

Seasonal Influence of Seaweed Gel on Growth and Yield of Tomato (*Solanum lycopersicum* Mill.) Hybrid COTH 2

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ABSTRACT

Keywords

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cost ratio.

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A study has been undertaken to study the effect of seaweed gel on growth and yield of tomato at College Orchard, Horticultural College and Research Institute, Coimbatore. There were ten treatments including one absolute control. The trial was laid out in a Randomized Block Design with three replications. The results showed that treatment T₇ receiving NPK @ 200:300:200 kg ha⁻¹ + O6 EM and MA GEL @ 12.5 kg acre⁻¹ + O6 EM and MA GEL 1% spray recorded highest plant height, number of leaves, number of branches and leaf area index. Early flower opening was also recorded in T₇. Individual fruit weight, fruit yield per plant, yield per plot and yield per hectare was found more in T₇ (NPK @ 200:300:200 kg ha⁻¹ + O6 EM and MA GEL @ 12.5 kg acre⁻¹ + O6 EM and MA GEL 1% spray). Benefit Cost Ratio is also high in this treatment.

Introduction

Tomato (*Solanum lycopersicum* Mill.) is one of the most widely grown vegetables in the world. The popularity of tomato among consumers has made it an important source of vitamins A and C in diets. It is popularly grown throughout India in an area of 634.4 (in 000 ha), production of 12433.2 in (000 mt) and productivity of 19.6 (in mt/ha) (Indiastat.com, 2009-10). Inorganic fertilizers are usually quick release forms where nutrients are made rapidly available to plants. Indiscriminate use of chemical fertilizers can build up toxic concentration of salts in the soil creating chemical imbalances and environmental hazards. Seaweed extracts contain natural plant growth regulators (PGR)

such as auxins and cytokinins which control the growth and structural development of plants. Application of seaweed (*Ascophyllum nodosum*) extract solution at one per cent to roots resulted in earlier germination and produced transplants with increased root length and shoot length compared to control in tomato (Poincelot, 1993). Application of seaweed extract (*Ascophyllum nodosum*) at one per cent solution increased the yield from 15.2 to 29.1 % and also improved the pulp consistency and shelf life in tomato (Povolny, 1976). Heckman (1994) reported that application of ROOT PLUS at two per cent solution in the soil before transplanting increased the fresh cabbage yield by 13 %.

Passam *et al.*, (1995) reported that foliar spray of maxicrop (50 ml/l) increased the crop yield and fruit quality in cucumber. The number of fruits per plant, fruit yield per plant and per plot significantly increased with the application of 1680 ppm seaweed extract. With this background, an attempt was made to study the effect of seaweed gel on growth and yield of tomato in College Orchard, Coimbatore.

Materials and Methods

An experiment was conducted to study the effect of seaweed gel on growth and yield of tomato (*Solanum lycopersicum* Mill.) hybrid COTH 2 at College Orchard, Department of Vegetable Crops, Horticultural College and Research Institute, Coimbatore.

O6 EM and MA GEL

It is a proprietary product of Bio Organic Technology (SNAP Natural and Alginate Products Ltd., Ranipet, Tamilnadu). O6 is a stabilized gel type sea algae based concentrate containing a consortium of beneficial bacteria, which acts as microbial inoculants 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 *Chroococcus turgidus*. O6 EM and MA were easy to dissolve in water and drenched in the soil (or) sprayed on the foliage. 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 stages 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 growth and yield characters were recorded at harvest. 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 holes are put in two sides of the mulching sheet at a recommended spacing of 60 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 experiment consists of the following treatments *viz.*

T ₁	NPK @ 200:300:200 kg per ha (control)
T ₂	T ₁ + O6 EM and MA GEL@7.5 kg acre ⁻¹
T ₃	T ₁ + O6 EM and MA GEL@10 kg acre ⁻¹
T ₄	T ₁ + O6 EM and MA GEL@12.5 kg acre ⁻¹
T ₅	T ₂ + O6 EM and MA GEL 1% spray
T ₆	T ₃ + O6 EM and MA GEL 1% spray
T ₇	T ₄ + O6 EM and MA GEL 1% spray
T ₈	Vermicompost (2.5 t ha ⁻¹)
T ₉	Vermicompost (2.5 t ha ⁻¹) + O6 EM and MA GEL@12.5 kg acre ⁻¹
T ₁₀	Vermicompost (2.5 t ha ⁻¹) + O6 EM and MA GEL@12.5 kg acre ⁻¹ + O6 EM and MAGEL 1% spray

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 was semi determinate.

