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Influence of Seaweed Gel on Quality of Tomato Hybrid COTH 2

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Field as well as laboratory experiment were conducted to study the influence of seaweed gel on quality parameters in tomato hybrid COTH 2 at Coimbatore during 2008-09. There were ten treatments including one absolute contr ol. The seaweed gel influence the quality parameters like TSS($_o$ brix), titrable acidity(%), ascorbic acid (mg 100 g^{-1}), total sugar (%), lycopene (mg 100 g^{-1}) content and were found higher in the plants applied with NPK @ 200:300:200 kg ha^{-1} + O6 EM and MA GEL @ 12.5 kg acre^{-1} + O6 EM and MA GEL 1% spray T_7.

Key words: quality parameters, seaweed gel, titrable acidity, EM and MA Gel.

The tomato fruit is consumed in diverse ways as raw, as an ingredient in dishes and sauces. It is considered a vegetable for culinary. The fruit is rich in *lycopene,* which may have beneficial health effects. Seaweed extract contains growth promoting hormones (Hong *et al.,* 1995; Mostafa *et al.,*1999; Rengasamy, 2004; Arumugam *et al.,* 2008; Rajalakshmi *et al.,* 2008) *viz*., cytokinin like substances (Hussian *et al.,* 1973; Finnie and Van Staden, 1985; Mooney and Van Staden, 1986) and gibberellins like substances (Kingman and Moore, 1982; and Kannathasan *et al.,* 2008). The seaweed extract prepared from *Sargassum* (20%) as seed treatment had significant by increased carotenoid, protein, sugar and lipid contents in bhendi and tomato (Selvaraj *et al.,* 2004). Hence the attempt was made to study the effect of seaweed gel on quality parameters of tomato.

Materials and Methods

An experiment was conducted to study the effect of seaweed gel on quality parameters of tomato (*Solanum lycopersicon* Mill.) hybrid COTH 2 at Department of Vegetable Crops, Horticultural College and Research Institute, Coimbatore during 2008-09.

O6 EM and MA GEL is a product of Bio Organic Technology (SNAP Natural and Alginate Products Ltd., Ranipet, Tamilnadu). O6 is a stabilized gel type sea algae base concentrate containing a consortium of beneficial bacteria, which acts as a microbial innoculant in the soil. EM (Effective Microorganism) consists of both aerobic and anaerobic beneficial bacteria such as photosynthetic bacteria, nitrogen fixing bacteria and phosphate solubilizing bacteria. MA (Micro Algae) is an efficient N-fixing Micro Algae, such as *Chroococus turgidus* the combined product of O6 EM and MA was easy to dissolved in water and applied in the soil. The soil drenching was done at five stages *viz.,* initial, vegetative, flowering, fruiting and harvesting stage. Foliar application was also done at three stages *viz*., vegetative, flowering and fruiting stage as per the treatment schedule.

The experiment was laid out in red sandy loam in Randomized Block Design with ten treatment combinations replicated thrice. The plot size was 4 m x 3 m and spacing followed was 60 cm x 45 cm. Observations on quality characters were recorded in five randomly selected plants.The soil was brought to fine tilth by giving four deep ploughing. At the time of last ploughing, FYM was applied at the rate of 10 t ha^{-1}. After leveling, beds were formed to accommodate the treatments. Black polythene mulch sheet of 50 gauge thickness was laid in the bed to keep the beds free of weeds to the maximum extent and to conserve the soil moisture. Paired row system of planting was followed and then the holes are put on either side of the mulching sheet covering the bed at recommended spacing of 60 cm X 45 cm. Fertilizers at the rate of 200: 300: 200 kg ha^{-1} were applied as urea (435 kg), superphosphate (1875 kg) and Murate of potash (333 kg) as source of N, P and K respectively. The full dose of phosphorus and potash fertilizers and half of the dose of nitrogenous fertilizers were applied at the time of transplanting and the remaining half dose of nitrogenous fertilizer was applied 25 days after transplanting as top dressing. Drip irrigation was resorted for irrigating the field. The plants were staked with bamboo poles of one metre height at 30 days after planting to prevent lodging as the hybrid is semi determinate.

Results and Discussion

Tomato fruit quality is judged by TSS, pH, acidity and ascorbic acid content of the juice. These qualities are important when it goes to industry for the development of products like jam, juice, sauce,

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ketchup and puree. In the present study NPK @ 200:300:200 kg ha^{-1} + O6 EM and MA GEL @ 12.5 kg acre^{-1} + O6 EM and MA GEL 1% spray (T_7) were found to be most effective treatment in increasing juice content of fruits in both the seasons.

