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To Study the Effect of Foliar Application of Yeast and Ascorbic acid on Growth and Yield of Tomato (*Lycopersicon esculantum*) Plant

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ABSTRACT: Tomato (*Lycopersicon esculantum)* is considered as an important horticultural crop worldwide. But instead of using various technologies and cultivars the production rate of tomato is low. With the increasing demand on consumption of tomato as well as on consumption of organic crops, there is a great necessitate for using new and organic technologies to increase the yield and maintain the environmental health. Therefore, the present experiment was conducted with a target to increase more quantity of tomato with the application of yeast and ascorbic acid. In our study we have given foliar spray of yeast (5 and 10g/L) and ascorbic acid (0.1 and 0.2 ml/L). The experiment was laid out in five different plots including one control; each plot consists of six to ten replicas. The parameters taken was plant height, leaves number, branches number, flowers per plant, fruits per plant, chlorophyll and carotenoid content of leaves; protein, sugar, ascorbic acid and lycopene content of the fruit. The results showed ascorbic acid treatment shows better result in comparison to increase in yield and fruit number per plant in comparison to yeast treated plants. But lowest yield was recorded in the control group.

Keywords: *Lycopersicon esculantum,* yeast, ascorbic acid, lycopene content, Yield of Tomato.

INTRODUCTION

Organic farming is an alternative cultivation technique whose demand is increasing in the present scenario (Dangour *et al.,* 2010). Since 1990 the demand for organic food and other products has increased rapidly as it is of high demand for consumers and farmers because of gradual change of people's mind for the go green lifestyle (Chopra *et al.,* 2013). Organic farming methods mingle the scientific knowledge of modern technology and ecology with traditional cultivation practices based on naturally occurring biological processes (Behera *et al.*, 2011). It is the global need as it also supports sustainable farming that sustains the health of ecosystem and people (Ferguson and Lovell 2014; Migliorini and Weze 2017; Yuva Raj *et al.,* 2020). Following this different methods are followed by the organic cultivators (Pare *et al.*, 2000). In this present experiment effect of yeast and ascorbic acid on the growth and production of tomato (*Lycopersicon esculantum*) was studied. Yeast is a fungi and has wide use in bakery and other food items (Ali *et al.,* 2012). Beside these properties yeast also contain many nutrients, can produce some phytohormones like auxin and Gibberellin, it has considerable amount of amino acids, mineral elements, enzymes, vitamins and therefore can be used in organic cultivation (Ignatova *et al.,* 2015). Besides Yeast ascorbic acid was also used in the present experiment which has the beneficial role in plants as it can enhance the nutritive value, it is a major redox buffer and serves as a required cofactor for several enzymes. Ascorbic acid also regulates cell division and growth and is involved in signal transduction (Gallie, 2013).

MATERIALS AND METHODS

The experiment was laid out in the experimental garden of Department of Botany, University of Science and Technology Meghalaya. Tomato seed (NS 592 cultiver) was collected from Guwahati and was planted at the experimental site. Seeds were surface sterilised with 0.1% Mercuric chloride and was followed by washing with distilled water four to five times. Tomato seeds were sowed on the experimental field (area $20m^2$) in the month of November, 2021. After few days, the seeds germinated and seedlings emerged. When they were grown up to a certain height and were strong enough, they were transferred into five different plots. The experiment was laid out in five plots each plot containing plants of different treated groups. Plots having plants of various treatments were named as C (Control group), T_1(Yeast treated group, 5g/L), T_2 (Yeast treated group, 10g/L), T_3 (ascorbic acid treated group, 0.1ml/L), T_4 (ascorbic acid treated group, 0.2ml/L). Treatments were given as an aerial spray. The growth parameters were measured at different days intervals. The physiological parameters were recorded in vegetative stage and also in the reproductive stage.

A. Growth parameters

Plant height was measured with a measuring scale after seven days interval. Total number of fully expanded leaves, total number of flowers, total number of fruits per plant and total numbers of branches including the primary and secondary branches were recorded at ten days interval and their average was taken.