Results and Discussion

Growth parameters

Plant height

The treatment, T₇ (NPK @ 200:300:200 kg ha⁻¹ + O6 EM and MA GEL @ 12.5 kg acre⁻¹ + O6 EM and MA GEL 1% spray) produced significantly taller plants and recorded 45.54 cm, 65.2 cm and 93.2 cm of plant height on 30, 60, 90 days after planting respectively (Table 1) followed by T₆ (NPK @ 200:300:200 kg ha⁻¹ + O6 EM and MA GEL @ 10 kg acre⁻¹ + O6 EM and MA GEL 1% spray) which recorded 40.24 cm, 62.6 cm, 87.6 cm respectively. The lowest plant height was recorded in T₁ (Control) with 38.5cm, 58.5 cm and 84.6 cm respectively at the respective stages. Similar trend was obtained in the second season also. The treatment T₇ registered the higher mean value of 65.1 cm when compared to all the other treatments. The lowest mean value of 54.9 cm was recorded in T₁ (Control).

Increased plant height may be due the macro and micro nutrients as well as growth promoting substances like cytokinin leading to increased growth (Zodape *et al.*, 2011). In addition to this, auxins, IAA in particular supplied through the same seaweed gel enhanced adventitious root formation as well as better growth. Aljuburi and Almarsry (1995) attributed that auxin marginally

increased Relative Growth Rate in Balady lime seedlings. In foliar sprays, an auxin containing product “ROOT PLUS” resulted in taller plants than fertilizer treatment in Broccoli (Russo *et al.*, 1994). The plants treated with *Ascophyllum nodosum* showed increase in plant growth characters (Goswami, 1992). Application of seaweed extract as foliar spray enhance the growth of the plants by making the growth promoting substances available to the plants through absorption and translocation (Ramamoorthy *et al.*, 2007).

Number of branches per plant

Number of branches per plant differed significantly among the treatments (Table 2) at all the growth stages *i.e.*, 30, 60, 90 days after planting. Number of branches progressively increased at all stages of crop growth. Plants treated with (T₇) had significant influence on number of branches per plant and recorded more branches per plant in all the stages (6.3, 10.8 and 13.8) followed by (T₆) which recorded 5.3, 10.3 and 12.8 respectively at 30, 60 and 90 days after planting. The treatment T₁ (Control) recorded the lowest number of leaves per plant at all the five stages of crop growth with the values of 3.5, 8.7 and 11.9. In the second season also the treatment T₇ registered the higher mean value of 9.8 when compared to all the other treatments. The lowest mean value of 7.4 was recorded in T₁ (Control).

Increased number of branches was obtained with the application of seaweed gel by Heckman (1994), while increased shoot growth and total fresh weight (15-20 %) over control was observed by Gendy (1993) in tomato.

Number of leaves per plant

Number of leaves per plant differed significantly among the treatments at all the growth stages *i.e.*, 30, 60, 90 days after

planting. Number of leaves progressively increased at all stages of crop growth (Table 3). Plants treated with T₇ had significant influence on leaf number per plant and recorded more leaf number per plant at all the stages (27.4, 59.4 and 76.9) 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 (T₆) which recorded 25.3, 57.8 and 74.8 respectively. The treatment, T₁ (Control) recorded the lowest number of leaves per plant at all the three stages of crop growth with the values of 19.7, 49.3 and 67.3.