Total Soluble Solids (TSS)

The significant difference in TSS of fruit in between treatment and seasons and their interactions, with the mean value of TSS ranged from 4.38^o brix (T_1) to 5.02^o brix (T_7) in the first season

Table 1. Influence of seaweed gel on total soluble solids ($_o$ brix) in tomato

Treatment	TSS ($_o$brix)		
	Kharif (2008-09)	Summer (2008-09)	Mean
T_1 - NPK @ 200:300:200 kg per ha (control)	4.38	4.29	4.33
T_2 - T_1 + O6 EM and MA GEL@7.5 kg acre^{-1}	4.63	4.50	4.56
T_3 - T_1 + O6 EM and MA GEL@10 kg acre^{-1}	4.72	4.71	4.71
T_4 - T_1 + O6 EM and MA GEL@12.5 kg acre^{-1}	4.73	4.72	4.72
T_5 - T_2 + O6 EM and MA GEL 1% spray	4.78	4.65	4.73
T_6 - T_3 + O6 EM and MA GEL 1% spray	4.86	4.83	4.84
T_7 - T_4 + O6 EM and MA GEL 1% spray	5.02	4.99	5.00
T_8 - Vermicompost (2.5 t ha^{-1})	4.73	4.67	4.70
T_9 - Vermicompost (2.5 t ha^{-1}) + O6 EM and MA GEL@12.5 kg acre^{-1}	4.80	4.80	4.80
T_{10} - Vermicompost (2.5 t ha^{-1}) + O6 EM and MA GEL@12.5 kg acre^{-1} + O6 EM and MA GEL 1% spray	4.86	4.82	4.84
Grand mean	4.68	4.63	
SEd	0.091	0.091	
CD(P=0.05)	0.193	0.191	

and from 4.29^o brix (T_1) to 4.99^o brix (T_7) in the second season (Table.1).

It was found that the TSS of fruit juice was influenced by seaweed extract. to higher level in both the seasons. In the Naveline orange, 'GEOMAR' a product containing seaweed extract resulted in increased TSS content (Frones 1995). The results of the present study are in agreement with the above report.

The specific requirement of tomato juice for processed product would not be less than 4-5 per cent TSS and maximum of 0.45 per cent acidity. Thus for acidic genotypes it would be better to go for foliar spray like seaweed extract to increase the pH without sacrificing the TSS or sometimes increasing the later.

Table 2. Influence of seaweed gel on Titrable acidity (%) of the fruit in tomato

Treatment	Titrable acidity (%)		
	Kharif (2008-09)	Summer (2008-09)	Mean
T_1 - NPK @ 200:300:200 kg per ha (control)	0.49	0.47	0.48
T_2 - T_1 + O6 EM and MA GEL@7.5 kg acre^{-1}	0.49	0.47	0.48
T_3 - T_1 + O6 EM and MA GEL@10 kg acre^{-1}	0.49	0.48	0.49
T_4 - T_1 + O6 EM and MA GEL@12.5 kg acre^{-1}	0.52	0.49	0.51
T_5 - T_2 + O6 EM and MA GEL 1% spray	0.51	0.50	0.50
T_6 - T_3 + O6 EM and MA GEL 1% spray	0.53	0.49	0.51
T_7 - T_4 + O6 EM and MA GEL 1% spray	0.56	0.54	0.55
T_8 - Vermicompost (2.5 t ha^{-1})	0.51	0.49	0.50
T_9 - Vermicompost (2.5 t ha^{-1}) + O6 EM and MA GEL@12.5 kg acre^{-1}	0.51	0.51	0.51
T_{10} - Vermicompost (2.5 t ha^{-1}) + O6 EM and MA GEL@12.5 kg acre^{-1} + O6 EM and MA GEL 1% spray	0.50	0.49	0.50
Grand mean	0.50	0.49	0.50
SEd	0.009	0.009	
CD(P=0.05)	0.020	0.020	

Titrable acidity

Significant difference in acidity of fruits was observed between treatments (Fig.1). The mean

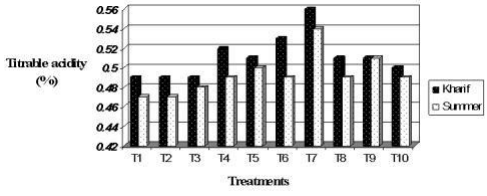

Fig. 1. Influence of seaweed gel on titrable acidity (%) in tomato

values ranged from 0.49 (T_1) to 0.56 (T_7) per cent in the first season and from 0.47 (T_1) to 0.54 (T_7) per cent in the second season (Table 2 , Fig. 1).