B. Physiological parameters

The chlorophyll a, chlorophyll b, total chlorophyll content and carotene content in the leaf were recorded following the method of Arnon (1949) at various growth stages. The freshly plucked leaves avoiding large veins were taken from plants of each pot to estimate chlorophyll. The total protein, sugar, ascorbic acid and lycopene content were estimated from the fruits. Total soluble protein was determined in the leaf following the method of Lowry *et al.* (1951). Total carbohydrates content in fruit was determined by Anthrone method (Yem and Willie 1954). The ascorbic acid content was estimated following the method of Habib *et al.* (2019). The lycopene content of the fruits were measured using hexane: ethanol: acetone (2:1:1) (V/V) mixture following the modified method of Gordon and Diane (2007); Godwin *et al.* (2015).

C. Statistical analysis

All the data was analysed and expressed as Mean±SD (standard deviation). Data analysis was done in MS Excel 2007 using one way ANOVA. Graphs were done in MS Excel and P value $<0.05$was considered to be significant.

RESULTS AND DISCUSSION

A. Growth parameters

Plant height is one of the most important parameters, which is positively correlated with the yield of tomato. A marked variation in plant height was observed (Table 1) due to influence of different organic nutrients. This variation in plant height was highly significant at different days. It was very evident that highest plant height was recorded in T_4 group (0.2ml/L, ascorbic acid) in 7th day as well as in 14th, 21st and 28th day; which is followed by T_2 group (10g/L, yeast) in the four consecutive days. Data on plant height of T_2 group was followed by T_3 and T_1 group. The lowest growth was observed in the C-group (control group). Ascorbic acid acts as an enzyme cofactor (Eskling *et al.,* 1997). It is also involved cell cycle as it regulated the cell elongation and progression, it helps in cell division and cell expansion (Horemans *et al*., 2000; Smirnoff, 1996; Azarpour *et al*., 2014). It was proved by various researchers that yeast produces various important compounds (phytohormones, amino acids, enzymes, vitamins etc); most prominently they produce auxins (IAA) (Moller and Weijers 2009; Scarpella *et al*., 2009; Sundberg and Ostergaard 2009; Mc Steen, 2010; Lyudmila *et al*., 2015) can be the most promising agent for increase in growth in plants.

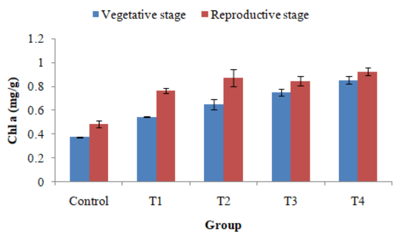
Significant variation was also observed in number of leaves among various treated groups. The T_2 and T_4 groups show similar number of leaves on 7th day; but this data changes on 14th, 21st and 28th Day. The T_4 group shows highest number of leaves during the later period of the experiment and significant difference was seen when compared with the other groups including control. Increase in the leaf number also observed in the yeast treated groups. It was proved by various researchers that yeast supplies most vital elements like amino acids and vitamins (Nagodawithana, 1991; Abdelaal *et al.,* 2017) apart from this yeast also acts as a natural source of cytokinin and thus promotes the cell division and differentiation or acts on signal transduction, producing growth promoters in plants (Medani and Taha 2015; Ragab *et al.*, 2021) and those perhaps illustrates the experimental results. However, in the present study better result in increase leaf number was attributed in ascorbic acid treated groups (Table 1). Many researchers have proved that ascorbic acid increases the plant height, leaf area, number of leaves, root length, stem diameter etc (Farahat *et al.,* 2017; Gamal, 2005). Ascorbic acid functions as enzyme cofactor in many biochemical reactions, functions in the xanthophylls cycle of plants, it also participates in the regenation of α-tochopherol (Asada, 1994; Gallie, 2013). It is involved in the regulation of cell elongation and progression through the cell cycle. Moreover, it also detoxifies ROS generated during photosynthesis in plants. In the present experiment better result in ascorbic acid treated groups also proved its potency and involvement in many physiological and biochemical process.

Increase in the number of branches, flowers and fruits per plant was observed in the yeast and ascorbic acid treated groups. As it was already established that yeast increases the number of flowers, yield and quality of the fruits (El-Tohamy and El-Greadly 2007; Hanna Ali and Fatma 2021) and similar results was also found in our experiment. But like the other results, here also ascorbic acid shows better result in comparison to the yeast extract.