In the summer season treatment T₇ registered the higher mean value of 52.4 when compared to all the other treatments. The lowest mean value of 43.5 was recorded in T₁ (Control). The growth parameters were found increased at lower concentrations of seaweed extract. Similar results were recorded in *Padina* which induced maximum seedling growth in *Cajanus cajan* (Mohan *et al.*, 1994) and *Phaseolus mungo* (Lingakumar *et al.*, 2006).

Leaf Area Index (LAI)

The treatment, T₇ recorded significantly higher LAI (Table 1) value (3.36) followed by the treatment, T₆ which recorded 3.06. The treatment, T₁ (Control) had recorded the lowest LAI (2.33) (Table 4). In the second season the treatment T₇ registered the highest LAI (2.98) followed by T₆ with 2.98, 2.73 respectively. The treatment T₁ (control) recorded the minimum LAI of 2.18. Days to first and 50% flowering:

The treatment, T₇ recorded earliest flower opening (25.1.days) followed by the treatment, T₆ which recorded 25.1 days.

The treatment, T₁ (Control) had taken the longest duration (27.9 days). In the second season, treatment T₇ registered the earlier flower opening (27.7 days) followed by T₆ with 28.2 days. The treatment T₁ (control) recorded the highest duration of 30.4 days.

Table.1 Effect of seaweed extract on plant height of tomato (*Solanum lycopersicum* Mill.) hybrid COH 2

Treatments	Plant height(cm) Kharif				Plant height (cm) Summer			
	30 DAT	60 DAT	90 DAT	Mean	30 DAT	60 DAT	90 DAT	Mean
T ₁	38.5	58.5	84.6	60.5	31.6	51.6	81.5	54.9
T ₂	39.5	59.4	85.6	61.5	35.4	55.4	81.6	57.4
T ₃	39.8	61.2	88.6	63.2	37.2	57.2	83.2	59.2
T ₄	39.5	59.2	85.2	61.3	36.2	56.6	86.6	59.8
T ₅	38.6	58.6	87.6	61.6	34.6	54.6	84.8	58.0
T ₆	40.2	62.6	87.6	63.5	34.4	54.4	91.1	59.9
T ₇	45.5	65.2	93.2	67.0	41.6	61.2	92.6	65.1
T ₈	35.6	55.6	85.5	58.9	34.5	54.5	80.6	56.5
T ₉	38.6	58.2	89.2	62.0	34.2	54.2	84.2	57.5
T ₁₀	38.4	58.4	89.6	62.1	35.2	55.2	85.2	58.5
Grand mean	38.9	58.9	86.2		35.0	54.7	84.3	
SEd	0.76	1.15	1.69		0.68	1.07	1.65	
CD(P=0.05)	1.60	2.43	3.56		1.44	2.26	2.65	

Table.2 Effect of seaweed extract on number of branches of tomato (*Solanum lycopersicum* Mill.) hybrid COTH 2

Treatments	Number of branches Kharif				Number of branches Summer			
	30 DAT	60 DAT	90 DAT	Mean	30 DAT	60 DAT	90 DAT	Mean
	T ₁	3.5	8.7	11.9	8.0	3.2	8.2	11.2
T ₂	3.9	8.9	11.9	8.2	3.4	8.4	11.4	7.7
T ₃	3.8	8.7	11.7	8.1	3.6	8.6	11.6	7.9
T ₄	4.1	9.1	12.2	8.4	3.0	8.2	11.4	7.5
T ₅	4.5	10.2	13.0	9.2	4.0	9.5	12.5	8.6
T ₆	5.3	10.3	12.8	9.4	4.8	9.8	12.8	9.1
T ₇	6.3	10.8	13.8	10.3	5.8	10.3	13.3	9.8
T ₈	5.1	10.3	11.8	9.0	4.2	9.2	12.2	8.5
T ₉	6.1	9.5	12.0	9.2	4.6	9.7	12.6	8.8
T ₁₀	4.7	10.6	12.7	9.3	5.4	9.0	12.4	8.9
Grand mean	4.6	9.6	12.2		4.1	8.9	11.9	
SEd	0.09	0.18	0.24		0.08	0.17	0.23	
CD(P=0.05)	0.19	0.39	0.50		0.17	0.37	0.49	