Acidity is yet another factor that decides the quality of fruit juice. A proper blend of soluble solids and acidity gives the flavour for the resultant product of any fruit namely, jams, sauce, ketchup etc. Treatment with seaweed gel resulted in a drastic drift to lower down the acidity. The highest drop in it was seen under NPK @ 200:300:200 kg ha^{-1} + O6 EM and MA GEL @ 12.5 kg $acre^{-1}$ + O6 EM and MA GEL 1% spray(T_7) followed by (NPK @ 200:300:200 kg ha^{-1} + O6 EM and MA GEL @ 10 kg $acre^{-1}$ + O6 EM and MA GEL 1% spray (T_6). It was observed that

Table 3. Influence of seaweed gel on Ascorbic acid (mg 100 g^{-1}) of the fruit in tomato

Treatment	Ascorbic acid (mg 100 g^{-1})		
	Kharif (2008-09)	Summer (2008-09)	Mean
T_1 - NPK @ 200:300:200 kg per ha (control)	22.65	22.06	22.35
T_2 - T_1 + O6 EM and MA GEL@7.5 kg acre^{-1}	22.87	22.08	22.47
T_3 - T_1 + O6 EM and MA GEL@10 kg acre^{-1}	22.98	22.14	22.56
T_4 - T_1 + O6 EM and MA GEL@12.5 kg acre^{-1}	24.76	23.83	24.29
T_5 - T_2 + O6 EM and MA GEL 1% spray	24.98	23.87	24.42
T_6 - T_3 + O6 EM and MA GEL 1% spray	26.34	26.12	26.23
T_7 - T_4 + O6 EM and MA GEL 1% spray	26.87	26.65	26.76
T_8 - Vermicompost (2.5 t ha^{-1})	25.65	24.75	25.20
T_9 - Vermicompost (2.5 t ha^{-1}) + O6 EM and MA GEL@12.5 kg acre^{-1}	25.53	25.21	25.37
T_{10} - Vermicompost (2.5 t ha^{-1}) + O6 EM and MA GEL@12.5 kg acre^{-1} + O6 EM and MA GEL 1% spray	25.87	25.45	25.66
Grand mean	24.52	23.90	
SEd	0.483	0.471	
CD(P=0.05)	1.016	0.991	

seaweed gel at specific concentration can tilt the overall quality by significant increasing the TSS with simultaneous slight reduction of acidity thus resulting in optimum soluble solid / acid ratio. This is supported by earlier studies in Naveline Orange by Frones (1995).

Table 4. Influence of seaweed gel on total sugar (%) in tomato

Treatment	Total Sugar (%)		
	Kharif (2008-09)	Summer (2008-09)	Mean
T_1 - NPK @ 200:300:200 kg per ha (control)	2.51	2.14	2.31
T_2 - T_1 + O6 EM and MA GEL@7.5 kg acre^{-1}	2.49	2.17	2.33
T_3 - T_1 + O6 EM and MA GEL@10 kg acre^{-1}	2.63	2.31	2.47
T_4 - T_1 + O6 EM and MA GEL@12.5 kg acre^{-1}	2.81	2.40	2.60
T_5 - T_2 + O6 EM and MA GEL 1% spray	2.85	2.49	2.67
T_6 - T_3 + O6 EM and MA GEL 1% spray	2.91	2.51	2.71
T_7 - T_4 + O6 EM and MA GEL 1% spray	3.21	2.75	2.98
T_8 - Vermicompost (2.5 t ha^{-1})	2.70	2.53	2.61
T_9 - Vermicompost (2.5 t ha^{-1}) + O6 EM and MA GEL@12.5 kg acre^{-1}	2.71	2.54	2.62
T_{10} - Vermicompost (2.5 t ha^{-1}) + O6 EM and MA GEL@12.5 kg acre^{-1} + O6 EM and MA GEL 1% spray	2.81	2.59	2.69
Grand mean	2.73	2.41	
SEd	0.054	0.047	
CD(P=0.05)	0.113	0.099	

Ascorbic acid

Ascorbic acid content ranged from 22.65mg 100 g^{-1} (T_1) to 26.87 mg 100 g^{-1} (T_7) in the first season and from 22.06 mg 100 g^{-1} (T_1) to 26.65 mg 100 g^{-1} in second season (Table. 2). Mean of two season showed that T_7 recorded the highest ascorbic acid content of 26.76 mg 100 g^{-1} followed by T_6 (26.23 mg 100g^{-1}) and T_{10} (25.66 mg 100 g^{-1}).The lowest ascorbic acid was recorded in the treatment T_1 (22.35 mg 100 g^{-1}) (Table 3).