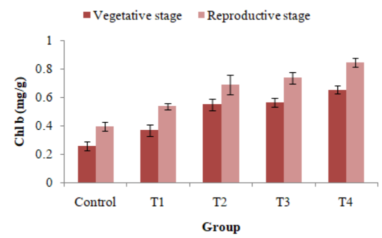
B. Physiological Parameters

The photosynthetic pigments data was recorded in vegetative as well as reproductive stages. In the control plant the elevation in the photosynthetic pigments data was found more in reproductive stages in comparison to the vegetative stage and similar elevation can be seen in all the treatments. Application of yeast and ascorbic acid significantly increased the chlorophyll a, b and carotene content; whereas best result was seen in the ascorbic acid treated groups. Yeast treatment increases the elevation in cytokinin content in plants and thereby delay the aging in leaves by reducing the degradation of chlorophyll and enhancing protein and RNA synthesis (Shalaby and El-Nady 2008). Ascorbic acid also plays a multifunctional role in photosynthesis. It plays a major role in cellular redox state and is important in maintaining photosynthetic function of the cell (Gallie, 2013). Ascorbic acid can directly detoxify the ROS produced in photosynthesis and respiration and thus delays the aging in leaves (Asada and Takahashi 1987).

The Fig. 2 (a-d) is showing the effect of yeast and ascorbic acid on the protein, lycopene, ascorbate and sugar content of the fruits. The results clearly shown the protein, lycopene and total sugar content value was maximum in T_4 group in comparison to control and the other groups but not much difference was noticed in the ascorbic acid content in T_4 group with the other groups including control. As it was already proved that yeast treatment increased protein synthesis (Shalaby and El-Nady 2008) and so similar result also seen in the present experiment as yeast treatment increased the protein content in comparison to control in a dose dependent manner. Moreover, yeast application produces auxins (IAA) which is required for fruit setting at anthesis and it also increases the amount of sugar and lycopene content per fruit at maturity (Scarpella *et al.,* 2009; Kataoka *et al.,* 2009; Hanan and Ghit 2020). Similar result can be viewed in our experiment. But in the present experiment best result was seen in group T_4 received ascorbic acid (0.2ml/L) as ascorbic acid has a prominent role in the photosynthesis and it helps in proper functioning of photosynthesis, it indirectly helps in CO_2 assimilation which directly effects the photosynthetic yield (Paciolla *et al.,* 2019). The result is depicted here with increase in the sugar content of the fruit. Increase in the vitamin C content in plants can have a triple-positive effect: producing food with a high content of vitamin C for human health which is also proved in the results after supplying the plants with ascorbic acid as though the increase is minimal but more in comparison to others (Fig. 2c). Since ascorbic acid also functions as cofactor in many enzymes may be responsible for increasing the total protein content in present experiment; moreover increase in the yield of the fruits may results in the increase in the lycopene content of the fruit.



(a)



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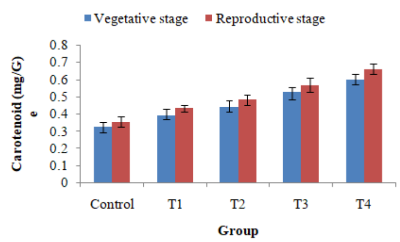
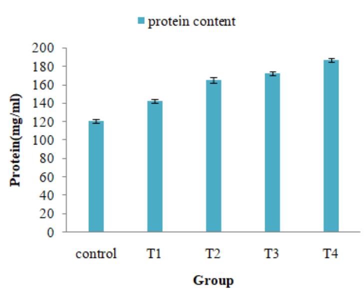


(c)

Fig. 1 (a-c): Effect of Yeast and Ascorbic acid on the Chlorophyll a (a), Chlorophyll b (b)and carotenoid (c) content of tomato (*Lycopersicon esculantum*) leaves in vegetative and reproductive stage. Data are represented as Mean ± SD with P<0.05 is considered as significant (One way ANOVA).



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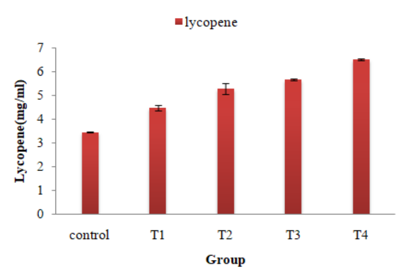

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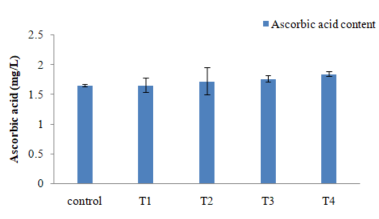

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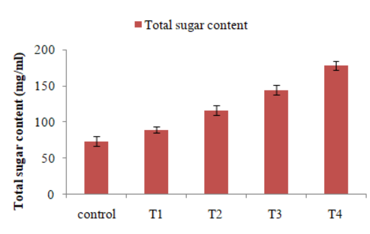

(d)

Fig. 2 (a-d): Effect of Yeast and Ascorbic acid on the protein (a), lycopene (b), ascorbic acid (c) and total sugar (d) content of tomato (*Lycopersicon esculantum*) fruits. Data are represented as Mean ± SD with P<0.05 is considered as significant (One way ANOVA).