Table.3 Effect of seaweed extract on number of leaves of tomato (*Solanum lycopersicum* Mill.) hybrid COTH 2

Treatments	Number of leaves Kharif				Number of leaves Summer			
	30 DAT	60 DAT	90 DAT	Mean	30 DAT	60 DAT	90 DAT	Mean
	T ₁	19.7	49.3	67.3	45.4	17.7	47.3	65.4
T ₂	20.4	50.3	69.3	46.6	18.3	48.3	67.4	44.7
T ₃	20.4	51.2	69.4	47.0	18.9	49.7	67.5	45.4
T ₄	21.7	52.3	70.3	48.1	19.7	50.6	68.4	46.2
T ₅	21.9	53.9	70.5	48.8	19.9	51.2	68.8	46.6
T ₆	25.3	57.8	74.8	52.6	23.7	55.2	72.3	50.4
T ₇	27.4	59.4	76.9	54.6	25.6	57.3	74.3	52.4
T ₈	21.8	54.7	71.8	49.4	19.5	52.5	69.1	47.0
T ₉	24.8	57.5	71.2	51.2	22.1	55.8	69.3	49.1
T ₁₀	25.6	57.4	72.4	51.8	23.1	55.4	70.3	49.6
Grand mean	22.6	53.7	70.5		20.6	51.6	68.4	
SEd	0.44	1.06	1.38		0.41	1.02	1.34	
CD(P=0.05)	0.94	2.22	2.91		0.86	2.14	2.82	

Table.4 Effect of seaweed extract on leaf area index of tomato (*Solanum lycopersicum* Mill.) hybrid COTH 2

Treatments	Leaf area index Kharif				Leaf area index Summer			
	30 DAT	60 DAT	90 DAT	Mean	30 DAT	60 DAT	90 DAT	Mean
T ₁	1.09	2.47	3.45	2.33	1.01	2.27	3.28	2.18
T ₂	1.24	2.68	3.67	2.53	1.20	2.49	3.43	2.37
T ₃	1.42	2.95	3.98	2.78	1.39	2.75	3.78	2.64
T ₄	1.64	2.76	3.74	2.71	1.21	2.54	3.51	2.42
T ₅	1.68	2.84	3.76	2.76	1.26	2.60	3.57	2.47
T ₆	1.78	2.98	4.43	3.06	1.46	2.86	3.89	2.73
T ₇	1.98	3.45	4.65	3.36	1.64	2.99	4.32	2.98
T ₈	1.74	2.83	4.12	2.89	1.32	2.63	3.80	2.58
T ₉	1.75	2.93	4.10	2.91	1.48	2.84	3.83	2.71
T ₁₀	1.87	2.89	4.05	2.93	1.57	2.91	4.03	2.83
Grand Mean	1.59	2.84	3.95		1.33	2.65	3.69	
SEd	0.032	0.056	0.077		0.027	0.052	0.072	
CD (p = 0.05)	0.068	0.118	0.163		0.057	0.110	0.152	

Table.5 Effect of seaweed extract on days to first flowering and days to 50% flowering of Tomato (*Solanum lycopersicum* Mill.) hybrid COTH 2

Treatments	Days to first flowering			Days to 50 % flowering		
	Kharif	Summer	Mean	Kharif	Summer	Mean
T ₁	27.9	30.4	29.1	42.3	44.2	43.3
T ₂	27.5	30.3	28.9	41.7	43.4	42.5
T ₃	27.6	30.2	28.8	39.7	41.4	40.5
T ₄	26.8	29.7	28.3	40.2	42.1	41.1
T ₅	27.1	28.9	28.0	41.9	43.9	42.9
T ₆	26.1	28.2	27.1	38.9	40.0	39.5
T ₇	25.1	27.7	26.4	36.4	38.4	37.4
T ₈	27.4	28.8	28.2	41.2	43.4	42.3
T ₉	26.9	28.1	27.5	39.8	40.6	40.2
T ₁₀	26.9	27.9	27.4	39.2	40.9	40.0
Grand mean	26.5	28.6		39.6	41.3	
SEd	0.52	0.56		0.77	0.81	
CD(P=0.05)	1.09	1.18		1.63	1.70	