Ascorbic acid or vitamin C is one of the most important qualitative traits especially in the human nutrition point of view. Just like any other organic acid, the synthesis and destruction in the plant system

Table 5. Influence of seaweed gel on Lycopene (mg 100^{-1} g) in tomato

Treatment	Lycopene (mg 100^{-1} g)		
	Kharif (2008-09)	Summer (2008-09)	Mean
T_1 - NPK @ 200:300:200 kg per ha (control)	6.40	6.20	6.30
T_2 - T_1 + O6 EM and MA GEL@7.5 kg acre^{-1}	6.61	6.30	6.45
T_3 - T_1 + O6 EM and MA GEL@10 kg acre^{-1}	6.71	6.40	6.55
T_4 - T_1 + O6 EM and MA GEL@12.5 kg acre^{-1}	6.81	6.40	6.59
T_5 - T_2 + O6 EM and MA GEL 1% spray	6.72	6.50	6.60
T_6 - T_3 + O6 EM and MA GEL 1% spray	6.92	6.72	6.82
T_7 - T_4 + O6 EM and MA GEL 1% spray	7.34	7.01	7.17
T_8 - Vermicompost (2.5 t ha^{-1})	6.58	6.56	6.57
T_9 - Vermicompost (2.5 t ha^{-1}) + O6 EM and MA GEL@12.5 kg acre^{-1}	6.72	6.50	6.61
T_{10} - Vermicompost (2.5 t ha^{-1}) + O6 EM and MA GEL@12.5 kg acre^{-1} + O6 EM and MA GEL 1% spray	6.83	6.43	6.63
Grand mean	6.67	6.41	
SEd	0.130	0.126	

CD(P=0.05)	0.274	0.266

and ultimate availability of it in the fruit juice depends upon the hormonal balance.

Total sugars

The mean values of total sugar of tomato fruits varied significantly between treatment and interactions (Table.3). The first season mean values of total sugar content ranged from 2.51 per cent (T_1) to 3.21 per cent (T_7) and from 2.14 per cent (T_1) to 2.75 per cent (T_7) in second season. Mean of the two season showed that the treatment T_7 recorded the highest total sugar content of 2.98 per cent followed by T_6 (2.71 per cent) and T_{10} (2.69 per cent). The lowest sugar content was recorded in the treatment T_1 (2.31 per cent) (Table 4). This may be due to the presence of micro elements and plant growth regulators especially cytokinin present in the cell sap. The results are in line with the findings of Zodape *et al.,* 2008. Another view is that enhanced chlorophyll concentration with seaweed extracts used in the present study increase sugar contents in both shoot and root systems of *Cyamopsis tetragonoloba*. This is supported by earlier studies in *Vigna catajung* and *Dolichus biflorus* (Anantharaj and Venkatesalu, 2001; 2002).

Lycopsene

The mean values of lycopene of tomato fruits varied significantly between treatment and interactions (Fig.2). The first season mean values of lycopene content ranged from 6.40 mg 100 g^{-1} (T_1) to 7.34 mg 100 g^{-1} (T_7) and from 6.20 mg 100 g^{-}

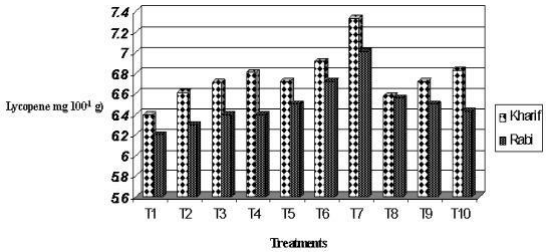

Fig. 2. Influence of seaweed gel on lycopene(mg 100^{-1} g) in tomato

^{1} (T_1) to 7.01 (T_7) in second season. The treatment T_7 recorded the highest lycopene content of 7.17 mg 100 g^{-1} followed by T_6 6.82 mg 100 g^{-1} and T_{10} 6.63 mg 100^{-1} g. The lowest lycopene content was recorded in the treatment T_1 6.30 mg 100 g^{-1} (Table 5, Fig. 2). The results are in line with the findings of Zodape *et al.,* 2008.

Conclusion

It is concluded that the treatment NPK @ 200:300:200 kg ha^{-1} + O6 EM and MA GEL @ 12.5 kg acre^{-1} + O6 EM and MA GEL 1% spray(T_7) recorded the highest quality in tomato. The combined application of inorganic fertilizers and seaweed gel significantly influenced the quality suitable for processing and in the tomato hybrid COTH2.

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