded that the maximum specific gravity was recorded in fruits treated with ethrel.

Total Soluble Solids

From the experiment, it has been observed that minimum TSS was under T_4 in control after 8 days and it was significantly differ than all other treatments. Maximum TSS was in T_3 followed by T_2 and T_1. T_3 was at par with T_2 and T_1. So decrease in TSS content is observed. From the initial days of experimentation TSS content increases with the ripening period increases. The increase in TSS during ripening may result from an increase in concentration of organic solutes as a consequence of water loss. Similarly, Bons *et al* [9] gave similar results that the treated fruits having higher TSS content as compared to fruits under control. They concluded that fruits treated with ethephon 1000 ppm had higher TSS i.e. 17.45^0 Brix.

Titratable acidity

The amount of acidity in tomato fruit decreases gradually during the entire period of ripening. From the experiment, it has been observed that minimum titratable acidity was under T_4 after 8 days and it was par with T_3 and significantly differs from T_1 and T_2. Maximum titratable acidity was in T_1 and T_2 followed by T_3 and T_1. Both treatments T_1 and T_2 give good result. Same trend was observed in other treatments titratable acidity decreases upto 8 days of ripening. Singh and Janes [10] studied that the fruits treated with control had maximum results and minimum titratable acidity was found in ethephon 2000 ppm.

Observations and Tables

Table 1: Effect of different concentrations of ethephon on change in fruit length (cm)

Days Interval of observation	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8
T_1	0	3.04	2.64	2.79	3.80	2.22	2.24	3.54
T_2	0	-0.57	-1.53	-0.73	-0.62	-0.15	0.25	3.30
T_3	0	2.43	2.22	-0.46	-0.48	0.82	1.24	1.95
T_4	0	-1.55	-0.97	1.88	0.83	3.13	1.79	3.29
CD	0	3.02	2.95	2.62	3.02	2.30	1.33	1.16

Table 2: Effect of different concentrations of ethephon on change in fruit breadth (cm)

Days Interval of Observation	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8
T_1	0	0.70	0.84	1.61	2.50	2.71	2.87	2.92
T_2	0	0.42	0.90	2.90	0.07	0.68	0.43	0.70
T_3	0	- 4.07	0.89	0.85	2.06	1.56	0.75	1.61
T_4	0	0.17	0.81	1.07	1.57	1.53	1.33	1.07
CD	0	0.92	0.06	1.05	1.62	1.14	1.53	0.89

Table 3: Effect of Different concentrations of ethephon on Specific gravity (gm/ml)

Days Interval of Observation	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8
T_1	0.88	0.91	0.85	0.82	0.91	0.86	0.83	0.99
T_2	0.78	0.96	0.85	0.85	0.92	0.76	0.73	0.95
T_3	0.91	0.93	0.90	0.89	0.97	0.87	0.88	0.93
T_4	0.78	1.09	0.81	0.99	1.12	0.76	0.76	1.08
CD	0.05	0.11	0.05	0.06	0.06	0.04	0.05	0.14

Table 4: Effect of different concentration of ethephon on Total Soluble Solids (^{o}Brix)

Days Interval of Observation	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8
T_1	4.80	4.86	4.96	4.30	5.03	4.7	4.9	5.1
T_2	5.0	4.56	4.80	4.36	4.20	5.0	4.6	5.3
T_3	5.10	5.0	5.43	4.20	4.21	4.56	5.1	5.4
T_4	4.50	4.40	4.60	5.0	4.23	4.0	4.4	3.9
CD	0.31	0.22	0.22	0.27	0.26	0.32	0.31	0.21

Table 5: Effect of different concentration of ethephon on Titratable acidity (%)

Days Interval of Observation	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8
T_1	0.69	0.68	0.66	0.47	0.49	0.41	0.39	0.40
T_2	0.67	0.60	0.44	0.41	0.42	0.32	0.33	0.40
T_3	0.60	0.49	0.31	0.37	0.36	0.31	0.34	0.25
T_4	0.82	0.80	0.38	0.44	0.42	0.25	0.24	0.22
CD	0.04	0.03	0.03	0.02	0.02	0.03	0.03	0.03

Conclusion

The results concluded from the present investigation that the tomato fruit when treated with different concentrations of ethephon showed significant effect on physic-chemical characters. All the treatments also showed significant differences among each other. Fruits were treated with different treatments of ethephon and fruits were ripened at ambient conditions.

It was observed that fruits dipped in ethephon resulted in better ripening of fruits after 8 days with high TSS, lower acidity and acceptable quality. Control fruits showed uneven ripening. Minimum decrease in fruit length and breadth was observed in fruits treated with ethephon of 1000ppm. The research revealed that TSS was maximum in 1500 ppm ethephon.

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