Table.6 Effect of seaweed extract on individual fruit weight of tomato (*Solanum lycopersicum* Mill.) hybrid COTH 2

Treatments	Single Fruit Weight(g)		
	Kharif	Summer	Mean
T ₁	49.87	47.63	48.75
T ₂	50.63	48.79	49.71
T ₃	50.43	49.87	50.15
T ₄	52.34	50.76	51.55
T ₅	53.24	51.28	52.26
T ₆	54.34	52.89	53.61
T ₇	55.31	54.98	55.14
T ₈	52.39	50.74	51.56
T ₉	53.43	51.26	52.34
T ₁₀	53.54	52.73	53.13
Grand mean	51.86	50.42	
SEd	1.019	0.990	
CD(P=0.05)	2.140	2.081	

Table.7 Effect of seaweed extract on yield per plant of tomato (*Solanum lycopersicum* Mill.) hybrid COTH 2

Treatments	Yield per plant (kg)		
	Kharif	Summer	Mean
T ₁	2.09	2.23	2.16
T ₂	2.11	2.27	2.19
T ₃	2.30	2.38	2.34
T ₄	2.31	2.43	2.37
T ₅	2.35	2.44	2.39
T ₆	2.49	2.62	2.56
T ₇	2.74	2.78	2.76
T ₈	2.34	2.50	2.42
T ₉	2.38	2.51	2.44
T ₁₀	2.48	2.61	2.54
Grand mean	2.44	2.33	
SEd	0.048	0.046	
CD(P=0.05)	0.101	0.097	

Table.8 Effect of seaweed extract on yield and their economics in tomato

Treatments	Yield of tomato per ha (kg)	Quantity of chemicals (kg)required per ha	Cost of chemical required per ha(Rs.)	Gross income per hectare (Rs.)	Net income per hectare (Rs.)	Cost benefit ratio
T ₁	67,500	-	-	3,37,500	1,80,091	1:2.14
T ₂	68,500	7.5	1162	3,42,500	1,83,929	1:2.17
T ₃	73,100	10	1550	3,65,500	2,06,541	1:2.32
T ₄	74,100	12.5	1937	3,70,500	2,11,154	1:2.35
T ₅	74,900	8	800	3,74,500	2,16,291	1:2.37
T ₆	79,800	10.5	1240	3,99,000	2,40,351	1:2.53
T ₇	86,200	13	2015	4,31,000	2,71,576	1:2.73
T ₈	75,600	-	-	3,78,800	2,21,391	1:2.40
T ₉	76,400	12.5	1937	3,82,000	2,22,654	1:2.42
T ₁₀	79,500	13	2015	3,97,500	2,38,076	1:2.52