Table 1: Effect of Yeast and Ascorbic acid on height and number of leaves of tomato plant. Data are represented as Mean ± SD with P<0.05 is considered as significant (One way ANOVA).

Groups	Treatment	Height of plants in c.m. (Mean±SD)					Number of leaves per plant (Mean±SD)				
		0 Day	7 Day	14 Day	21 Day	28 Day	0 Day	7 Day	14 Day	21 Day	28 Day
C	–	8.66±2.13	10.5± 2.16	12.51±1.8	16.61±2.5	20.1±3.3	7.16±1.3	9.16±2.1	15.5±2.8	28±4.3	38±4.6
T_1	Yeast (5g/L)	8.66±3.09	12.76± 2.9	16.96±3.7	23.36±6.7	28.4±7.7	7.5±1.5	13.16±3.3	20±2.7	35.16±5.8	43.16±6.8
T_2	Yeast (10g/L)	8.33±1.77	12.95± 2.6	18.16±3.2	26.81±6.8	33.81±6.6	7.16±2.1	15.16±2.2	26.33±6.9	36.66±2.4	47±4.4
T_3	Ascorbic acid (0.1ml/L)	8.23±1.63	12.63± 1.7	16.31±1.6	24.25±2.7	29.51±3.3	7.5±2.6	13.5±6.2	19±4.7	31.5±5.8	39±4.04
T_4	Ascorbic acid (0.2ml/L)	8.53±2.73	14.25± 2.4	19.18±3.2	27.35±6.7	35.5±4.3	6.66±1.3	15.13± 3.05	29±8.2	37.83±5.5	49±5.7
One way ANOVA	F	0.92	0.15	0.07	0.08	0.05	0.9	0.1	0.3	0.06	0.2

Table 2: Effect of Yeast and Ascorbic acid on number of branches, flowers and fruits per plant. Data are represented as Mean ± SD with P<0.05 is considered as significant (One way ANOVA).

Groups	Treatment	Number of branches per plant (Mean±SD)				Number of flowers per plant (Mean±SD)			Number of fruits per plant (Mean±SD)	
		7 Day	14 Day	21 Day	28 Day	14 Day	21 Day	28 Day	21 Day	28 Day
C	–	**1.5±0.5**	**3.5±0.9**	**6.16±1.3**	**8.5±1.7**	**2±1.1**	**7.5±3.4**	**14.6±5.4**	**1.33±0.4**	**4.66±1.1**
T_1	Yeast (5g/L)	2.1±1.06	5.33±1.1	8.16±1.7	9.66±3.2	3.33±2.2	11.3±4.3	16.5±2.7	2.66±1.2	7±0.8
T_2	Yeast (10g/L)	3.5±0.9	5.66±1.3	8.5±2.2	11.16± 3.02	5.33±2.2	13.4±2.5	18±2.1	3±1.5	7±1.6
T_3	Ascorbic acid (0.1ml/L)	2±1	5.16±1.06	7.83±1.5	10±3.4	3.66±1.3	11.5± 2.06	18±2.1	2.33±0.9	6.33±1.7
T_4	Ascorbic acid (0.2ml/L)	3±1	7.16±1.06	8.66±2.3	12±3.3	6.33±1.5	17.3±3.1	19.6±4.7	3.66±1.5	8.66±1.9
One way ANOVA	F	0.05	0.07	0.2	0.3	0.05	0.07	0.1	0.07	0.07

CONCLUSIONS

It is clear from the above experimental study that yeast and ascorbic acid both have potency in increasing the vegetative growth, yield and nutritional quality of the tomato crops. Though ascorbic acid has more potency but the effectiveness of the yeast treatment cannot be ignored and this experiment also proves a better arena for the use of bio fertilizer for the crop improvement.

FUTURE SCOPE

The present research work also proves the way of improving agricultural yield by using alternative method without using chemical fertiliser which will also help in the further research in the field of sustainable agriculture.

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Conflict of Interest. None.

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