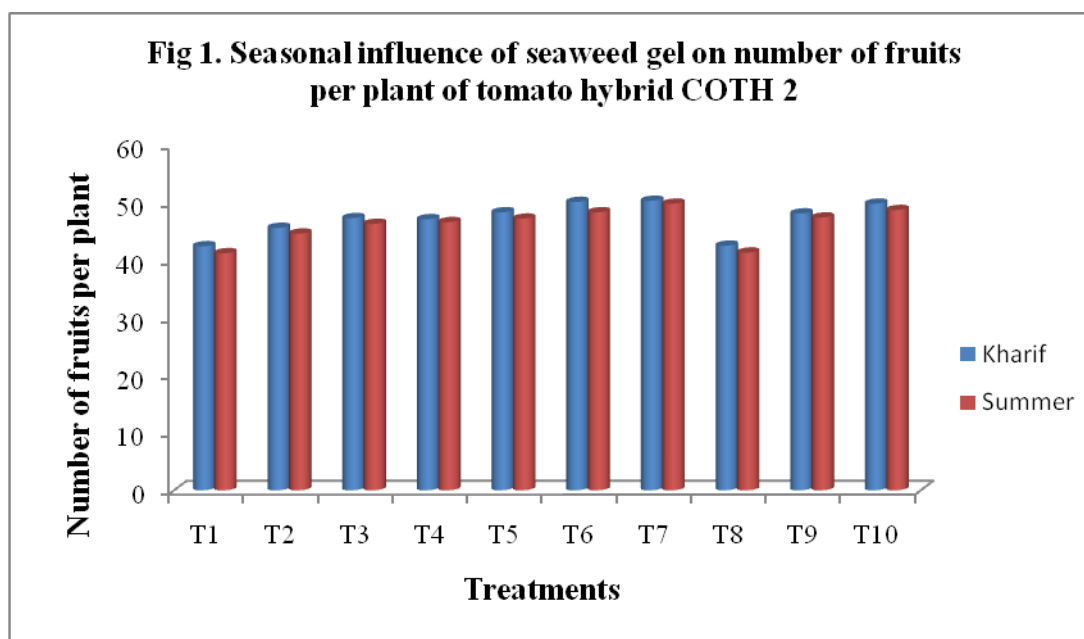
Quantity of spray solution required: 500 litres/ spray 1500 litres per hectare for 3 sprays

Quantity of seaweed gel required for drenching: 25kg per hectare for 5 sprays

Rate of seaweed gel: Rs. 155/kg (Rs.0.15/g)

Cost of tomato: Rs. 5/kg

Cost of cultivation: Rs. 1,57,409/ha



Significant differences were noted with regard to days taken for 50% flowering in the first season. The treatment, T7 recorded minimum days for 50% flowering (36.4 days) followed by the treatment T6 which recorded 38.9 days (Table 5).

The treatment, T1 (Control) had taken the longest duration for 50 % flowering (42

days). The treatment T7 registered the earlier flower opening (38.4 days) in the second season followed by T6 with 40.0 days. The treatment T1 (control) recorded the highest duration of 44.2 days in the second season.

Increased dry matter may be due to the increased carbohydrate accumulation resulting from a more efficient photosynthetic

activity brought about by the anatomical modifications. Nelson and Van Staden (1984) observed that application of KELPAK 60, a seaweed extract concentration increased plant dry mass in cucumber. Poincelot *et al.*, (1993) reported that application of 'ROOTS', a patent product containing *A. nodsum* at one per cent increased root length and shoot height compared to control in tomato plants.

Earliness is one of the important favourable phenomena since early crop fetches a premium price in the market. From the analysis of the data, it was found that the treatment comprising NPK @ 200:300:200 kg ha⁻¹ + O6 EM and MA GEL @ 12.5 kg acre⁻¹ + O6 EM and MA GEL 1% spray (T₇) induced early flowering as compared to control in both winter and summer season.

The early flowering and fruiting in the treated plants might be due to the fact that such plants were able to build suitable carbohydrate reserves early. As far as seaweed gel is concerned, early flowering might be due to the availability of cytokinins, the accumulation of which in lateral buds would have made them more effective sink in the diversion of photoassimilates as well as other flower inducing plant hormones which ought to have ultimately resulted in better flowering and in turn yield.

There is considerable evidence that auxins act primarily in a catalytic or regulatory capacity in some plants (Chhonkar and Singh, 1959). In tomato, Sinnadurai and Amuti (1971) found that flowering increased when night temperature were cooler (71-74⁰F) though tomato is day neutral with regard to flowering under long days. Poincelot (1994) observed that application of 'ROOT PLUS' (*Ascopyllum nodosum*) at one per cent resulted in increased flowering and early flowering in Broccoli and Tomato.

Yield parameters

Number of fruits per plant

The number of fruits was recorded more in the treatment (50.3) T₇ (NPK @ 200:300:200 kg ha⁻¹ + O6 EM and MA GEL @ 12.5 kg acre⁻¹ + O6 EM and MA GEL 1% spray. This was closely followed by T₆ with a value of 48.3 and they are statistically on par with T₁₀ (Fig. 1) The treatment T₇ registered the highest fruit number per plant of (49.85) followed by T₆ NPK @ 200:300:200 kg ha⁻¹ + O6 EM and MA GEL @ 10 kg acre⁻¹ + O6 EM and MA GEL 1% spray with 48.3 and they are statistically on par with T₁₀. The treatment T₁ (control) recorded the minimum number of fruits per plant of 41.2 in the second season.

Highest fruit yield may be due to the most pronounced effects of seaweed extract application on development of vigorous root system, which is often expressed as higher yields due to more cytokinin synthesized and translocated to axillary buds. Increased yield may be due to increased fruit set and latter fruit weight through better canopy establishment, better inception of light and through significant reduction in inter plant competition for solar energy and nutrients. This would increase efficiency of plants to do photosynthesis and translocation of assimilates to the points of fruit set (Zodape *et al.*, 2011). Treatment with 'ROOT PLUS' a patent compound containing seaweed extract resulted in taller plants and earlier, increased flowering and fruiting than fertilizer treatment (Poincelot, 1993). Similarly, increased fruit yield (29 per cent) was recorded by the application of seaweed extract at 1 per cent by Povolny (1976).

Individual fruit weight (g)

The fruit weight was recorded more (55.31g) in the treatment in T₇ (Table 6). This was

closely followed by T₆ (NPK @ 200:300:200 kg ha⁻¹ + O6 EM and MA GEL @ 10 kg acre⁻¹ + O6 EM and MA GEL 1% spray) with a value of 54.34 g and they are statistically on par with T₁₀ and T₉.

The treatment T₇ registered the highest fruit weight of (54.98 g) followed by T₆ with 52.89 g. The treatment T₁ (control) recorded the minimum fruit weight of 47.63 g in the second season.

Individual fruit weight is another component that influences yield and it was also found altered by the different treatment. Generally in tomato, the number of fruits and individual fruit weight are the major component that decide the yield and exhibit a negative relationship with one another.

Chandra and Shivaraj (1972) and Warade and Singh (1977) attributed increased weight and yield of fruit in the treated plants to the fact that they remained physiologically more active to build up sufficient food materials and reserve for developing flowers and fruits. In the presence of these substances, the plants could produce flowers early with greater fruit set, increased number of fruits with more fruit weight that ultimately led to the high yield. Similar results were found by Mote *et al.*, (1975) and Chandra *et al.*, (1976) in chillies.

Fruit yield per plant (kg) (Table 7)

The mean fruit yield varied from 2.09 kg in T₁ to 2.74 kg plant⁻¹ in T₇ and from 2.23 kg in T₁ to 2.78 kg plant⁻¹ T₇ in the first and second season respectively. In both the seasons, the treatment T₇ recorded the highest yield and T₁ recorded the lowest yield. Mean of two season showed that T₇ recorded fruit yield per plant of 2.76 kg followed by the treatment T₆ (2.56 kg) and T₁₀ (2.54 kg). In T₉ and T₁₀, addition of vermicompost released humic acid which leads to the development of more fruits

per plant. The difference in concentration of chemical to influence yield could possibly be due to interaction of chemicals with the variation existed in weather parameters like light intensity, temperature *etc.*, Increased fruit yield (29 per cent) per plant was reported with application of seaweed extract 1 per cent by Povolny (1976).

Cost Benefit Ratio

The treatment, T₇ (Table 8) registered the highest benefit - cost ratio of 2.73 which was followed by T₆ (2.53) and T₁₀ (2.52). The lowest benefit - cost ratio was noticed in the treatment T₁ (2.14). Combined application of inorganic fertilizer and seaweed gel extract *i.e.* drenching and foliar spray gave better result. It may be due to the presence of micro and macro elements present in the seaweed extract. Similar findings were also reported by Abdel Mawgoud *et al.*, 2010.

It could be 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 (T₇) recorded the highest net return in tomato. The combined application of inorganic fertilizers and seaweed gel significantly influenced the growth and yield of tomato hybrid COTH 2.

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